# A Laboratory Investigation of Stress-Induced Eating Behaviour

NOREEN CASWELL

Thesis submitted to the Department of Psychology,
University of Central Lancashire, in partial fulfilment
of the Degree of Doctor of Philosophy

January 2007

uclan

# Student Declaration

**Concurrent registration for two or more academic awards**

I declare that while registered as a candidate for the research degree, I have not been a registered candidate or enrolled student for another award of the University or other academic or professional institution

**Material submitted for another award**

I declare that no material contained in the thesis has been used in any other submission for an academic award and is solely my own work.

**Signature of Candidate** N. Carroll

**Type of Award** **Degree of Doctor of Philosophy**

**Department** **Psychology**

# ABSTRACT

Studies suggest that the experience of anxiety or exposure to stressful events may contribute to the 'disinhibition' of dietary restraint (diet breaking) and promote symptoms of binge eating and bulimia. Mechanisms by which such factors lead to overeating are not clearly understood, and competing theoretical explanations have not been sufficiently tested using reliable and robust methodological approaches within the laboratory. The current research adopted a psychophysiological approach to the measurement of stress-eating and information processing, using an aggregation of experimental paradigms taken from cardiovascular/stress and dietary restraint literatures, to investigate the effects of self-directed ego threat stress on female restrained eaters, with and without bulimic symptoms.

The first main aim was to test two competing theoretical explanations of overeating [bingeing] in response to stress – the limited capacity versus the 'escape' theory. Taken together, the results obtained from three experiments revealed only limited support for the limited capacity model. Some support was obtained for the 'escape' theory. These results were also discussed in relation to restraint theory, and the continuum and new generation cognitive models of BN.

The second main aim was to ascertain the existence of information processing and memory biases for scheme-relevant cues *unrelated* to eating [self-directed ego threat] in the two target populations. Results from these analyses provided further support for restraint theory, the 'escape' theory of bingeing, and the continuum and new generation cognitive models of BN.

Two more minor aims of the current research were a) to assess arousal responses in response to post-stress food ingestion in the two target populations, b) to assess whether temporal/habituation effects occurred in respect of information processing of ego-threat stimuli.

## Contents

# List of Tables

# List of Figures

# Acknowledgements

Firstly, I would like to thank the University of Central Lancashire for awarding me the studentship that made this research possible.

I would like to thank my Supervisors, Dr. Mark P. Roy and Dr. Hugh Wagner for the provision of their time, experience, resources and patience.

I would like to thank Professor Bob Stern of Pennsylvania State University for the provision of training and advice relating to the acquisition, reduction and analysis of the Electrogastrogram (EGG) (although not reported within this thesis).

I would also like to thank Belinda F. Hornby and Mark P. Roy for the provision of training and advice relating to the acquisition, reduction and analysis of cardiovascular and biochemical dependent measures.

My thanks go also to the UCLAN Department of Psychology technical team for their excellent support over the past four years.

I would like to say a special thank you to all of my participants for their kind co-operation and enthusiasm.

I would like to thank all of my friends and colleagues at the University for their intellectual and much needed emotional support – especially Professor John Thomas Manning and Dr. Andrew Churchill.

Finally, I would like to thank my brother Michael for his continued love and support throughout this endeavour. Most of all, I would like to thank my darling daughter Charlotte Hannah for demonstrating enormous patience, independence and maturity far beyond her years. Thank you sweetheart x

# Abbreviations

Abbreviations used widely in the thesis are listed below. Those that occur in only isolated sections are defined as they occur.

**Anthropometric Abbreviations**

| | |
|---|---|
| Body Mass Index | BMI |
| Waist-to-hip ratio | WHR |

**Questionnaire Abbreviations**

| | |
|---|---|
| Revised Restraint Scale | RS_R |
| Dutch Eating Behaviour Questionnaire | DEBQ |
| The Bulimia Test | BULIT-R |
| State-Trait Anxiety Inventory | STAI |
| The State Self-Esteem Scale | SSES |
| The Eating Attributional Style Questionnaire (Revised) | EASQ-R |

**Eating Pathology Abbreviations**

| | |
|---|---|
| Anorexia Nervosa | AN |
| Bulimia Nervosa | BN |
| Binge Eating Disorder | BED |
| Eating Disorders Not Otherwise Specified | EDNOS |

**Physiological Abbreviations**

| | |
|---|---|
| Heart Rate | HR |
| Beats Per Minute | BPM |
| Systolic Blood Pressure | SBP |
| Diastolic Blood Pressure | DBP |
| Thyroid Stimulating Hormone | TSH |
| Adrenocorticotrophic Hormone | ACTH |
| Central Nervous System | CNS |
| Sympathetic Nervous System | SNS |

| | |
|---|---|
| Sympathetic-Adreno-Medullary System | SAMS |
| Pituitary-Adreno-Cortical System | PACS |
| Hypothalamic-Pituitary-Adrenal Axis | HPA |
| Parasympathetic Nervous System | PNS |
| General Adaptation Syndrome | GAS |

**Study Abbreviations**

| | |
|---|---|
| Baseline Phase | B |
| Task Phase | TA |
| Stroop task | |
| Block 1 | B1 |
| Block 2 | B2 |
| Block 3 | B3 |
| Mental Arithmetic Test | MAT |
| Matrix 1 | M1 |
| Matrix 2 | M2 |
| Matrix 3 | M3 |
| Matrix 4 | M4 |
| Recovery Phase | R |

| | |
|---|---|
| High restraint/high bulimic | HR/HB |
| High restraint/low bulimic | HR/LB |
| Low restraint/low bulimic | LR/LB |

# Chapter 1. An overview of the thesis

Dietary restraint research shows that different laboratory stress manipulations can exert diverse effects on eating behaviour in different populations. Stress manipulations that threaten the individual's physical well being have been found to suppress eating in unrestrained eaters (non-dieters) whereas manipulations involving a threat to the ego have been found to contribute to the 'disinhibition' of dietary restraint (diet breaking) and promote symptoms of binge eating disorder and bulimia in restrained eaters. Similarly, non-clinical females with bulimic tendencies have been shown to overeat in response to threat that is unrelated to eating (e.g., ego-threat), and to demonstrate both an attentional bias towards and cognitive avoidance away from such threat.

This research aggregates experimental paradigms taken from cardiovascular/stress, dietary restraint, and information processing literatures to investigate the effects of laboratory stress on the cognitive, physiological and biological reactivity in non-clinical females classified as high in dietary restraint and bulimic symptoms, in a series of three experiments.

Chapter 2 describes the background to the stress-eating relationship, and includes a critical review that charts the evolution of Restraint Theory from early obesity research to the present day. Sources of contention and areas where more research is required are highlighted, with a particular focus on how 'stress' can disrupt dietary restraint, leading to overeating, binge eating and bulimic symptoms, and the factors that have been found to influence this effect.

Chapter 3 highlights similarities between restrained eaters and bulimics, with a particular focus on their cognitive and behavioural response to ego-threat stress. A critical overview is provided in respect of a) existing and newer models of bulimia, b) an evaluation of existing models of bulimia, c) commonalities between clinical and non-clinical women with eating pathology.

Chapter 4 describes the physiology of stress, and develops an argument for adopting a psychophysiological approach to the measurement of the stress response in order to further elucidate mechanisms that underlie the stress-eating relationship.

Chapter 5 provides the specific aims and hypotheses for the present research. Chapter 6 describes the methodology employed throughout the thesis. Chapter 7 contains a report of the first of three experiments. Experiment 1 compares the effects of a computer driven emotional Stroop task containing ego threat stimuli and a conventional Stroop task containing incongruent colour-words. A between subjects design is employed, with females classified as restrained eaters, with bulimic symptoms. Self-reported anxiety, self-esteem, response times to and recall of ego threat and neutral stimuli were recorded, along with ice cream and water consumption. Subsequent experiments adopted a psychophysiological approach to the measurement of the stress response. Heart rate was measured continuously, and measures of systolic and diastolic blood pressure and salivary cortisol were obtained at various time points throughout the laboratory protocol.

Chapter 8 describes the second experiment. Experiment 2 compares the effects of two laboratory stress manipulations that were equal in terms of emotional content, but that differed in terms of cognitive load (amount of cognitive effort required to complete each task) in order to test two competing theories that attempt to explain the 'disinhibition' effect. In a between subjects design, the effects of a computer driven emotional Stroop task, containing ego threat stimuli (also used in study 1 of this thesis) was tested under two conditions: with and without pre-test instructions for later word recall, with restrained eaters, both with and without bulimic symptoms. Self-reported anxiety, self-esteem, response times to and recall of ego threat and neutral stimuli were recorded, along with ice cream and water consumption.

Chapter 9 documents the third experiment. Experiment 3 employed a repeated measures design to compare the effects of a mental arithmetic task (MAT) that was varied in terms of both cognitive demand and emotional loading, on individuals who self-report high levels of both dietary restraint and bulimic symptoms. There were three conditions, a) mental arithmetic task with no audio distraction tape (MAT: no tape), b) mental arithmetic task with audio distraction tape incorporating ego-threat words (MAT: ego tape), and c) mental arithmetic task with audio distraction tape incorporating neutral-word stimuli (MAT: neutral tape). Measures of self-reported anxiety, self-esteem and recall of threat and neutral stimuli were recorded, together with intake of snack foods categorized as sweet, salty or bland and water consumption. Chapter 10 provides a general discussion, and includes suggestions for future research.

# Chapter 2. Background to the stress-eating relationship

## 2.1 Chapter Overview

It is widely accepted that stress can lead to overeating, but the mechanisms underlying this relationship are still very poorly understood (see Greeno & Wing, 1994 for review). The present Chapter provides an outline and evaluation of two models of stress-induced eating that have been tested, **The General Effects Model** and the **Individual-Difference Model**.

## 2.2 The General Effect Model

The general effect model predicts that stress will increase eating in all organisms. Tests of this model have focused on highlighting physiological pathways to explain stress-induced over-eating. Aside from two studies with human participants, conducted in France by Bellisle, Louis-Sylvestre, Linet, et. al. (1990) and Michaud, Musse, Kahn, et al. (1989), this model has been tested primarily with animals that were exposed to physical stressors. A review of the literature suggests conflicting results, and several factors may account for these inconsistent findings. These include the type of stress manipulation employed, variation of exposure (i.e. in terms of intensity and duration), deprivation level, prior stress experience and timing of intake measures.

**2.2.1 Stressor Type.** Studies employing electric shock (Siegel & Brantley, 1951; Ullman, 1951, 1952), noise (Kupfermann, 1964; Rasbury & Shemburg, 1971; Wilson & Cantor, 1986), tail pinch (Antelman & Szechtman, 1975; Levine & Morley, 1982) or social conflict (Teskey, Kavaliers & Hirst, 1984) report increased eating. In contrast, experiments using cold swim stress (Waggoner, Sardar, Levine, & Morley, 1985; Vaswani, Tejwani & Mousa, 1983) or behavioural restraint (Krahn, Gosnell, Grace & Levine, 1986) report decreased eating.

**2.2.2 Intensity.** With regard to the intensity of the stressor, where electric shock has been used, high intensities have been found to decrease feeding behaviour, whereas moderate and low intensities increase eating behaviour (Strongman, 1965; Strongman, Coles, Remington & Wookey, 1970).

**2.2.3 Duration.** In terms of duration of stress exposure, eating is increased by acute noise (Kupfermann, 1964) and shock exposure (Ullman, 1951, 1952) whereas chronic noise (Alario, Gamallo, Beato & Trancho, 1987) has been found to decrease feeding.

**2.2.4 Deprivation level** (Mirsky & Rosvold, 1953) and **prior stress experience** (Wilson & Cantor, 1986) has also been found to influence the experimental outcome, as well as **timing of intake measures**. For example, mild electric shock has been shown to increase food intake during exposure, but to reduce it afterwards, compared to a no-shock control group (Sterritt, 1962, 1965).

Given these variations, the extent to which results from animal research can be applied to humans is uncertain. For example, one cannot be certain that the 'stress' manipulation is actually eliciting a 'stress' response. The two aforementioned studies conducted with human participants revealed either no effect on intake when awaiting surgery (Bellisle et al., 1990) or inconsistent results for examination stress (increase was significant for girls only) (Michaud et al., 1989) when compared to a control day. Given the problems associated with the general effects model, it is now the general consensus that an individual difference model of stress-induced eating is the best one for researchers to adopt (Greeno & Wing, 1994).

It is acknowledged that researchers have proposed a variety of individual-difference non-human animal models of disorders of eating behaviour. For example, several authors have documented that a history of caloric restriction, coupled with stress, causes rats to binge eat on palatable food (e.g., Boggiano, Chandler, Viana et al., 2005; Hagan, Wauford, Chandler et al., 2002; Hagan, Chandler, Wauford et al., 2003) (for a review of behavioural animal models of binge-type eating see Corwin & Buda-Levin, 2004). For anorexia nervosa, animal models include transgenic mice over expressing corticotropin-releasing factor (Stenzel-Poore, Heinrichs, Rivest et al., 1994); the thin-sow syndrome in pigs (Treasure & Owen, 1997); the anorexia produced by low-protein diets (Mercer, Kelley, Haq & Humphries, 1996); strain differences in the ingestive effects of morphine in mice (Marrazzi, McQuarters, Barnes & Lawhorn, 1996); restraint-stress anorexia (Grignaschi, Mantelli, & Samanin, 1993); the spontaneous anorexias associated with hibernation (see Rieg, 1996); neurochemical depletion of the noradrenergic innervation of the paraventricular hypothalamic nucleus (Smith, 1989); the exercise-stress syndrome model (Aravich, Stanley & Doerries, 1995); and various contingent-exercised or forced-exercised models (see Rieg, 1996). However, the focus here is on the individual-difference model as applied to human animals.

### 2.3 The Individual-Difference Models

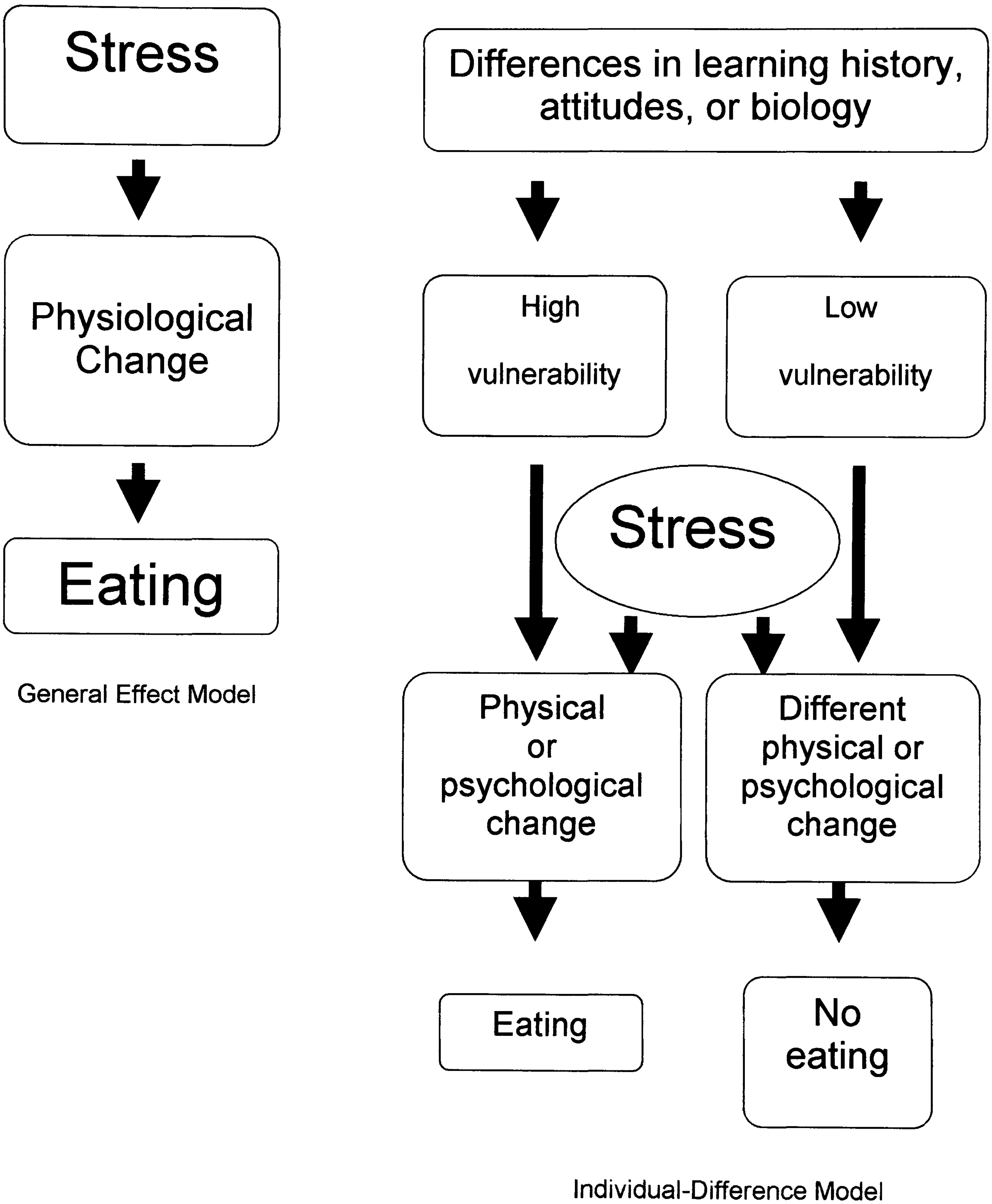
When applied to humans, the individual-difference model suggests that individual differences in attitude, learning history, or biology determine the effects of stress on eating behaviour. Tests of this model have focused on highlighting psychological or environmental mechanisms to explain stress-induced over-eating (eg. Bruch, 1961, 1973; Kaplan & Kaplan, 1957). However, one form of the model does propose that individual differences in physiology may mediate the relationship between stress and eating behaviour (Nisbett, 1972 - see Section 2.5.1).

Individual difference models posit that groups of individuals will differ in terms of their eating behaviour when they are stressed, for example obese individuals versus normal weight individuals, or males versus females. The focus of this thesis is on another such group, individuals who expend great effort in order to control their food intake for the purposes of either reducing or maintaining body weight (i.e., "restrained" eaters). A comparison will be made with "unrestrained" eaters (people who report that they do not expend very much effort in controlling their eating). Figure 1 depicts both the general effect and individual difference models of stress-induced eating.

### 2.4 Dietary Restraint: A Historical Perspective

Herman & Mack developed the concept of dietary restraint in 1975. Dietary restraint refers to "*the tendency to cognitively restrict food intake in order to maintain weight or induce weight loss*" (Polivy & Herman, 1980). Restraint theory arose out of attempts to establish the aetiology of obesity. The review that follows charts the evolution of Herman & Mack's ideas from early obesity research to the present day. Sources of contention and areas where more research is required are highlighted, with a particular focus on how 'stress' can disrupt dietary restraint, leading to overeating, and the factors that have been found to influence this effect.

**Figure 1. Models of stress-induced (over) eating**




From Greeno & Wing, 1994

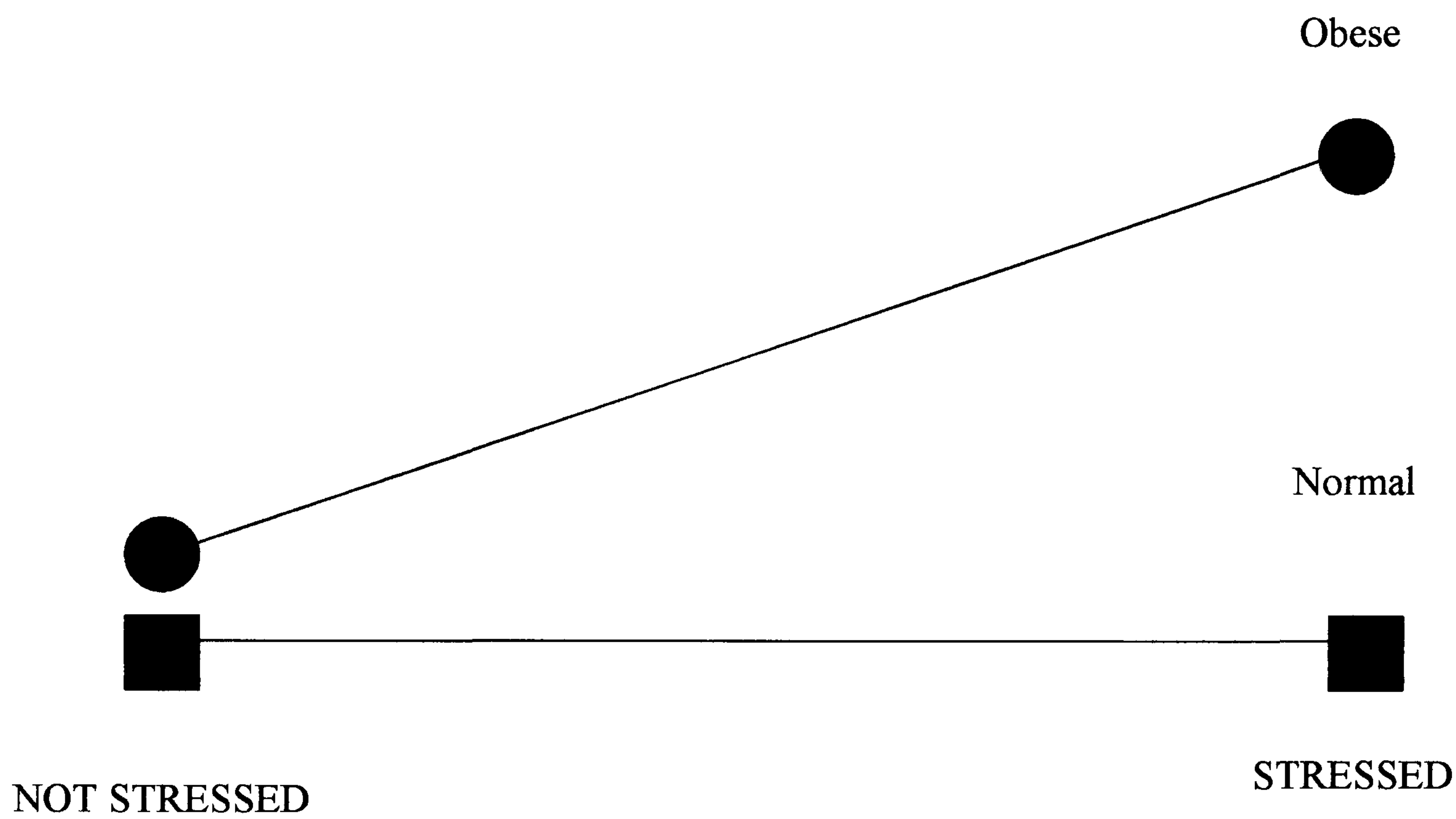
**2.4.1 Obesity Research.** It was noted from clinical observations that obese individuals were more likely to self-report eating when stressed compared to normal weight people (Leon & Chamberlain, 1973). The medical and social implications of obesity prompted an abundance of research investigations from the 1940s onwards (eg. Rodin, 1981). With regard to stress-induced eating in obese individuals, two primary and opposing theories have been tested: the psychosomatic theory and the "internal/external" theory put forward by Stanley Schachter (Schachter, Goldman, & Gordon, 1968). A summary of the predictions made by the two theories can be seen in Figure 2.

**2.4.2 The Psychosomatic Theory of Obesity.** Implied in the writing of various 'psychosomatic' theorists is that over-eating is a mechanism or coping strategy adopted in order to reduce anxious internal emotional states, such as feelings of anxiety, low self-esteem and depression (see Leon & Roth, 1977 for review; Bruch, 1973; Kaplan & Kaplan, 1957). The eating response to emotional distress ('comfort eating') is proposed to be a causal factor in obesity, and is believed to have developed as a result of inappropriate feeding experiences in infancy and early childhood (eg. Kaplan & Kaplan, 1957). Hilda Bruch (1973) has proposed that internal cues to hunger become 'confused' with cues generated from negative emotional states. 'Inappropriate' eating is therefore considered to be derived from failure to discriminate between the anxious state and feelings of hunger. Thus, some individuals will respond to stress as if it is hunger (i.e., by overeating).

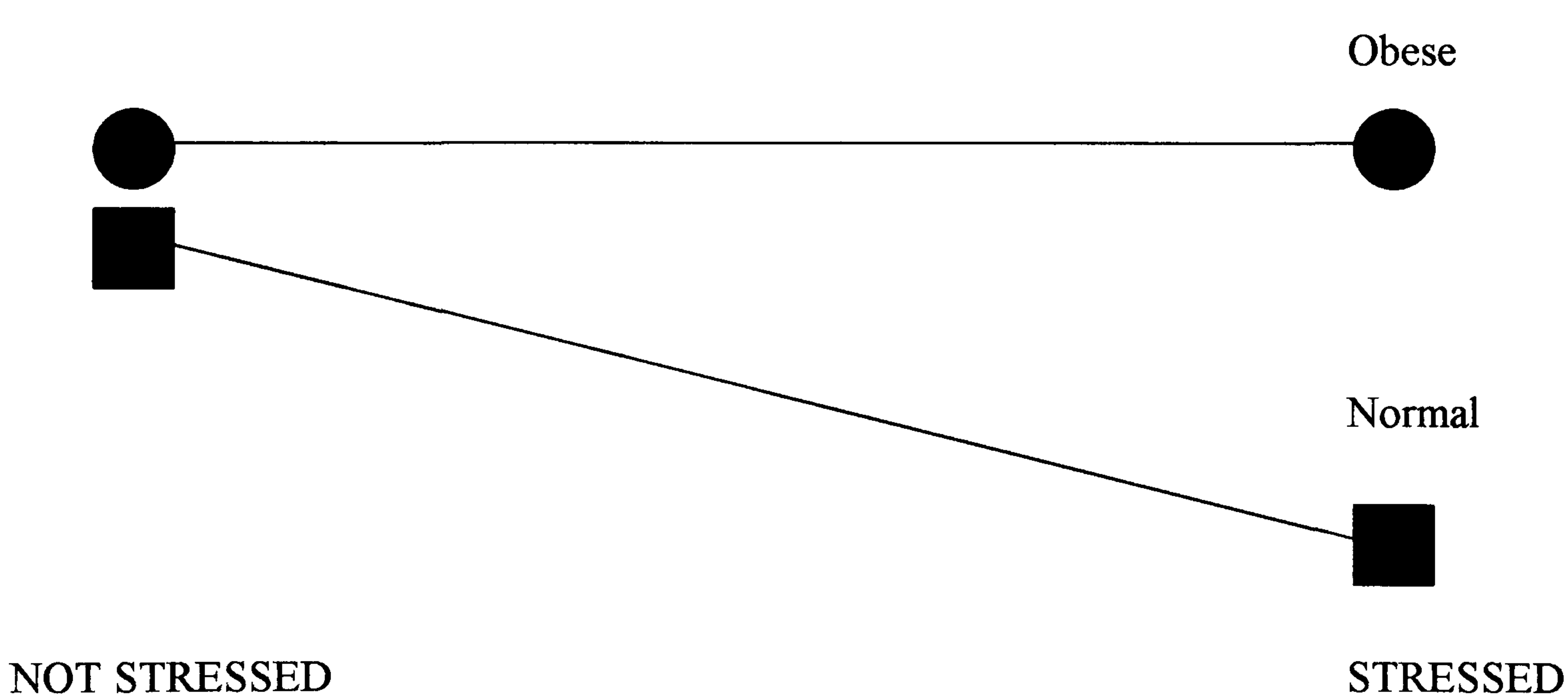
An alternative model proposed by Robbins & Fray (1980) suggests, in line with Bruch (1973) that although obese individuals do eat compulsively in response to emotionality, this emotional eating does *not* result in stress reduction. In support of this contention, in everyday life many overweight individuals report feeling even more negative after overeating (Leon & Chamberlain, 1973).

**2.4.3 Evidence for the psychosomatic theory of obesity**. Empirical support for the psychosomatic theory of obesity has been mixed, with studies commonly failing to find that eating has an anxiety-reducing effect in the obese group.

**Figure 2. Comparison of the Psychosomatic and Internal-External Theories of Obesity**




**<u>THE PSYCHOSOMATIC THEORY</u>**




**<u>INTERNAL/EXTERNAL THEORY</u>**
(Schachter et al., 1968)

Two studies that have found no evidence to support the psychosomatic position (Schachter, Goldman & Gordon, 1968; McKenna, 1972) have been criticised because they manipulated "objective fear" rather than "neurotic anxiety", which the psychosomatic theorists postulate affects eating behaviour. Therefore, Abramson & Wunderlich (1972) threatened obese individuals with both objective fear (threat of shock) and neurotic anxiety (predicting social failure for participants). Obese individuals ate the same amount in the two experimental conditions and the control condition, despite the fact that data from questionnaires collected in the study suggested that the experimenter had been successful in generating different emotional states. Thus, findings from this study also provide no support for the psychosomatic hypothesis.

However, Slochower (1976) criticised the assumption of Abramson & Wunderlich (1972) that neurotic anxiety was in fact generated by the prediction of social failure. Slochower suggested that the "arousal" induced would have been too specific and easily identifiable to be interpreted by the participants as "anxiety". To remedy this, Slochower varied the degree to which participants would be able to attribute high levels of arousal to an external cause. Participants were led to believe that their heart rate was being monitored with auditory feedback, in order to generate either low or high anxiety states. One sub-group of obese or normal participants with fast-rate feedback was provided with a good reason why their heart rate was apparently high (i.e. an artefact of the sound characteristic of the room). This was the 'labelled arousal' condition. In the other sub-group, individuals were *not* provided with a good reason for their apparent rapid heart rate. This was the 'unlabelled arousal' condition. Consumption of cashew nuts was then measured in a 3-minute period with "covert" procedures.

Results revealed a striking dissociation. Obese participants demonstrated large increases in food intake in the high arousal, unlabelled condition compared with the normal-weight individuals, who showed a reduction in food intake. Thus the "high, unlabelled anxiety" condition produced obese-normal weight group differences in eating behaviour, in the opposite direction. Slochower concluded in favour of a role for anxiety in eliciting food-intake, although no firm conclusions were made as to whether eating is accompanied by anxiety reduction.

A further study to support the proposition that stress *can* elicit eating in obese individuals was conducted by Meyer & Pudel in 1972. These researchers used a food dispenser that disguised the visual feedback of intake received by the participants. They established baselines of eating over seven sessions in 100 participants. They then introduced stressors (noise, flickering lights, unsolvable anagrams) over three sessions. In some participants, these conditions produced hyperphagia (overeating), and in others hypophagia (undereating). Mature, obese women showed the greatest hyperphagic effects, whilst children and the aged showed the smallest effects.

Jung (1973) reported that the stress of removing toys from children reduced their food intake, whereas Jung (1976) reported that suspense-films seemed to enhance eating in four to six year-old children, with the largest effects for overweight, older girls. Finally, in a review, Ganley (1989) concluded that, in hugely obese individuals seeking treatment, emotional eating appears to be very common, with many studies reporting that emotional eating is most often precipitated by negative emotions such as anger, depression, boredom, loneliness and anxiety. Table 1 includes a summary of the literature comparing obese and normal-weight populations in terms of food consumption following exposure to stress.

**2.4.4 The "Internal/External" Theory of Obesity: the "Obese Eating Style".** Taking up the ideas about early learning history and reinforcement favoured by the psychosomatic theorists, Stanley Schachter and his colleagues (Schachter et al., 1968) made somewhat different predictions (see Figure 2). Schachter's hypothesis of individual differences in eating behaviour between obese and normal-weight individuals when stressed relates to differences in the salience of cues used to initiate (and terminate) food consumption. According to the "internal/external" hypothesis, normal-weight individuals rely on 'internal' cues relating to their current physiological state (nutritional energy requirements) when deciding whether or not to eat. Thus, the determinant of eating for normal-weight individuals was deemed to be physiological components such as gastric contractions and circulatory and hypothalamic influences. Because gastric contractions decrease when the individual is under stress (eg. Cannon, 1915), and normal-weight individuals

## Table 1. Summary of Studies: Stress and Eating Behaviour

[i] **Key:**

**Participant classification**: **n/w** (normal weight); **o/w** (over weight); **u/w** (under weight); **R** (restrained eaters); **UN** (unrestrained eaters); **AN** (anorexia nervosa); **HR/HE** (high restraint/high emotional); **HR/LE** (high restraint/low emotional); **LR/HE** (low restraint/high emotional); **LR/LE** (low restraint/low emotional).
**Stress tasks: CF** (Concept formation task); **MA** (Mental Arithmetic task); **MAT** (Mental Arithmetic Task);**TSST** (Trier Social Stress Test.
**Physiological measures: BP** (Blood pressure); **GSR** (Galvanic skin response); **HR** (Heart rate).
**Questionnaire Measures**: **BDI** (Beck Depression Inventory); **BES** (Binge Eating Scale); **BMIS** (Brief Mood Introspection Scale); **BS** (Binge Scale); **COPE** (assessment of coping style); **CSS** (Coping Strategies Scale); **DACL** (Depression Adjective Check List); **DFS** (Daily Food Schedule); **DiSM** (Dieting Status Measure); **DLEQ** (Dutch Life Events Questionnaire), **EASQ** (Eating Attributional Style Questionnaire); **EAT** (Eating Attitudes Test); **EDQ** (Eating/Dieting Questionnaire); **EI** (Eating Inventory); **EPI** (Eysenck Personality Inventory); **FCQ** (Food Choice Questionnaire); **GHQ** (General Health Questionnaire), **GHQ** (General Health Questionnaire); the **Hassles Scale**; **HDL** (Health and Daily Living Questionnaire); **J-FFSIF** (Janis-Field Feelings of Social Inadequacy Scale); **LAQ** (Lifestyle Assessment Questionnaire, **MAACL** (Multiple Affect Adjective Checklist); **MAS** (Multiple Affect Scale); **MCSDS** (Marlowe-Crowne Social Desirability Scale); **MLM** (Multilevel Linear Model); **PANAS** (Positive and Negative Affect Schedule); **POMS** (The Profile of Mood States); **PSS** (Perceived Stress Scale), **PSS** (Perceived Stress Scale); **QSU** (Questionnaire on smoking urges); Questionnaire Measures: **RS** (Restraint Scale); **RSE** (Rosenberg Self-Esteem Scale); **RS-R** – Revised Restraint Scale; **SACL** (Stress Arousal Check List); **SCL-90-r** (the Symptom Checklist); **S-CQ** (Self-Consciousness Questionnaire); **SSES** (State Self-Esteem Scale); **STAI** (State-Trait Anxiety Inventory); **S-TAIS** (Trait form of the State-Trait Anxiety Inventory); **SUDS** (Subjective Units of Distress); **TFEQ** (Three-Factor Eating Questionnaire); **VAMS** (Visual Analogue Mood Scales); **VAS** (Visual Analogue Scales);

LABORATORY STUDIES

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Rotenberg, Lancaster, Marsden, Pryce, Williams,& Lattimore, 2005** | 80 female students | Priming a lack of control | Acute. Between subjects. | RS-R (continuous variable) STAI EASQ | Ice cream. 3 bowls of vanilla, each containing 100g | Priming thoughts of a lack of control resulted in sig. greater food intake than did priming thoughts of control. The effect was not mediated by restraint status | |
| **Shapiro & Anderson, 2005** | 153 female students | Unsolvable anagrams vs read a story and circle each 'e' | Acute. Between subjects. | RS (median 16 and 12) SSES SUDS Taste ratings | Intake: 4 food classes: high fat/high sugar, low fat/high sugar, high fat/low sugar, low fat/ low sugar. | No sig. difference between R and UN eaters when under stress | R eaters consumed a greater proportion of calories from grapes, but also consumed more high calorie energy dense food (potato chips) when stressed than when not stressed |

**LABORATORY STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Bellisle, Dalix, & Slama, 2004** | 48 females | Distraction: watching TV vs listening to a detective story | Repeated measures | TFEQ (continuous variable) Sub-scales: Restraint. Disinhibition. Hunger | Hachis parmentier (ground beef & potatoes). Fruit sherbets. Served each week for 4 consecutive weeks. The first and last meals were included for control purposes | TV viewing and listening to a detective story provoked a similar and sig. intake of food, compared to baseline intake. No significant correlations were obtained for the restraint and disinhibition sub-scales. | |
| **Chua, Touyz, & Hill, 2004** | 40 o/w, highly restrained binge eaters | Neutral vs sad film clip | Acute. Between subjects | DEBQ (median 2.9) VAS (mood) | 4 different types of chocolate, presented after the film. Milk, Dark, White, and Fruit and Nut. | Participants in the negative (sad) mood condition consumed sig. more food than did those in the neutral film condition, and R eaters consumed the most. However, the expected R x Mood interaction was only marginally significant ($p = 0.06$) | |

**LABORATORY STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Lattimore & Caswell, 2004** | 40 female students | Active coping task: reaction-time response to computer generated tone with monetary reward.<br>Passive coping task: cold pressor task.<br>Control task: reading magazines | Acute.<br>Between subjects.<br>PROTOCOL: Baseline, Task, and Recovery. | DEBQ (median 2.3)<br>STAI<br>HR<br>SBP<br>DBP | Snack food.<br>Crisps.<br>Crackers.<br>Chocolate | R eaters sig. increased their intake when compared to UN eaters following the active coping task.<br>R eaters consumed sig. less than UN following the control task.<br>Although R consumed less than UN following the passive coping task, this comparison failed to achieve sig. at the adjusted alpha level. | |
| **Lattimore & Maxwell, 2004** | 119 female students | Low cognitive load:<br>ego Stroop (ETS) or colour Stroop (CNS).<br>High cognitive load:<br>ETS or CNS plus memorisation.<br>Tasks were computer driven | Acute.<br>Between subjects. | RS plus sub-scales:<br>Concern for dieting (CD) and Weight fluctuation (WF).<br>STAI.<br>Hunger ratings. | Snack food:<br>Crisps.<br>Chocolate.<br>Dried fruit. | R eaters sig. increased their intake following high cognitive load with ego threat, when compared to the colour Stroop task condition, and sig. more than UN in the high cognitive load plus ego Stroop condition. | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Wallis, & Hetherington, 2004** | 38 University students and staff | Stroop:<br>3 Conditions:<br>Ego.<br>Neutral.<br>Incongruent colour. | Acute.<br>Between subjects.<br>4 groups:<br>HR/HE<br>HR/LE<br>LR/HE<br>LR/LE | DEBQ (median split of 2.8 on both the Restraint and Emotional sub-scales).<br>STAI<br>BDI<br>SSES | Chocolate | R was associated with a sig. greater intake following both stress tasks, compared to the control task.<br>Emotional eating was associated with a sig. greater intake following the ego Stroop task, relative to the control Stroop. | |
| **Haynes, Lee, & Yeomans, 2003** | 80 females | No-stress (CF task).<br>Stress (CF + MA task) adapted from the TSST | Acute.<br>Between subjects.<br>4 Groups, classified using TFEQ_R and TFEQ-Dis<br>HR-HD<br>HR-LD<br>LR-HD<br>LR-LD | Restraint.<br>Disinhibition.<br>Mood and Appetite ratings. | Following a standardised breakfast:<br>8 food items prepared in bite size portions and classified as savoury or sweet. | LR-HD consumed more than the other groups in the no-stress condition and reduced intake in response to stress.<br>HR-HD and LR-LD both consumed more in the stress than no-stress conditions.<br>HD were more responsive to stress. | HD consumed sig. more sweet foods, regardless of stress.<br>HR consumed sig. less savoury foods than LR. |
| **Boon, Stroebe, Schut, & Ijntema, 2002** | 126 female students | Perceived calorie content (high vs low).<br>Distraction: identify number of animal words contained within an audio tape vs no audio tape | Acute.<br>Between subjects.<br>Taste-test: with or without distraction. | RS (median 11) | Ice cream:<br>Vanilla<br>Chocolate<br>Strawberry<br>(600g each) | In the high calorie condition, R eaters consumed the same amount as UN eaters when not distracted.<br>Both R and UN eaters consumed more when distracted than when not distracted. | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Kahan, Polivy, & Herman, 2002** | 42 female & 17 male students | Visual perception task (Asch type conformity task). Conflict condition (pressure to conform via seen responses from confederates). No conflict condition (participants had knowledge of only their own responses). | Acute. Between subjects. | RS (Median/ cut off?). SSES MAS J-FFSIS (Modified version). | Three types of freshly baked palatable cookies | R eaters in the conflict condition consumed sig. more than R eaters in the no-conflict condition. No sig. difference in intake between UN in the conflict vs no-conflict conditions. | |
| **Roemmich, Wright, & Epstein, 2002** | 23 boys and 17 girls (8-11 yrs) | 3 Conditions: Interpersonal videotaped speech. Reading children's magazines. Colouring. | Acute. Within subjects. 4 Groups, based on median split DEBQ and change in perceived stress (reactive): LR-LR LR-HR HR-HR HR-LR | Gender DEBQ VAS: Hunger ratings and food liking | Snack food and macronutrient intake | LR-LR consumed sig. less and HR-HR consumed sig. more following stress than following the control condition, when % body fat as entered as covariate. | HR-HR consumed more total energy, snack grams, and total grams of protein and carbohydrates. |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Urbszat, Herman, & Polivy, 2002** | 41 female students | 2 Conditions: DIET: informed they would undertake a low-fat calorie-reduced plan for 1 week. NO-DIET. | Acute. Between subjects. | RS (cut off 15) SSES PANAS | Cookies: Double choc. Choc chip. Mini Oreos. | R in the diet condition ate sig. more than R in the no-diet condition or UN in either condition. UN consumed the same amount, regardless of condition. There was no effect for self-esteem or mood | |
| **Bellisle & Dalix, 2001** | 41 females | 4 Conditions: Eating alone. Eating when listening to a recording relating to the sensory properties of the food (attention). Eating when listening to a detective story (distraction). Eating in groups of 4 people. | Repeated measures | TFEQ (continuous variable) Restraint. Disinhibition. Hunger. | Hachis Parmentier (ground beef and potatoes). Fruit sherbet. served for each condition. | The difference in energy intake between the baseline (Condition 1) and the Distraction condition (3) was significantly associated with cognitive restraint, but not with disinhibition or hunger. | |

**LABORATORY STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Cavallo & Pinto, 2001** | 60 female students selected from 390 – selected because they scored >13 on the RS, and because they smoked 5-30 cigarettes daily for at least 1 month. | Positive (comedy) vs Negative (domestic violence) film clip. | Acute. Between Subjects. Restrained smokers vs restrained non-smokers. PROTOCOL: Baseline, Task, and Recovery. | PANAS<br>BP<br>HR<br>QSU | M&Ms<br>Potato chips | Emotional arousal, regardless of valence, did not result in a difference in food consumption between restrained eaters who were either smokers or non-smokers. | |
| **Epel, Lapidus, McEwen & Brownell, 2001** | 59 healthy pre-menopausal women | Modified version of the TSSR: visuospatial puzzles, serial subtraction of a prime number from a high number, and delivery of a videotaped speech (with audience observation) | Acute. Within subjects. Participants *invited* to eat. | EAT<br>POMS<br>Salivary Cortisol | Basket of snacks provided post experimental session. High fat sweet & salty and Low fat sweet & salty. | High cortisol reactors consumed more calories on the stress day compared to low reactors, but ate similar amounts on the control day. Increases in negative mood in response to the stressors were also sig. related to greater food consumption. | High cortisol reactors consumed sig. more sweet food across days. |

**LABORATORY STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Giner-Sorolla, 2001**<br><br>**Study 3 (study 1 & 2 n/a)** | 57 female students who responded "sometimes", "often", "usually" or "always" to the statement "I engage in dieting behaviour" | Sentence-scramble puzzle. Each puzzle contained emotion words relevant to one of four categories of emotion: self-conscious: positive and negative; hedonic: positive and negative | Acute. Between subjects. PROTOCOL: Baseline taste-test (3 mins), Puzzle. Post-priming taste-test (1) Post-priming taste-test (2) Post-priming taste-test (3) | S-CQ. Mood (two 9-point scales). Three 5-point scales assessing whether the participant ate more or less than she wanted to, needed to, and should have. | Taste-test: Baseline (8 pieces of caramel coated popcorn). Post-priming (1) (10 puffed "cheese curl" snacks & 10 potato chips). Post-priming (2) (50 M&Ms & 5 Reese's Brand peanut butter cup candies). | Negative self-conscious primes reduced the amount eaten by dieters. Positive self-conscious primes increased the amount eaten by dieters. Hedonic positive and negative emotion words had the opposite effect. | |
| **Oliver, Huon, Zardo, Kipling, Williams, 2001** | 57 female under-graduates | Interpersonal Stress. Condition: (ostracism/ argument) x source/ target) | Acute. Between subjects. Taste-test. | TFEQ DiSM | Sweet (choc.); savoury (crisps); 50g of each food. | High disinhibitors ate sig. more compared to low disinhibitors when targets; ns group diff. when sources. | More sweet than savoury food consumed. |

**LABORATORY STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Tice, Bratslvsky, & Baumeister 2001**<br><br>Study 1 (study 2 & 3 did not include a measure of restraint) | 43 men & 31 women students | Mood induction (positive or negative) vs mood freeze or no freeze conditions. Participants read a story: Distress condition: driver kills a child. Happy condition: protagonist saves a child's life. Participant was required to experience the event as the main character, including emotions provoked, then write a brief essay summarising how they felt at that moment. | Acute. Between subjects. Taste-test | RS(?) MBIS | Pretzels, chocolate chip cookies, and small cheese crackers | When mood could be changed, emotional distress led to an increase in consumption. This pattern was reversed when people were told that their moods would not change during the experiment. Dietary restraint status did not moderate the results. | |

**LABORATORY STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Oliver, Wardle, & Gibson, 2000** | 27 men and 41 women; n/w; non-smoking | Anticipation of speech performance (video taped) vs listening to a passage of emotionally neutral text (extracted from *Under Milk Wood*) | Acute. Between subjects. Buffet lunch (6 food categories) | BP<br>HR<br>PANAS<br>STAI (trait)<br>DEBQ (Median)<br>Food Appetite ratings and Food intake | Sweet, salty, and bland food categories, further divided into high and low fat groups | Dietary restraint did not sig. affect appetitive responses to stress.<br>Stress did not alter overall intake, nor intake or appetite for the 6 food categories | Stressed emotional eaters (DEBQ-emotional eating sub-scale) ate more sweet high-fat foods and a more energy-dense meal than unstressed and non-emotional eaters |
| **Sheppard-Sawyer, McNally, & Fischer, 2000** | 31 female students | Sad v Neutral film segments | Acute. Repeated measures. | RS-R (median 14)<br>VAMS | Hot buttered salted popcorn | Sad film: UN decreased their intake; R showed a ns increase in consumption, relative to the neutral film condition | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Tanofsky-Kraff, Wilfley & Spurrell, 2000** | 82 females | 4 conditions: Failure: Spin Out Puzzle. Speech threat. Interpersonal: ostracism. Control: participants presented with a page of randomly typed letters and asked to circle every fifth 'e' | Acute. Between subjects. | RS-R (cut-off 15) | Ice-cream 3 flavours (500g each) | R eaters in the stress conditions ate more than participants in the control group. In the interpersonal group, the greater the restraint, the more participants ate, whereas in the other three conditions, the pattern was reversed, although ns. | |
| **Stroud, Tanofsky-Kraff, Wilfley, & Salovey, 2000** Exp. 1 | 50 female students | YIPS Interpersonal stressor vs Control: participants presented with a page of randomly typed letters and asked to circle every fifth 'e' | Acute. Between subjects | RS-R (cut-off 15) The Sensation Questionnaire. Bogus Social Perceptions Questionnaire | Ice-cream 3 flavours (500g each) | R eaters ate more after exposure to the YIPS than UN eaters | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Ward & Mann, 2000** Study 1 | 60 female students, n/w | High vs Low cognitive load. High: participants watched a series of art slides in anticipation of a recognition-memory test, and simultaneously, periodically responded to a reaction-time task intended to serve as a manipulation check. Low: participants simply responded to the reaction time measure (i.e. respond with a foot pedal to a beep emitted by the computer at random intervals) | Acute. Between subjects | RS-R (cut-off 16). Pre-test VAS: mood and hunger. Post-test VAS: task descriptives (simple, complex and stress). | Doritos nacho chips, M&Ms, and chocolate chip cookies (food items consumed *during* the task) | R eaters ate sig. more in the high than low cognitive load conditions. UN eaters ate less food in the high than low cognitive load conditions | |
| Study 2 | 29 female students, R eaters (cut-off 16) | As per study 1, but low cognitive load participants were told that the r-t task was not intended to be stressful. In addition participants were required to complete a word-fragment task and were asked to estimate how much food they had eaten | " | " | " | R eaters consumed more food while performing the high cognitive load condition. | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Polivy & Herman, 1999** | 137 female students | Failure at a timed cognitive task (anagrams) | Acute. Between subjects. Unlabelled (failure at a cognitive task) or Labelled (participants informed they probably felt badly because they had performed so poorly) Distress vs No distress | RS (cut-off 15) SSES. Goals and purposes questionnaire. | Ice cream 3 flavours: *ad libitum* - 900g of each. Limited eating: 1 small spoonful of each flavour. | A restraint x distress interaction was obtained using a 2 (R vs. UN) x 2 (control/failure) ANOVA. R eaters attributed more negative affect to the ice cream than did UN eaters. R eaters who ate *ad libitum* attributed more negative feelings to the ice cream than did R eaters who ate only a taste of ice cream. R eaters who did not eat were the only group to attribute positive affect to the experiment. R eaters who ate *ad libitum* attributed more negative affect to the experiment than did R eaters who did not eat *ad libitum*. All participants who failed at the anagram task attributed the amount they ate (large or small) to being upset about the task. There was an interaction trend (restraint x failure). R eaters were sig. more likely to the make this attribution after failure than after the neutral task. UN did not differ from each other, and R eaters who had failed tended to make this attribution slightly more than did UN eaters who had failed. | |

**LABORATORY STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Rotenberg & Flood, 1999** | 58 female students | 3 Conditions: Sad (participant asked to think about two personal experiences that made her feel sad (2 mins. each) then recall one of these aloud for 1 min.) vs. Neutral (participant was asked to think about her route to school that day and imagine making a telephone call to no-one in particular (2 mins. each), then to recall the latter out loud for 1 min.) vs. Loneliness (participant given 2 items from the UCLA Loneliness Scale, and was required to think about the times when she felt that way (2 mins each item), and to recall aloud for 1 min, the experience that made her most lonely.) | Acute. Between subjects. Taste-test. | RS (continuous variable). EAT TFEQ POMS BDI (short form). Dieters/ Non-dieters. | 3 different types of cookies. | Dieters consumed more in the loneliness than the neutral mood condition, whereas non-dieters displayed the opposite pattern. In relation to dietary restraint, the amount consumed increased as a function of loneliness for high R eaters, whereas the amount consumed decreased as a function of loneliness for low R eaters. There were no effects for the sad mood condition, or dispositional depression, regarding the amount of food consumed as a function of restraint. | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Heatherton, Striepe, & Wittenberg, 1998** | | | | | | | |
| **Study 1** | 69 female students | Task failure (self-involving threat), Musical mood-induction (non-self-involving threat), Control (neutral-music) | Acute. Between subjects. | RS (cut-off 16). Dieters vs. Non-dieters. SSES. Mood scale (24 adjectives: 15 negative and 9 positive.) | Ice cream (3 flavours, presented in "very large bowls" | Both task failure and musical mood induction led to sig. increased eating among dieters when compared to the control condition. | |
| **Study 2** | 90 female students | 2 music conditions: Sad or neutral. Half were assigned to the attribution label condition (informed that the music may make them feel sad) | " | " | " | The addition of an attribution label to the mood induction procedure eliminated the disinhibited eating observed in the unlabelled condition (for dieters). | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Heatherton, Striepe, & Wittenberg, 1998 cont....**<br><br>**Study 3** | 41 female students | Neutral mood (self-relevant), Neutral mood (non-self-relevant), Sad mood (self-relevant) Sad mood (non-self-relevant). Participants were asked to imagine themselves in a negative situation (causing an accident: self-relevant condition), or a person named Jon causing the accident (non-self-relevant condition). Participants were allowed 10 mins. to read the scenario and write an essay about how they (or Jon) were feeling following the accident. | " | "<br>Same mood and self-esteem measures as in Studies 1 and 2: Negative affect (distressed, hopeless, sad, depressed, and uncertain). Anxiety (fearful, apprehensive, jittery, anxious, and nervous). Hostility (annoyed, confused, irritated, and bored). | " | Chronic dieters ate more ice cream in the sad than neutral story condition, only when the sad story was self relevant | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Mcfarlane, Polivy, & Herman, 1998** | 103 female students | False weight feedback | Acute. Between subjects. R and UN were weighed 5lbs heavier or 5lbs lighter than their actual weight, or were not weighed (controls) | RS (cut-off 15) VAS: mood & self-image. STAI | Bite size cookies: English Bay double choc. English Bay oatmeal raisin, Monsieur Felix & Norton choc. chip. | R & UN told 5lbs less were not affected. R told 5lbs more reported lower self-esteem, less positive moods and more negative moods than did R eaters in the other 2 conditions. R eaters told 5lbs more also ate sig. more food than did each of the other groups. | |
| **Mitchell & Perkins, 1998** | 48 women | Computerized memory recall task: repeating numbers, either forwards or backwards, vs simple target (control task) | Acute. Between subjects. R and UN smokers: non, ad-lib and abstinent. | RS-R (cut-off 16) STAI SACL VAS: anxious & tense. | Snack food: potato chips, vanilla yoghurt, raisins, choc. candy, pretzels, granola bar. | Stressor was effective (compared to the control task) for all groups, aside from R ad lib smokers. Stress was highest for smoke-abstinent R eaters. ns effect was observed for food intake. During stress, desire for a cigarette was sig. higher in R than UN eaters. | |
| **Rutledge & Linden, 1998** | 77 female students | Tasks: Mental arithmetic, Stroop (colour), Word scramble task. | Acute. Between subjects. Incidental eating PROTOCOL: Baseline, Task, and Recovery. | RS (median 18) TFEQ-D PANAS Vulnerability to Stress Scale. BP HR | Snack food: miniature choc. chip cookies and crackers. | A restraint x negative affect interaction was observed for food intake. Physiological reactivity predicted a reduction in food intake for UN only. Food intake was associated with impaired physiological recovery for R but not UN eaters. | |

**LABORATORY STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Waller & Mijatovich, 1998** | 60 non-eating disordered women | An ego (self-esteem) threat, a physical threat or a neutral message was presented subliminally via a tachistoscope. | Acute. Between subjects. | EDI | 200g roasted salted peanuts. Eating time: 5 mins. | Women with healthy eating attitudes ate slightly more after exposure to the ego threat, but not after the physical threat. Women with unhealthy eating attitudes ate more after exposure to both forms of threat, but particularly after the ego threat. | |
| **Levine & Marcus, 1997** | 40 females, with and without bulimic symptoms. n/w, students. | Stress: prepare and deliver a videotaped speech about their negative qualities. No-stress: relaxing and reading nature magazines. | Repeated measures: symptomatic vs controls (between subjects factor). Stress vs no-stress (within subjects factor). | RS<br>SCL-90-R<br>BULIT-R (cut off 88; top 10%)<br>STAI<br>POMS<br>MCSDS | M&Ms, miniature choc. chip cookies, cheese crackers, potato chips, pretzels, small boxes of raisins. | Females with bulimic symptoms did not increase their intake when exposed to interpersonal stress. | Both bulimic and control participants increased their intake of carbohydrates following the stressor. Bulimics consumed sig. fewer fat calories under both conditions compared to controls.<br>In both conditions, bulimics consumed sig. fewer calories from binge foods (cookies, M&Ms, cheese crackers and potato chips) and sig. more calories from non-binge foods (pretzels, raisins) than did controls. |

LABORATORY STUDIES cont....

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Bleu, 1996** | 24 year two (13yrs) & 20 year five (16yrs) females from a Scottish Comprehensive High School. | High (threat of providing a blood sample) vs Low (no mention of providing a blood sample) anxiety conditions. | Acute Between subjects. Taste-test (forbidden vs permitted foods) | TFEQ (median 12) Age. STAI | Biscuits: sugar coated fruit shortcake, shortcake, custard cream, chocolate hobnob, and krackawheat cracker. | Total intake: only the 16 year-old R females overate in the high anxiety condition. Counter-regulation was observed for R eaters in both age groups for some forbidden foods. Effects were more pervasive for the 16 year old group. No sig. effects were found for the permitted food category. | |
| **Mitchell & Epstein, 1996** | 32 female students | Stroop stress (card method). Practice card (incongruent colour words). Experimental card (forbidden food words). | Acute. Between subjects. Appetite and intake (taste-test) PROTOCOL: 5 min rest, 2 min baseline. | RS-R (cut-off 15). Salivation. HR. 100-mm line VAS: hunger, fullness, food liking & arousal. Stroop times & errors. | Strawberry yoghurt 0.05ml for 8 trials. Taste-test: 2 bowls of yoghurt; 1 strawberry & 1 vanilla. | R: no effect (non-significant increase), UN: significant decrease in intake compared to controls R eaters consumed slightly less then UN eaters in the no-stress condition. | No sig. difference in amount consumed between same (strawberry) and novel (vanilla) flavours. |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Polivy, Herman & McFarlane, 1994** | 96 female students | Anticipation of ego threat (public speaking). Palatability manipulated. | Acute. Between subjects. Taste-test. | RS (cut-off 15) STAI SSES | Cookies: good vs bad tasting. | R: increased intake of good *and* bad tasting cookies. UN: no effect for either good or bad tasting cookies. | |
| **Strauss, Doyle & Kreipe, 1994** | 86 female students | 3 Conditions: Videotape with no ads. vs videotape with neutral ads. relating to dieting, diet products and desirable body images. (Videotape – 39 mins. of *Terms of Endearment*) | Acute. Between subjects. Pre-load 6oz low fat banana shake. Taste-test. | RS (median 14) MAACL | M&Ms (550g) Peanuts (400g) | High R eaters who viewed the sad video clip plus diet-oriented commercials ate more than other participants. | |
| **Eldredge, 1993** | 80 female students n/w | Intelligence test: 'Guilford Abstract Design Test' | Acute, between subjects: High/low restraint; self-esteem by success/ failure. | RS (cut-off 15) RSE (cut-off 32) BDI MAACL HDL EPI Self-complexity task. | Crackers. | Current dieting, but not self-esteem, influenced consumption. R dieters ate sig. less in a negative mood state than in a positive mood state. Non-dieters, irrespective of restraint status consumed comparable amounts in both mood states. | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Heatherton, Polivy, Herman & Baumeister, 1993** | 80 female students | Spin-out puzzle, 4 conditions: Simple failure, Failure videotaped, Failure distraction, Control. | Acute. Between subjects. | RS (cut-off 16). Classified as dieters vs non-dieters. | Ice cream (3 flavours) 500g each. | Only conditions which allowed/prompted low self-awareness (failure/distraction, and simple failure) disinhibited eating in dieters. | |
| **Steere & Cooper, 1993** | 48 n/w female students | False elevated HR and GSR feedback. | Acute. Between subjects. Incidental eating. | DEBQ (median 2.3) VAS (hunger and anxiety) GHQ | Cashew nuts | UN: no change in response to either anxiety or hunger. R: anxious/hungry R eaters ate less than relaxed/hungry participants, and the same amount as relaxed individuals who were not hungry. | |
| **Cools, Schotte & McNally, 1992** | 91 female students | Stressful film vs comedy film and neutral film. | Acute. Between subjects. Eating as an incidental activity. | RS-R (median 16) POMS VAMS | Popcorn provided during film. | Neutral film: food intake decreased with increasing dietary restraint. Horror and comedy films: food intake increased with increasing dietary restraint. | |
| **Grunberg & Straub, 1992** | 26 male and 26 female n/w students. Non-smoking. | Stressful vs control film. | Acute. Between subjects. | Gender | Choice of sweet, salty, and bland snack foods *during* film. | Men: anxious reduced intake of all foods compared to control men. Women: no sig. effect for overall intake BUT sig. increase for sweet and bland food compared to control women. | Females: sig. increase sweet & bland food (almost twice that of control women) |

**LABORATORY STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Patton, 1992** | 80 undergraduate females | Abandonment vs control stimulus: Presented at either subliminal (4 msec.) or supraliminal (200 msec.) exposure durations. | Acute. Between subjects. Taste-test. | EDI MAACL Recognition lists to assist the participants' awareness of the stimuli viewed. | Crackers 3 bowls, each containing 50 crackers, weighing 100g. | Following exposure to an abandonment stimulus, the high eating disorder group ate sig. more crackers than did participants in any other condition. | |
| **Heatherton, Herman & Polivy, 1991** | 75 female students | Fear (shock threat) vs ego threat (task failure) vs anticipation of ego threat (speech anticipation) vs control. | Acute, Between subjects. Taste-test. | RS (cut-off 16) | Ice cream | R: no effect with shock threat, but increase with real and anticipated ego threats. UN: decreased intake with shock threat. No effect with ego threats. | |
| **Schotte, Cools, McNally, 1990** | 60 female students | Stressful vs neutral (control) video. | Acute. Between subjects. Incidental eating. | RS(R) (median 17) POMS VAMS | Buttered Popcorn (400g) | R: exposed to the horror film consumed more than R eaters exposed to the neutral film or UN eaters exposed to either films. | |

LABORATORY STUDIES cont....

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Herman, Polivy, Lank & Heatherton, 1987** | 80 female students | Anticipation of ego threat: market research. Performance anxiety (composition of an advertising jingle) vs control. Effects of anxiety and food deprivation and food intake were examined. | Acute. Between subjects. Taste-test. | RS (cut-off 15) Hunger. STAI. Pre-load. | Ice cream (vanilla, chocolate, and strawberry) (500g each) | Non-dieters: anxiety decreased hunger but had no effect when participants were not initially hungry. Dieters: anxiety increased eating only when the participant was initially hungry. | |
| **Pine, 1985** | 40 male, 40 female American Indians vs 40 male, 40 female White Americans. o/w and n/w. | Threat of shock. | Acute. Between subjects. High anxiety group informed the shock would be painful. Low anxiety group informed the shock would be barely noticeable. | S-TAIS Weight. Ethnicity. | Peanuts | All o/w and high anxious condition obese individuals consumed more food than did non-obese and low anxiety condition obese individuals. The overall consumption of food was greater with American Indians than with White Americans. Obese and non-obese American Indians overeat in response to stress. | |

**LABORATORY STUDIES cont….**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Ruderman 1983** | 83 female students. 42 n/w vs 41 o/w. | Impressing a stranger. | Acute. Between subjects. Relaxation vs high or low anxiety. Taste-test. | Weight | Ice cream: chocolate, vanilla, and mint chip. (? Grams) | n/w: consumption similar all conditions. o/w individuals decreased their food intake when highly anxious compared to when mildly anxious. Consumption when relaxed was at an intermediate level. For o/w individuals, maximum food consumption occurs with moderate levels of anxiety. | |
| **Frost, Goolkasian, Ely, Blanchard, 1982** | 55 female students. | Depressed vs elated vs neutral mood induction. | Acute, between subjects. Eating as an incidental activity. *Velten Mood Induction Procedure,* used to elicit a depressed, neutral or elated mood. | RS-R (median on: total scores, weight fluctuation sub-scale, and concern for dieting sub-scale. MAACL-D | Candy (243 M&M's) | R: increased intake in depressed mood condition compared to R eaters in both the neutral and elated conditions, and more than UN eaters in the depressed condition. The effect was most prominent for individuals who scored high on the weight-fluctuation factor of the RS. The effect did not occur for individuals who scored high on the concern for dieting factor of the RS. | |
| **Baucom & Aiken, 1981** | 56 male and female students, divided into o/w dieting, o/w non-dieting, n/w dieting, n/w non-dieting. | Negative mood induction – task failure vs control. CF Task. Depressed vs non-depressed mood induced. | Acute, between subjects. Taste-test. | Weight DACL | Crackers of different flavours. | Dieters ate more when depressed than when not-depressed, and non-dieters ate less when depressed than when not-depressed. Among depressed students, dieters ate more than non-dieters. Among non-depressed students, dieters ate less than non-dieters. This pattern existed for obese students and for non-obese students. | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Meyer & Pudel, 1977** | Newborn infants (50)<br>Children (4-6yrs.) (42)<br>Adults (u/w) (34)<br>Adults (n/w) (56)<br>Adults (o/w) (28)<br>Adults over 65 (81) | Task-induced stress: noise, flicker lights. | Repeated measures. | Age<br>Weight | Changes in % of food intake; speed of calorie consumption. | Older, o/w females reacted more often with hyperphagia.<br>ns change in intake for adults >65 years.<br>Children displayed hypophagia. | |
| **Reznick & Balch, 1977** | 64 males: n/w & o/w.<br>18 male and 46 female students. | Threat of shock performance linked to intelligence.<br>Low response cost (chocolates unwrapped);<br>High response cost (chocolates tightly wrapped) | Acute. Between subjects. | Weight.<br>Anxiety (high vs Low)<br>Response cost (high vs low)<br>STAI | Chocolates | n/w were unaffected by anxiety and response cost.<br>More o/w participants in the low-response cost and low anxiety conditions tended to eat than did o/w individuals in the high response cost, high anxiety conditions.<br>o/w individuals were also more inaccurate in estimating the amount they consumed. | |
| **Slochower 1976** | 80 males: n/w & o/w. | Labelled or unlabelled, fast or slow false HR feedback. | Acute. Between subjects. | Weight | Cashew nuts 800g | o/w high arousal unlabelled increased their intake compared to n/w high/low arousal and o/w low arousal. | |

**LABORATORY STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Herman & Polivy, 1975** | 42 female students. | Fear (shock threat) vs control. | Acute. Between subjects. Taste-test. | RS (cut-off 15) | Ice cream | R: no effect (non-sig. increase) | |
| **Abramson & Wunderlich, 1972** | 33 n/w and 33 o/w men. | Fear (shock threat) vs Interpersonal anxiety vs Control. | Acute. Between subjects. Taste-test. | Weight | Crackers (150) | o/w men: no difference between the conditions. n/w men: stressor was not effective. | |
| **McKenna, 1972** | 40 n/w men 40 o/w men | Fear (shock threat) vs control. | Acute. Between subjects. Taste-test. | Weight Palatability | Tasty cookies vs unappetising shortbread. | Tasty cookies; increase in stressed o/w decrease in stressed n/w. No effects for unappetising food. | |
| **Meyer & Pudel, 1972** | 63 n/w 38 o/w 16 u/w (mostly AN) | Monotonous sound. Irregular noise. Unsolvable puzzles. | Within subjects. Day: 1-2 (adaptation) 3-7 (standard) 8-10 (stress) | Weight | Cumulative intake curves plotted using Stunkard's food dispenser (liquid diet). | Stress response: o/w, hyperphagia, u/w, hypophagia. Means of average caloric intake was approx. the same for all 3 groups, but the standard deviation differed sig. The amount of food intake varied in the o/w more than in the n/w and u/w groups, both inter- and intra-individually. Average caloric intake of n/w group was related to height and/or weight. There was no relationship between food intake and height for the o/w group. | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Schachter, Goldman & Gordon, 1968** | 37 n/w 43 o/w females | Shock threat and food deprivation. | Acute. Between subjects. Taste-test. Manipulating pre-loading: full stomach vs empty stomach. Manipulating fear: high (rather high voltage) vs low (slight tingle). | Weight Hunger | Crackers (low calorie) | n/w individuals consumed more when they were calm than when they were frightened, and eat more when they were food deprived than when they were satiated. No effect for o/w individuals. o/w individuals consumed the same amounts in all experimental conditions. | |

**NATURALISTIC STUDIES**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Macht, Haupt, & Ellgring, 2005** | 42 males and females | Exam stress | Between subjects. Stress group tested 3-4 days prior to exam. Control group tested 3-4 weeks prior to exam | Gender | Paged at random 10 times a day. Reported: emotional state and motivation to eat | Stress group reported significantly higher feelings of tension, fear and emotional stress and an increased tendency to eat in order to 'distract' from various worries. | |
| **Freeman & Gil, 2004** | 48 female students self-identified as binge eating at least two to three times per month | Daily life stresses | Within subjects. Restraint entered as dichotomous variable in MLM analyses. | DEBQ-R (?) Daily diary: completed at the end of each day for 30 days. Participants identified the most stressful event/issue of the day. VAS: stress, depressed affect. CSS: social support, direct action, acceptance, and distraction | Daily frequency of binge eating episodes. Largest binge eating episode each day | Regardless of depressed mood, higher stress was associated with increased risk of same day binge eating. Distraction coping was associated with increased risk of future binge eating, and social support was associated with decreased risk of same day binge eating. Use of distraction by low and average (but not high) R eaters was associated with same day bingeing as stress increased. For low R females, increased stress was associated with a decreased probability of binge eating when acceptance coping was used. | |

**NATURALISTIC STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Henderson & Huon, 2002** | 105 o/w females | Self-reported negative affect using the PANAS and coping style | Participants completed a battery of questionnaires that assessed binge eating severity, negative affect and coping style. | BES<br>COPE<br>PANAS | Self-reported binge eating episodes | Women with higher levels of negative affect had more severe binge eating problems than those who experienced a low level of affective distress. Among those who had a low level of distress, those who tended to use dysfunctional coping (disengagement) reported more severe binge eating than those who reported they were less likely to employ this coping style. | |
| **Wardle, Steptoe, Oliver, & Lipsey, 2000** | 95 male and female staff of a London Department Store | High and low work stress session: hours of work in the last 7 days; extent to which work interfered with home life | Within subjects | PSS<br>DEBQ (median ?)<br>GHQ<br>Workload | Food intake over the previous 24 hours using standard interview protocol | R: significant increase.<br>UN: no significant change | R consumed more overall, and specifically more sweet and fatty foods in the high work stress period, particularly for those who perceived more stress |
| **Macht & Simons, 2000** | 23 female students. | Self-reported momentary motivational state and motivation to eat | Within subjects. | Dietary restraint measured using the Eating-Behaviour and Weight-Problem Inventory. R eating was relatively low: mean 8.03 | Motivational state and motivation to eat, measured on 6 consecutive days at 11am, 2pm, 5pm, 8pm, and 11pm. | Cluster analyses revealed that most of the self-rated motivations to eat were increased during periods of negative emotions, anger, tension and fear. | |

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Crowther, Sanftner, Bonifazi, & Shepherd, 2000** | 34 n/w females. Non-clinical. | Self-reported daily hassles | Between subjects. Binge-eaters vs non-binge-eaters | BES (cut off $\geq$20) EDQ The Hassles Scale | Self-reported daily intake using the DFS (2 week period) | Women who binge-eat rated daily hassles as significantly more stressful than women who do not binge. Women who binge eat consumed significantly more calories on high than low stress days | |
| **Connor, Fitter, & Fletcher, 1999** | 33 female and 27 male students | Self-reported daily hassles and between meal eating | Naturalistic Longitudinal Within and Between subject differences | DEBQ Gender. Hassles: arguments, deadlines, oversleeping, number of hassles | Self-reported number of snacks consumed each day for 7 days | Number of hassles significantly correlated with number of snacks consumed. The relationship was moderated by external eating: those with high external eating scores showed a positive relationship between hassles and snacking. No significant effect for severity of hassle, emotional and restrained eating or gender as moderators of the hassles-snacking relationship | |
| **Oliver & Wardle, 1999** | 63 male and 149 female students | Self-reported stress-induced hyper- and hypophagia | Naturalistic | Gender. Weight concern: 5-pt scale: very under- to very overweight. Dieting: are you trying to diet to lose weight at present? | Self-reported intake and palatability/food type in response to perceived stress | 42% reported hyper-phagia and 38% reported hypophagia. No significant effect of gender. Almost twice as many dieters as non-dieters reported hyper-phagic responses to stress | Intake of sweets, chocolate cake, biscuits and savoury snacks was reported to increase in response to perceived stress, regardless of dieting status. Meal-type foods: intake (fish, meat, fruit and veg.) was reported to decrease during stressful periods. |

**NATURALISTIC STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Ball, Lee, & Brown, 1999** | 212 Australian females | Life events. Perceived stress (how often do you feel stressed?) | Naturalistic | GHQ-12<br>BMI: actual ideas and discrepancy between the two | Disordered eating behaviours | Results showed few strong relationships between stress and eating variables for the sample overall. However, women with high psychological stress levels were more likely to engage in disordered eating behaviours than women with low levels of stress. | |
| **Weinstein, Shide & Rolls, 1997** | 52 women (15% o/w) and 49 men (29% o/w) | Recent life event-stressed > 1 day | Naturalistic | STAI<br>RS-R<br>EI<br>EAT<br>BS | Self-reported consumption during a specific experience and during stress, in general. | High disinhibition scores were sig. correlated with greater consumption during a specific stressful period, and during stress, in general for females only, while high scores on cognitive R were not. For males, neither disinhibition nor cognitive R were associated with the relationship between eating and stress. | |
| **Gerace & George, 1996** | 438 male fire-fighters | Life stresses | Prospective study of weight gain. | Predictors: demographic, smoking history, physical activity, dietary intake (self-reported) eating habits, Type A behaviour, stress (self-reported), and recent life events | Weight measures taken in 1984 and again in 1991 to assess possible weight gain. | Those worried over financial security gained significantly more weight than non-worriers | |

**NATURALISTIC STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Pollard, Steptoe, Cantaan, Davies, & Wardle, 1995** | 51 females, 64 males (stress group) 48 females and 16 males (control group). Students. | Exam stress | Between subjects. Measured at baseline then exam period, or equivalent time for control participants | Gender DEBQ (median ?) STAI-S PSS GHQ SSQ FCQ STAI-T | 24 hour dietary record | No general effects of exam stress on food intake were observed, and there was no interaction between stress and dietary restraint. However, students in the exam stress group with high trait anxiety and low social support showed significant increases in total energy intake between baseline and exam sessions, whereas individuals with low trait anxiety and high social support showed a reduction in energy intake | Students with high trait anxiety and low social support showed increases between baseline and exam sessions in the amount of fat and saturated fat consumed |
| **Stone & Brownell, 1994** | Married couples (total N = 158) | Daily stress | Longitudinal; 84 days. Daily record of mood, events and eating 'more/the same/less than' usual. | Gender | 'Did you eat more/same/less than usual'? For 84 days | Hypophagia was the dominant response, especially at higher levels of stress. During higher levels of stress more people ate 'less than usual'; no change in 'more than usual'. | |

**NATURALISTIC STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Griffin, Friend, Eitel, & Lobel, 1993** | 32 male and 47 female students | Academic demands, academic stress, daily hassles and uplifts, and perceived stress. Two assessments: week 2 of classes and 7 weeks later (exam period). | Longitudinal Within subjects. No control group | Gender<br>PSS<br>PANAS<br>LAQ - wellness inventory | 'Choosing healthy foods' | Increases in academic demands completed in the previous week were associated with improvements in nutrition | |
| **Schlundt, Taylor, Hill et al., 1991** | 236 o/w females, non-smoking, in a weight-loss program | Self-reported mood | Within subjects. Daily intake. | Weight.<br>Diet Q.<br>The Binge Scale.<br>TFEQ.<br>SCL-90.<br>Body composition data.<br>Energy expenditure. | Food record, daily intake for 14 days | Increases under stress for some individuals. Hierarchical cluster analyses revealed 5 groups: moderately healthy eating habits, chronic food restrictors, alternating diet-binge eaters, emotional overeaters, and unrestricted meal overeaters. The 5 groups differed on measures of emotional adjustment and eating behaviour. | |

**NATURALISTIC STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Niaura, Herbert, Saritelli, Goldstein, et al., 1991** | | | | | | | |
| **Study 1** | 25 males and 15 females. Accountants and controls. | Stressful vs not-stressful work periods | Naturalistic. Repeated measures | Blood sampling. PSS Food record Smoking history. | Participants asked to record all food items and beverages consumed during stress and no-stress periods | No significant change in dietary intake: Fat, saturated and unsaturated | |
| **Study 2** | 9 male and 15 female students | Exam time vs midterm break | " | Blood sampling. MAACL Food record. Smoking status | " | " | |
| **Study 3** | 2 male and 14 female medical students | Final exam period vs spring break | " | " | " | " | |

**NATURALISTIC STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Hill, Weaver, & Blundell, 1991** | | | | | | | |
| **Phase 1** | 206 female University students and staff, and hospital nursing and clerical staff | n/a | n/a | DEBQ<br>FTEQ<br>VAS: craving | n/a | Correlational analyses showed that food craving was only weakly related to dietary restraint, but significantly correlated with external and emotional eating, and to susceptibility to hunger | |
| **Phase 2** | 10 food cravers and 10 non-cravers | n/a | n/a | Prospective records of food intake, daily mood and food craving episodes | n/a | Cravers consumed slightly more daily energy than non-cravers. Cravers had higher ratings of boredom and anxiety, and dysphoric mood was prominent prior to cravings. Food deprivation was not necessary for craving to occur. | |
| **Michaud et al., 1990** | 225 school students (78 boys, 147 girls) | Exam day vs no-exam day | Within subjects. 24 hour recalled food intake | Gender | 24 hour food record | Girls consumed more on exam day | Boys ate more fat |

**NATURALISTIC STUDIES cont....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **McCann, Warwick, & Knopp, 1990** | 14 females | High and low work load times. No control group | Within subjects; objective and subjective measures of stress | Measurement of lipoproteins. VAS (stress) | Total intake over 14 days | Higher total energy intake during high work load | Higher total fat, saturated fat, % energy from fat ++ cholesterol |
| **Bellisle et al., 1990** | 12 n/w men | Anticipation of surgery | Within subjects. Test meal: 1 day pre-surgery vs 1 month post-surgery. No control group | None | Choice of foods from test buffet-style lunch | No difference between stress and non stress days | No effect |
| **Popper, Meiselman, Smits & Hirsch, 1989** | 475 marines | Experience of combat (first and second combat situation) | Reports of change in eating and reasons during combat | None | Recollection of amount eaten in relation to the usual amount (%) | Food intake was reduced during combat. The main reasons cited were the lack of time to eat and prepare food. Fear was also important in accounting for reduced consumption during the marines' initial exposure to combat. | |
| **Rookus, Burema, & Frijters, 1988** | 350 men and 395 women aged 20-35 years | Number of life events | Change in BMI in relation to events over 1-2 years | Gender | Change in BMI | Men: increase in BMI with many life events at 1 yr and 2yr follow-up.<br>Women: increase in BMI with many life events at 1yr but not 2yr follow-up | |

**NATURALISTIC STUDIES cont.....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **O'Donnell, O'Meara, Owens et al., 1987** | 8 male and 5 female medical students (final year) and controls (laboratory staff) | Final exams vs 3 months prior to final exams | Naturalistic. Repeated measures. Stressful life event | Plasma catecholamines and lipoproteins. Diet was assessed 12 weeks before and in the week before exams using a 3-day recording of dietary intake | Caffeine, alcohol, fat and cholesterol intake | Apart from a decline in the modest alcohol consumption, there was no change in dietary intake in the medical students or control participants over the study period | |
| **Van Strien, Rookus, Bergers, Frijters & Defares, 1986** | 589 men and 619 women. | Life events; 2 assessment times, separated by 6 months. | Weight change over 18 months in relation to stress. | Gender. Emotional eaters (high vs low: median split DEBQ). DLEQ Life event experiences; none vs >3 | Change in BMI | Men: high emotional eating & negative life events showed an increase in BMI at 6 months follow-up. Women: no interaction between emotional eating and negative life events. | |
| **Bradley, 1985** | 431 males and females. o/w, requesting assistance to lose weight | Participants were asked to recall factors/events associated with their weight gain during childhood, adolescence and adulthood, and to quantify the weight gains during childhood. | Naturalistic | | Weight gain in adulthood | Episodes of weight gain were associated with pregnancy, psychological stress, medications, and some surgical procedures. These factors accounted for 75% of total weight gained in 243 women. In 88 men, adult weight gain was largely attributed to lifestyle factors | |

**NATURALISTIC STUDIES cont.....**

| Author | Participants | Type of stress/ condition(s) | Design | Variables | Type of food investigated | Effect of stress on overall intake | Effect of stress on macronutrient and/or food category intake |
|---|---|---|---|---|---|---|---|
| **Slochower Kaplan & Mann, 1981** | 14 n/w and 23 o/w female students. | Exam stress measures taken during (high anxiety) and three weeks after exams (low anxiety) times | Within subjects. Incidental eating. | Weight Mood | Candy (M&Ms) 600g. Amount consumed during an incidental task. | o/w consumed sig. more during than after their exams. Eating was positively correlated with anxiety level and negatively related to their sense of control over feelings. After final exams eating was correlated with low self-esteem. n/w students' eating did not vary as a function of life stress, although a negative correlation was found between self-reported anxiety and eating during the exam period. | |
| **Leon & Chamberlain 1973** | o/w – 26 female, 2 male 'regainers' vs 17 female, 3 male 'maintainers' vs 19 female, 1 male controls. | Subjective (negative affect) recall & mood. | Within subjects; 24hr dietary ratings on 3 separate days, including 1 w/e day. | Gender Maintenance of weight loss. | 24 hour food record. | 'regainers' more likely to eat high calorie foods (sweets) between meals and in response to non-food cues. | |

[1] The abbreviation and full name of each measurement instrument can be found in the reference section of this thesis in bold text at the end of each associated reference. For example, Sarason, I. G., Sarason, B.R., Shearin, E.N., & Pierce, G. (1987). A brief measure of social support: Practical and theoretical implications. *Journal Social and Personal Relationships*, *4*, 497-510. **[SSQ: Social Support Questionnaire].**

correctly label gastric contractions, it was predicted that stress-induced decreases in gastric contractions would lead normal-weight individuals to decrease their food intake when stressed.

Obese individuals, on the other hand, are considered to be unresponsive to internal physiological indexes (of hunger or stress) and rely on external cues in the environment that are processed cognitively and perceptually, such as the sight, smell, availability and palatability of food, to initiate and terminate eating. It was therefore predicted that obese individuals would not respond to stress by reducing their food intake.

In terms of common ground both the psychosomatic and "internal/external" theory of obesity share the following predictions, a) there will be an interaction between weight category and the effect of stress on eating, b) when stress is present, obese individuals will eat more than normal-weight participants, c) in the absence of stress, food consumption by obese and normal-weight groups will be similar (Greeno & Wing, 1994).

**2.4.5 Evidence for the "Internal/External" Theory of Obesity.** In 1968 Schachter and colleagues set the precedent for the study of stress-induced eating in humans in the laboratory using experimentally manipulated stress. In this study, 94 male obese and normal weight undergraduate students were exposed to threat of electric shock. These researchers also tested whether obese and normal-weight individuals responded differently to internal hunger cues by manipulating hunger. All participants were required to skip the meal immediately preceding the experimental session. On arrival at the laboratory only half of them were satiated with roast beef sandwiches. Participants were left alone in a room for 15 minutes to `taste and rate` crackers, so that the amount of food consumed in response to stress could be measured inconspicuously. The `taste-test` paradigm is still commonly employed by researchers in the field of stress-induced eating to assess the affects of hunger, eating and macro and micro nutrient intake in response to stress.

Schachter and colleagues predicted that overweight individuals would eat regardless of their physiological state and that normal-weight participants would eat only when they were both unstressed and hungry. The predicted interaction between weight category and stress was found.

For normal-weight people, stress decreased food consumption among those who were hungry, and had no effect on those who had eaten. Obese individuals did not respond to either manipulation.

Studies investigating the hypothesis that weight category would predict individual differences in stress induced eating have used a variety of different stress induction methods. For example, threat of shock (Abramson & Wunderlich, 1972; McKenna, 1972; Pine, 1985; Reznick & Balch, 1977) and examination stress (Slochower, Kaplan & Mann, 1981). One study stressed females by asking them to try to impress a strange man (Ruderman, 1983), and some (field) studies have measured self-report of life events or negative moods and related these occurrences to self-reported intake or changes in body mass index (BMI) (Lowe & Fisher, 1983; Schlundt, Taylor, Hill, Sprocco, et al., 1991; van Strien, Rookus, Bergers, et al. 1986).

An examination of study findings reveals that the prediction made by Schachter et al. (1968) that normal-weight individuals would consume less food when stressed than when not stressed was not well supported (e.g., Lowe & Fisher, 1983; Pine, 1985; Reznick & Balch, 1977, Ruderman, 1983, Slochower, Kaplan & Mann, 1981). McKenna (1972) *did* replicate Schachter et al.'s original finding, with palatable food only, and a study by Abramson & Wunderlich (1972) did not report results for measures of normal-weight individuals because they failed to respond significantly to anxiety manipulations.

Having been met with initial acceptance, Schachter's theory was later deemed to be inadequate for several reasons (see Rodin, 1981 for review). For example, both internally and externally responsive eating styles can be found in individuals of all weight categories (e.g., Rodin & Slowcher, 1976, Tom & Rucker, 1975).

The original aim of much of this research was to find the *cause* of obesity. Despite the initial optimism that both the Psychosomatic and Externality theories provided, subsequent research suggests that any differences in eating style between obese and normal weight individuals are as likely to be *effects* as *causes* of obesity (Wardle, 1980).

In 1981 findings from a study by Baucom & Aiken redirected the focus of research on individual differences in stress-eating behaviour from weight category to level of dietary restraint. Baucom & Aiken's (1981) study revealed that non-dieting and dieting normal-weight individuals displayed different patterns of food intake in response to stress; stress was associated with an increase in food consumption among dieting participants, and with a reduction in food intake among non-dieting, normal-weight individuals. Consideration of this finding, in conjunction with studies showing that only some overweight people respond to stress by eating (Schlundt et al., 1991; Van Strien et al., 1986) led to the suggestion that level of dietary restraint, rather than weight category, may be the most important predictor of stress-induced eating. Thus, the importance of body weight in predicting eating under stress found in earlier studies was apparently explained in terms of the fact that many obese individuals chronically restrain their food intake in attempt to lose weight. In support of this, some studies have noted a positive correlation between BMI and dietary restriction (e.g., Wardle & Marsland, 1990).

## 2.5 Restraint Theory

Restraint theory grew out of the Set-Point theory of obesity. Set-Point theory was proposed by James Nisbett in 1972 to address some of the shortcomings evident in Schachter's theory.

**2.5.1 Set-Point Theory.** The set-point theory asserts that the brain continuously adjusts our metabolism and subconsciously manipulates our behaviour to maintain a genetically determined target weight. Although the set-point may change with age, it does so according to a fixed *genetic* program; diet or exercise can move an individual away from their biological set-point for a time, but the target itself cannot change. Thus, if the set-point is high, then the individual will be 'overfat' by cultural and medical standards, but may still have great difficulty losing weight. Like Schachter's theory, this model predicts that overweight and normal weight people differ in external responsiveness. However, the results of studies making such comparisons have been inconsistent.

Rodin, Slochower & Fleming (1977) tested Nisbett's theory by measuring individuals' changes in external responsiveness as they lost weight. Contrary to Nisbett's predictions, they found that external responsiveness did not vary as a function of weight loss. Nisbett's theory also predicts that individuals will become more emotional as they lose weight; however, this has generally not been found. The critical implication arising from this theory is that any attempt at weight loss, (i.e., deviations away from the individuals 'set-point' for weight) trigger powerful physiological (and psychological) adaptations, which act to restore homeostasis.

Perhaps the biggest problem with 'set-point' theory is that no procedure has yet been developed to determine what an individual set-point actually is (Levitsky, 2002). Despite this, many investigators today believe that physiological mechanisms ultimately control food intake and body weight, and the 'set-point' theory of body weight remains popular (Levitsky, 2002). However, there are some who argue that the 'set-point' theory has limitations as a general theory of feeding and body weight control. For example, Wirtshafter and Davis (1977) argue that a strict set-point theory could not account for the changes in body weight that result from changes in diet, season, hormones, or other conditions that occur either inside or outside the body. They suggest a model of body weight based on 'control' theory, rather than 'set-point' theory. They point out that the body weight (fat) 'settles' on a value that is proportionate to the difference between energy intake and energy expenditure, and they suggest a 'settling-point' theory of body weight. Other researchers have proposed similar ideas (eg. Booth, 1978). It is suggested therefore that biology does not determine a fixed body weight, but rather a range or zone of body weight that depends on environmental cues.

Nisbett's theory drew attention to the role of dieting in determining eating patterns, and this provided impetus for much subsequent theorizing and research (Ruderman, 1986). Building on the notion that dieting is a key factor in food regulation, Herman & Mack (1975) developed the construct of restraint. The construct was further developed and elaborated upon by Herman & Polivy (see Section 2.6.2).

According to restraint theory eating patterns are influenced by the balance between the physiological factors that drive the desire for food and cognitive efforts to resist that desire. Thus 'restraint' is the cognitively mediated effort to combat the urge to eat (Herman & Polivy, 1980).

Two basic hypotheses have been developed concerning restraint. Firstly, as mentioned previously in this Chapter, differences in level of restraint underlie obese-normal differences in behaviour. Obese individuals are expected to show systematically higher levels of restraint than normal weight people, and "obese characteristics", such as an external orientation, are deemed to be correlates of conscious restraint, rather than of obesity as Schachter had suggested. Thus, dietary restraint exists irrespective of weight category, and is exercised very commonly in the non-clinical population (eg. Rodin, Silberstein, & Striegel-Moore, 1985).

The second major hypothesis is that restrained eaters are deemed to be characterised by an anomalous eating pattern that consists of frequent bouts of dieting, interspersed with periodic overindulgence – the 'disinhibition' hypothesis (Herman & Polivy, 1980).

**2.5.2 The disinhibition hypothesis.** For restrained individuals, hunger and eating are normally only distantly related in that, although restrained eaters experience feelings of hunger, they manage to maintain cognitive control over their food intake. However, when confronted with certain triggers, the phenomenon that has been labelled 'disinhibition' occurs. When disinhibition of dietary restraint occurs restrained eaters overeat not only by their own standards but they also consume more than would a non-dieter or unrestrained eater. Polivy & Herman (1983) attribute binge overeating – the extreme of which is bulimia – to the person's attempts to restrain their eating in the effort to go below their natural weight or 'set-point'. The work of Herman & Polivy is in line with that of popular writers (eg. Bennett and Gurin, 1982) and the dominant research approaches in the field (Stunkard, 1981) in maintaining a view of human eating (and especially overeating) that is essentially the same as that held by biological theorists in respect of alcoholism and drug addition. Individuals are seen to be under the influence of invariant forces that, in the long run, they cannot hope to contravene.

The argument forwarded by restraint theorists is that stress disrupts the chronic inhibitions that dieters normally exercise in the face of persistent hunger (Herman & Polivy, 1980). According to this cognitive theory of stress-induced overeating, stress is deemed to "unmask" hunger, or at least remove inhibitions on eating; permitting eating, rather than producing it.

### 2.6 Triggers of 'disinhibition' of dietary restraint

There are essentially three main triggers of `disinhibition`. A significant *increase* in eating is observed in restrained eaters intoxicated with alcohol (Polivy & Herman, 1976), when forced to consume a diet-exceeding pre-load (most commonly a milkshake) (Herman & Mack, 1975) or what they thought was a diet-exceeding pre-load (Polivy, 1976), and when exposed to stress (Heatherton

& Baumeister, 1991). In all these cases, including multiple replications, unrestrained eaters have responded to manipulations with either a significant *decrease* in eating, or the manipulations have had no effect (Herman & Polivy, 1980). For each disinhibitor, a different process has been proposed to account for the way in which control over dietary restraint is relinquished. Although the focus of the current research is the role of stress as a disinhibitor of dietary restraint, for the sake of completeness, a brief summary of (food and alcohol) 'pre-loading' is provided.

**2.6.1 Pre-loading as a trigger of 'disinhibition'.** Providing participants with a meal of known calorific content (usually a milkshake) prior to the experimental test situation has become known as 'pre-loading'. 'Pre-loading' was first introduced by Schachter in his basic experimental research paradigm, and later employed in studies of restrained eating. These studies showed that individuals classified as highly restrained exhibited an anomalous eating response to a forced pre-load, known as counter-regulation. These studies were taken as confirmation that cognitively controlled restriction of food intake resulted in disordered eating patterns. The explanation for this is that restrained eaters perceive dieting in an all-or-nothing fashion, and respond to violations of dietary restriction with cognitions such as "I've blown it – I may as well continue to eat." Cognitions such as this are deemed to lead restrained eaters to break their diet and overeat. However, many studies *failed* to replicate the effect (see Section 2.6.3).

**2.6.2 The Boundary Model.** In 1984 Herman & Polivy incorporated their hypotheses concerning restraint into a "boundary" model of eating regulation. The defining feature of this model is that eating is regulated within *boundaries*, i.e. biological pressures work to keep regulation within a certain range. Aversive controls operate at one end to maintain consumption *above* a minimum level, and at the other end to maintain consumption *below* a maximum level. Between hunger and satiety lies the range of 'biological indifference'. Within this central zone, biological factors play a very small part in the control of eating behaviour, whereas psychological factors have the commanding role. This model draws two distinctions between restrained and unrestrained eaters; 1) restrained eaters have lower hunger boundaries and higher satiety boundaries, and so it takes greater deprivation to report hunger, and greater consumption to report satiety for these individuals. Restrained eaters have a wider zone of biological indifference, 2) Restrained eaters have a further, self-imposed `diet` boundary between hunger and the satiety boundaries that indicates the maximum desired intake.

Counter-regulation and bingeing are reported to occur following consumption of a `diet-breaking` food. The Boundary Model claims that this involves restrained eaters overstepping their self-imposed diet boundary, which clears the way for eating to continue until satiety is achieved. An assumption of the Boundary Model pertinent to dieters is that, given their zone of biological indifference is wider, dieters will show a decreased sensitivity to *internal* cues and an increased sensitivity to *external* cues.

The Model has also been used to account for the eating patterns of binge eaters and anorexics. Binge-eaters differ from restrained eaters in that they go beyond satiety when they break their diets and stop only at capacity. Anorexics, on the other hand, are said to have lower diet boundaries which they rarely break, and often tolerate the discomfort of going below the hunger boundary (see Figure 3).

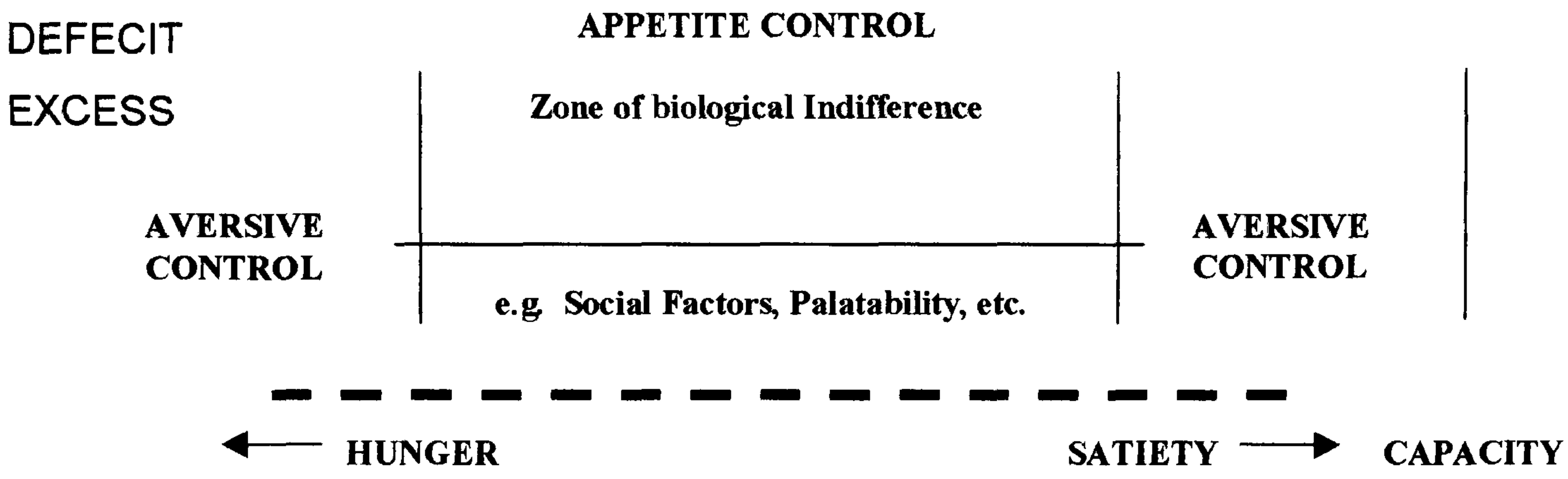
**2.6.3 Evidence for the Boundary Model of Counter-Regulation.** A summary of studies employing the Restraint Scale (RS) along with a pre-load disinhibitor show that a significant interaction between restraint and condition is only found seven times. In only three out of these seven studies did restrained eaters counter-regulate their food consumption following the pre-load (Herman & Mack, 1975; Herman, Polivy & Esses, 1987; Polivy et al., 1988).

In a further three (of the seven) studies restrained eaters did not regulate their food consumption at all, whereas unrestrained eaters did (Hibscher & Herman, 1977; Jansen, Merckelbach, Oosterlaan & van den Hout, 1988; Ruderman & Christensen, 1983). In another study, the authors observed a pre-load x diet interaction, rather than a pre-load x restraint interaction (Lowe, Whitlow & Bellwoar, 1991).

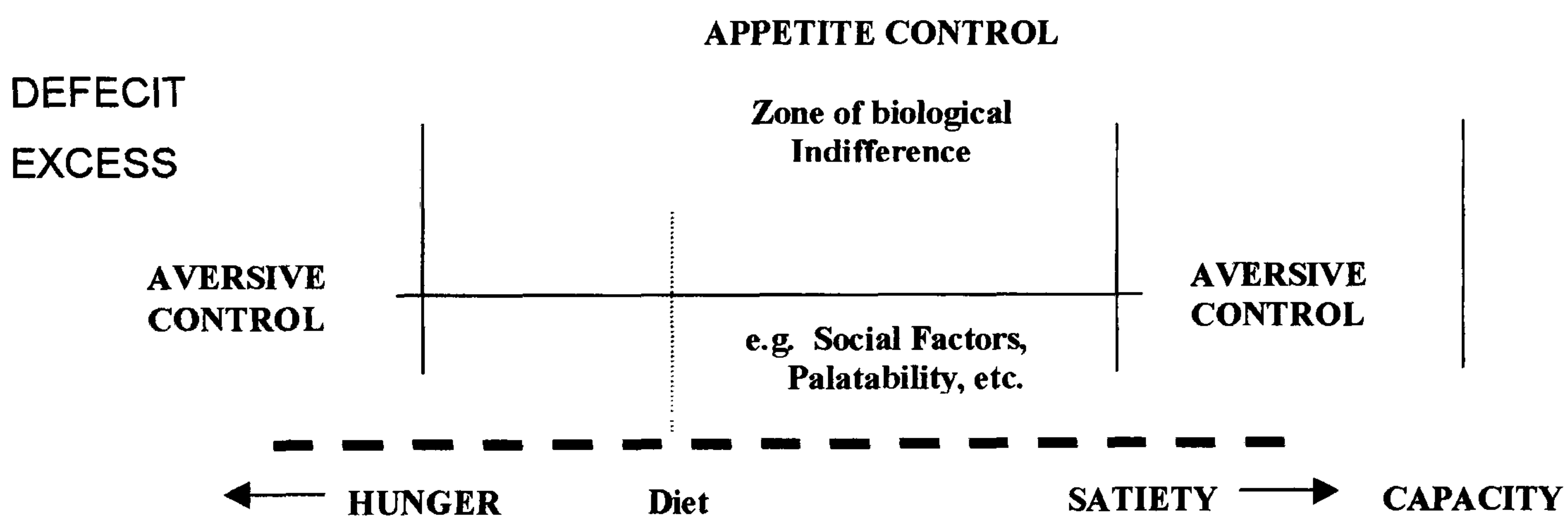
Other studies have also failed to establish a significant restraint x pre-load interaction when classification is achieved using the Restraint Scale (RS: Herman & Mack, 1975) (Dritschel, Cooper & Charnock, 1993; Kirschenbaum & Dykman, 1991; van Strien, Cleven & Schippers, 2000; Westenhoefer et al., 1994), the Dutch Eating Behaviour Questionnaire (DEBQ: van Strien, et. al., 1986), and the Three-Factor Eating Questionnaire (TFEQ: Stunkard & Messick, 1985) (Dritschel et al., 1993; Lowe & Kleifield, 1988; van Strien et al., 2000; Wardle & Beales, 1987, 1988;

## Figure 3. The Boundary Model

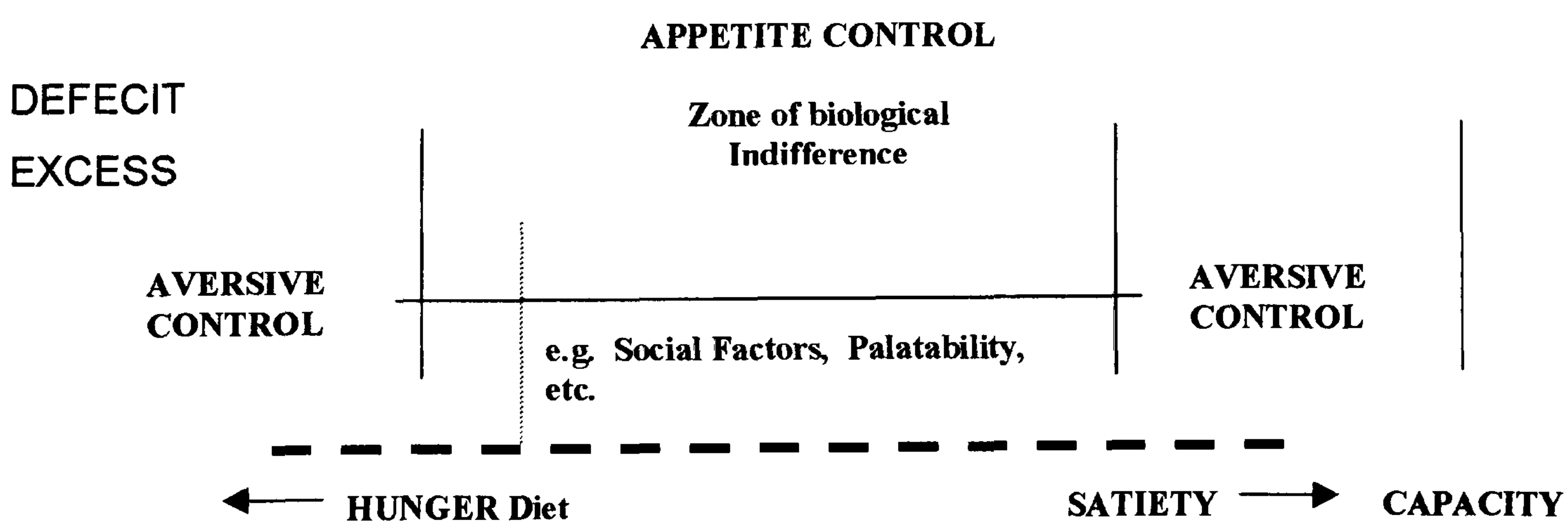
**Normal Eater (Non-dieter/Unrestrained)**




**Restrained Eater (Dieter)**
**Binge Eater**




**Anorexic**



Westenhoefer et al., 1994) (see section 1:8:2). More recent pre-load studies have shown that tendency toward overeating is a better predictor of food consumption than restraint (Ouwens, van Strien & van der Staak, 2003a; van Strien et al., 2000).

Polivy and colleagues (Polivy, Herman, Hackett & Kuleshnyk, 1986) have also undertaken variations on the standard pre-load paradigm. Polivy et al., (1986) conducted two experiments to assess the effects of self- and public attention to food intake on eating by dieters and non-dieters (assessed according to the RS: Herman & Polivy, 1975). Female dieters ate the greatest number of candies *ad libitum* after consuming a forced two-milkshake preload. The addition of either self-attention or implied public attention (through the manipulated availability of a wastebasket for the disposal of candy wrappers) inhibited eating substantially. For non-dieters, the preload itself inhibited candy consumption, which declined further only under conditions of public attention to candy intake. In a second experiment, self-and public attention again inhibited the cookie consumption of preloaded dieters, but preloaded non-dieters were not influenced by the attention manipulation, eating minimally in all conditions. Non-dieters who were not preloaded, however, did reduce their intake in the two attention conditions.

**2.6.4 Alcohol as a trigger of 'disinhibition'.** Two studies undertaken by Polivy & Herman (1976a, 1976b) highlighted the fact that an alcohol pre-load can trigger 'disinhibition' in restrained eaters. In study one, half of the sample was provided with tonic water, the other a glass of tonic water mixed with vodka. All participants were informed that the drink was a vitamin C drink. According to the disinhibition hypothesis, restrained eaters in the alcohol pre-load condition should have consumed more food than those in the tonic water condition; unrestrained eaters in the alcohol condition were expected to eat less than those in the tonic water condition, because alcohol contains more calories than tonic water. However, although a Restraint x Pre-load interaction was obtained, findings were exactly the opposite of those predicted.

It was suggested that eating behaviour, i.e., high consumption of restrained eaters and the low consumption of unrestrained eaters in the tonic water condition, was mediated by anxiety and apprehension about participating in an experiment. The unlabelled alcohol reduced this anxiety, thereby decreasing consumption among restrained eaters and increasing it among unrestrained eaters. Results of this study also suggest that both pharmacological properties and expectancies are important in respect of disinhibition.

In a test of this post-hoc explanation, a second study was carried out (Polivy & Herman 1976b). This time, participants' perceptions about the content of the drink, along with the actual content of the drink, as well as mood were assessed. Mood was measured twice; once upon receipt of the information that the experiment concerned the influence of household drugs on taste, and which drug (alcohol, vitamin C) they would receive, and again 15 minutes later, following absorption of the drug.

A three-way interaction of beliefs (alcohol, vitamin C), true content (alcohol versus tonic water), and dietary restraint was revealed. Restrained eaters consumed most in the "told vitamin C-received tonic water " condition and least in the, "told vitamin C – received alcohol" condition. Unrestrained eaters showed the opposite pattern. In terms of mood, participants who were told they received vitamin C felt better when the drink contained alcohol than when it contained tonic water. Participants who were told they had received alcohol felt better when they received tonic water, rather than alcohol.

By way of explanation for these findings, Herman & Polivy (1976b) proposed two different, and rather complex processes for restrained and unrestrained individuals. Ruderman (1986) criticizes these explanations as confusing, and involving numerous untested assumptions. By way of a summary of the aforementioned studies, Ruderman (1986) suggests that overall it appears that alcohol, knowingly consumed, may increase food consumption among restrained eaters. However, the processes accounting for this behaviour are unclear.

Results of a study by Yeomans, Hails & Nesic (1999) revealed no support for the hypothesis that restrained eaters would become disinhibited by an alcohol pre-load. In this study restrained eaters (as measured by the Three-Factor Eating Questionnaire: TFEQ; Stunkard & Messick, 1985) showed no significant difference in food intake after consuming an alcoholic or non-alcoholic drink. The unrestrained participants consumed the most after the alcoholic drink. It could be that inconsistent findings may be related to the fact that different measures of restraint were employed (see Section 2.8.1).

In a more recent investigation of the disinhibiting effects of alcohol, Owens, van Strien and van der Staak (2003b) employed the RS, the TFEQ and the DEBQ as continuous measures to assess restraint and tendency towards overeating in response to an alcohol pre-load. Female college students (n=116) participated in a questionnaire-based assessment and a taste-test. Prior to the taste-test, half of the participants consumed a pre-set amount of alcohol-laced orange juice, the other half were given plain orange juice. No disinhibition effect was found for amount of savoury crackers consumed. Rather, participants scoring high on restraint consumed even less food than those having lower scores. Thus, findings from this study also failed to replicate those of Polivy & Herman (1976a, 1976b).

**2.7 Stress as a trigger of 'disinhibition'.** Herman & Polivy (1984) hypothesized that strong emotions make demands on restrained eater's energies, temporarily decreasing their motivation to diet and allowing them to overeat. Alternatively, it has been proposed that when distressed, restrained eaters may seek to distract themselves from their worries with the comfort of food ("distraction" hypothesis)(Herman & Polivy, 1980). For unrestrained eaters, it was suggested that anxiety might lead to sympathiomimetic internal cues that would suppress eating (Herman & Polivy, 1980).

The following section reviews negative life events, naturalistic and laboratory studies investigating individual differences underlying the stress-eating relationship. For the sake of completeness, this section also includes studies that have not specifically employed restraint status as a classification variable. (see Table 1 for a summary of studies of stress and eating behaviour).

**2.7.1 Negative life events studies.** Bradley (1985) surveyed 341 overweight individuals (241 females; 26 males) seeking medical assistance in losing weight. When asked about conditions they believed had been associated with episodes of weight gain, 18% of females and 21% of males believed that psychological stress had been associated with weight gain, although the reliability of this finding may be limited by use of self report and its associated biases (see Baum, Grunberg, & Singer 1982). Gerace & George (1996) conducted a prospective study of weight increase in male fire service personnel. Those who reported experiencing financial worries gained more weight than those free from financial burden over a period of seven years.

Rookus, Burema & Frijters (1988) employed a retrospective questionnaire study (6-monthly intervals for 3 years) to monitor change in BMI and negative life events in over 700 men and women. After one year, experience of many life events was associated with a gain in BMI in both genders. After two years, however, the weight gain had disappeared in women, possibly due to dieting activities, but not in men, despite attempts at dieting. Deurenberg & Hautvast (1989) conducted a longitudinal study with approximately 4000 males and females over a period of 4 years, designed to assess the prevalence of overweight and obesity. Twice yearly assessments of body weight and self reported incidence of life events were found to be associated with experience of life events, and body weight increase. However, as in Rookus et al.'s (1988) study, weight gain was temporary for females, and resolved by dieting activities.

Van Strien, Rookus, Bergers, Frijters & Defares (1986) investigated the role of emotional eating as a predictor of weight gain following negative life events. After 6 months, emotional eating was associated with weight gain in both men and women, but after 12 months this was true only of men. It could be that weight gained by females during stressful life periods exists because stress serves to disrupt weight control practices, more commonly employed by females than males. This notion is supported by a retrospective study of 36 African-American women conducted by Walcott-McQuigg in 1995. Over 50% reported that stress negatively affected their weight-control behaviour.

A study examining the psychological correlates of weight fluctuation was conducted by Foreyt, Brunner, Goodrick, Cutter et al. in 1995 with 468 normal weight and obese adults. Individuals whose weight fluctuated by the greatest amounts over a 1-year period reported higher stress than those whose weight remained stable, regardless of weight category. In a study conducted by Rand & Stunkard in 1978 with normal weight and obese psychotherapy patients, obese individuals were more likely to report gaining weight during negative emotional periods (83% versus 14%), and were also more likely to report eating when depressed, anxious or angry (98% versus 43%). In contrast, 53% of normal weight individuals reported that they sometimes lost their appetite when upset. In addition, whereas none of the obese individuals reported losing weight during periods of stress, 20% of normal weight individuals did so.

**2.7.2 Naturalistic studies.** Naturalistic studies have the advantage of ecological validity. They allow for food choices and eating behaviour to be assessed free from constraints and restrictions imposed by a laboratory environment, but are limited by the multiple extraneous variables that can potentially impact on findings. Methods available for measuring food intake are limited in accuracy due to their reliance on self report measures, known to be open to subjective biases and errors (Baum et al., 1982). For example, several studies have shown that obese individuals underreport their dietary intake substantially, whether intake is self reported or assessed via interview (Black, Jebb & Bingham, 1991; Schoeller, 1990). Underreporting tends to be selective, with snack food items (high energy, low protein) being 'forgotten' (Heitmann & Lissner, 1995). Despite these shortcomings, naturalistic longitudinal studies do allow co-variations between stressful events and dietary selection to be revealed. This is important in assessing the potential impact of stress-induced changes in eating on health.

Several naturalistic studies have investigated the effect of examination stress on eating behaviour. Examinations are most commonly precisely timed, and include an anticipatory period, allowing for systematic changes in food choice to emerge. However, findings relating to examination stress to food choice and intake have been inconclusive, with no dietary changes being observed in some studies (O'Donnell et al., 1987; Niaura, Herbert, Saritelli, et al., 1991); increased energy intake in others (McCann, Warnick & Knopp, 1990; Michaud et al., 1989) and a decrease in the 'nutritional quality' of the diet occurring in another study (Weidner, Kohlmann, Dotzauer & Burns, 1996).

Michaud et al. (1989) asked 225 French High School students aged 15-19 years to record their food intake on the day of an examination, and again on a day with no exam. Although males ate approximately 9% more calories on exam day, and girls ate approximately 7% more calories, only the difference for girls reached significance. Both genders showed a slight tendency to consume more fat on exam day. The distribution of calories throughout the day was not significantly affected by stress; boys consumed a slightly higher number of calories in snacks on the day of the exam. However, this study is limited by the fact that time constraints affecting eating may be different on stressful days. A problem with many naturalistic studies is that a non-stressed group is often unavailable, to eliminate a potential time and stress-level confound.

Pollard, Steptoe, Canaan, Davies & Wardle (1995) did include a control group. They found no overall change in total energy intake, nor in the proportion of energy obtained from fats, protein, starch or sugars between control and examination stress students. However, a significant interaction between trait anxiety and social support was obtained. Anxious students with poor social support showed an average increase of 19.7% in total energy intake from baseline to examination sessions, whereas the group with low anxiety and good social support reduced intake by 14.4%. In terms of anticipatory stress (leading up to the examination period) the high anxiety/low social support students demonstrated an increase in total (28.5%) and saturated (32.1%) fats. This finding highlights the importance of *individual differences* in influencing the effect of stress on food choice and intake, and may offer the solution for the discrepancy of findings from studies of similar design.

Macht, Haupt, & Ellgring (2005) investigated changes of eating in response to exam stress with males and females using a control group design with pre- and post-test measures. Students awaiting an exam (N = 22) and control participants (N = 20) were assessed 3-4 weeks and 3-4 days respectively prior to the exam. They were given a pager, which beeped ten times a day at random intervals. Upon each signal, participants rated their emotional state and motivations to eat. Compared to control participants, students awaiting an exam reported higher feelings of tension, fear and emotional stress and an increased tendency to eat in order to distract themselves from stress.

McCann, Warwick & Knopp (1990) evaluated the impact of work stress on food choice. Fourteen (predominantly female) office workers were monitored over periods of high and low workload, using 4-day food diaries to assess food intake. The energy value of the diet, total fat intake, and percentage energy derived from fat were found to be significantly greater during periods of high than low workload. However, the validity of this study is limited by the lack of control group, and small sample size.

Bellisle et al. (1990) also employed a small sample (12 men). They assessed the impact of imminent hernia surgery on a single meal intake. Intake from a buffet-style lunch was measured on the day prior to surgery, and again in the hospital environment one month later. Although anxiety ratings on the day prior to surgery were significantly higher, neither total energy intake, nor macronutrient composition of the meals consumed differed on the two test days. Intakes ranged from a 125%

*increase* to a 53% *decrease* in consumption on pre-surgery day. This finding highlights the importance of individual variation, which may have contributed to the apparent overall lack of effect of stress on intake.

Popper, Smits, Meiselman, & Hirsch (1989) used retrospective questionnaires to assess eating habits of 475 male soldiers in combat situations during the Vietnam War. For the first combat situation encountered, 68% reported eating less and only a small percentage reported eating more. However, the reliability of this finding is questionable since the data are based on recall of events occurring at least ten years previously.

Some naturalistic studies have looked at co-variations between daily measures of mood and food intake, rather than assessing the effect of a specific 'stressor' upon eating. Leon & Chamberlain (1973) found that individuals who had been unsuccessful in maintaining a previous weight loss were more likely to eat in response to cues unrelated to eating, such as negative moods. Lowe & Fisher (1983) compared overweight and normal weight female college students by monitoring mood prior to eating for 13 consecutive weekdays. They found that overweight individuals were more likely to eat when in a negative mood, but not significantly so. Lowe & Fisher (1983) also analyzed the intake data in terms of meals and snacks eaten. They found an interaction between weight category and type of mood for snacks, but not for meals; overweight females consumed more calories in a snack if they were experiencing a negative mood. For normal weight females, amount of calories obtained from snack food was associated with a positive mood state.

Stone & Brownell (1994) took daily measures of 'daily hassles' and mood for at least 84 days. Because this study was originally designed to investigate stress and coping, only a very brief measure of food intake was used. Participants were required to say whether they consumed more, the same, or less than usual each day. The predominant response to stress (72%) was hypophagia. However, these data are heavily reliant on self-report and do not take into account variations in awareness of food intake between individuals.

A more detailed study conducted by Steptoe, Lipsey & Wardle (1998) required participants to complete daily and weekly diaries of food intake, psychological stress and hassles. These researchers also assessed the importance to the participants of choosing foods that help maintain positive moods, using the mood scale of the Food Choice Questionnaire (Steptoe, Pollard & Wardle, 1995), and examined the influence of tendency towards 'mood eating' upon food consumption when stressed. The main finding for all participants was that the number of fast food meals eaten increased during periods of high stress. Cheese was consumed more frequently by high 'mood' eaters when under stress, whilst sweet foods were eaten more during stress, but only by individuals with low scores on the mood eating sub-scale.

Wardle, Steptoe, Oliver, & Lipsey (2000) examined the association between work stress and nutritional status in relation to dietary restraint in a community sample of adults. 58 women and 32 men, employed at a large department store were assessed on four occasions over a 6-month period with measures of diet, weight and perceived stress. Work stress was indexed in terms of the hours of work over the past 7 days. High-workload periods (47 hours versus 32 hours on the low-work stress session) were associated with higher energy and saturated fat and sugar intake. There was a significant moderating effect of restrained eating. Restrained eaters, compared to unrestrained eaters, consumed more overall, but specifically more sweet and fatty foods. This was true particularly for restrained eaters who had a larger increase in perceived stress between the low- and high-workload sessions, implicating emotional reactions in the response.

No clear conclusions can be drawn from naturalistic studies as to the effects of stress on eating, firstly because of the constraints on accuracy of recorded dietary information in the real world environment, and secondly because they commonly fail to account for individual difference parameters.

**2.7.3 Laboratory studies of stress-induced eating.** The laboratory situation has the advantage that each participant can be exposed to the same stressful experience, and subjective self-reports of negative affect can be corroborated with physiological stress indices (see Chapter 4 for a discussion of the advantages of adopting a psychophysiological approach to the measurement of the stress response). However, laboratory stressors are often weaker and more acute than real world stressors, and so the impact on the individual is likely to be less severe. The laboratory situation allows for greater control over extraneous variables, and food intake can be determined with far greater accuracy than is possible with subjective indices.

The majority of studies investigating the 'disinhibition' of dietary restraint have taken place in the laboratory setting. As with studies investigating the hypothesis that weight category would predict individual differences in stress induced eating, studies concerned with emotional arousal, restraint and the disinhibition hypothesis have similarly employed a variety of experimental manipulations in order to induce arousal. These have been classified as *physical* stress induction procedures, for example threat of electric shock, (Heatherton, Herman & Polivy; 1991; Herman & Polivy, 1975; Pine, 1985), and *ego threat* procedures that are designed to threaten the individual's emotional stability or wellbeing. These procedures generally involve an evaluative or performance related component, such as false-feedback, anticipation of giving a speech to an audience (Baucom & Aiken, 1981; Heatherton, Herman, & Polivy, 1991; Ruderman, 1985) or the Trier Social Stress Test (TSST: Kirschbaum, Bartusseck, & Strasburger, 1992; Kirschbaum, Pirke, & Hellhammer, 1993). Other manipulations include viewing films (Cools, Schotte & McNally, 1992; Schotte, Cools & McNally, 1990), interpersonal stress involving ostracism and argument (e.g., Oliver, Huon, Zardo, & Williams, 2001), generation of vivid imagery (Telch & Agras, 1996; Wright & Mischel, 1982), and use of the Velten mood induction technique (Velten, 1968; Frost, Goolkasian et al. (1982). Very few studies have attempted to induce an increase in positive mood (Frost et al., 1982; Cools et al., 1992; Cavallo & Pinto, 2001). The following section provides a critical review of studies that have employed these procedures in the laboratory.

**2.7.4 Threat of Electric Shock.** Herman & Polivy (1975) manipulated anxiety by leading participants to expect painful electric shocks (high anxiety) or mild electric shocks (low anxiety). A stress x restraint interaction was revealed, however tests of simple effects underlying this interaction were not entirely consistent with the disinhibition hypothesis. As predicted, unrestrained eaters consumed significantly *less* in the high- than the low- anxiety condition. However, restrained eaters ate slightly, but non-significantly more in the high- than the low-anxiety condition. The explanation for these findings is that physical fear suppresses hunger sensations that are attributed to physiological mechanisms (Herman, Polivy, & Heatherton, 1990).

**2.7.5 Film Induced Affect.** Cavallo & Pinto (2001) employed a domestic violence and comedy film segment in order to monitor consumption of sweet and salty snack foods, high in both fat and calories (M&Ms and potato chips) in female restrained eaters, who were either smokers or non-smokers. Self-reported mood increased significantly following the negative film clip only, indicating the difficulty of experimentally inducing a positive mood. In addition, blood pressure and heart rate did not change across the three time points (end baseline, task and food ingestion), suggesting that the stress manipulations were not of sufficient magnitude, or sufficiently emotive to the subject population to induce a physiological stress response. Univariate tests of the main effect for smoking status indicated a significant effect for heart rate only. Measures of heart rate were higher for non-smokers than for smokers. However, it should be pointed out that smokers have been reported to show blunted cardiac (and cortisol) reactivity to laboratory stressors (Koo-Loeb, Pedersen, & Girdler, 1998). Cavallo & Pinto's (2001) study revealed that film induced negative emotional arousal did *not* result in a significant difference in food intake between restrained eaters who were either smokers or non-smokers.

Schotte, Cools, & McNally (1990) employed a between-subjects design with 60 undergraduate students, classified as high or low restrained based on a median split of the Revised Restraint Scale (RS_R: Herman & Polivy, 1980). Participants were invited to consume salted popcorn during exposure to a frightening film (taken from 'Halloween') or a neutral film (scenes from a travelogue). Participants in the negative mood induction condition reported significantly greater levels of anxiety and depression and significantly less relaxation, happiness, and drowsiness, plus higher levels of tension, anger, depression, and confusion when compared to the neutral condition. High restraint individuals consumed significantly more during the negative film than during the neutral film, and more than low restraint individuals during both the negative and neutral conditions. However, a possible confound with this study is consumption of food *during* manipulation of mood (see Section 2.8.3 for a discussion of the influence of food on mood).

Cools et al., (1992) employed a design similar to that of Schotte et al., (1990), with the addition of a positive mood condition (comedy scenes taken from 'Candid Camera'). Results revealed a negative correlation between food intake and restraint score in the neutral condition (i.e., food intake decreased as restraint score (RS_R) increased), and a positive correlation in the positive and negative conditions (i.e., food intake increased with increasing levels of restraint). The positive correlation was higher in the frightening film condition.

When data were re-analyzed according to a median split of restraint scores, high restraint individuals consumed significantly more in the negative and positive mood conditions than low restraint individuals. There was no significant group difference in the neutral condition. It was concluded that any emotional arousal, irrespective of valence, could disinhibit restrained eaters (Schotte, 1992).

Sheppard-Sawyer, McNally, & Fischer (2000) tested whether film-induced sadness enhanced food intake in restrained eaters. Female participants classified as possessing high or low restraint status according to a median split of the RS_R viewed two film segments in counterbalanced order on successive days: an emotionally neutral travelogue and a sad film, depicting the death of a the young female protagonist. Results showed that film-induced sadness significantly reduced food intake in low restraint individuals, but only non-significantly increased it in high restraint individuals.

**2.7.6 Anticipation of Public Speaking.** Heatherton et al. (1991) found that the anticipation of giving a speech to a peer group resulted in considerable increases in anxiety. Heatherton et al. (1991) investigated the different effects of physical fear and ego threat on the subsequent food consumption of high versus low restrained eaters. Food consumption was assessed following the anticipation of electric shock, failure in the concept formation task (see Section 2:7:7 for a description of the concept formation task), and anticipation of giving a speech to their peers.

Results showed that reports of anxiety and apprehension increased significantly in the speech and shock conditions, but not the failure condition, compared to control. However, >63% of the concept formation group reported 'feeling bad about themselves' compared to 5.9% in the speech and 0% in the shock and control conditions. High restraint participants in the failure and speech groups consumed significantly more than high restraint individuals in the control condition. There was no significant difference in food intake between the shock and control conditions for high restraint individuals. For the low restraint groups, only the shock group consumed significantly less than controls low in restraint.

Employing a similar stressor to that of Heatherton et al. (1991) and Cattanach, Malley & Rodin (1988) with eating-disordered individuals, Levine and Marcus (1997) employed repeated measures to assess eating behaviour in a non-clinical sample of female psychology students, with significant bulimic symptoms. Of the 314 individuals screened, 240 participants met the preliminary screening criteria. Of these 40 females were selected based on their scores on the Bulimia Scale (BULIT-R: Smith & Thelan, 1984). A cut off score of 88 on the BULIT-R was used to classify individuals as possessing "significant bulimic symptomatology" (top decile). Women with scores in the 25-50 percentile range of all scores who did not report a history of an eating disorder served as the asymptomatic controls. Control participants were selected from the second quartile rather than the lowest quartile because the authors believed this group to be more representative of a normal comparison group. On the stress day, participants were required to prepare and deliver a three-minute speech about their negative qualities to a video camera that they believed to be filming them. During the no-stress, control day, participants were told that they had been assigned to the relaxing and reading condition. They were provided with nature magazines and picture books and left alone for five minutes. Pre- and post-test measures of mood and state anxiety were obtained, and following the taste-test participants completed either the Marlowe-Crowne Social Desirability Scale (MCSDS: Crowne & Marlowe, 1960) (day 1) or rating of food preferences (day 2).

Four of the six foods chosen for the study (M&Ms, cookies, cheese crackers, and potato chips) were selected to be food types often preferred by binge eaters (i.e. sweets, salty snacks, cookies, and pastries). These foods were high in both fat and calories. Pretzels and raisins were selected to provide an adequate range of food types and macronutrients. All foods were provided in abundance. Results showed that, counter to the hypothesis, women with bulimic symptoms did not differentially increase their intake when exposed to stress. However, results for the intake of each macronutrient indicated that both bulimic and control women increased their consumption of carbohydrates following the stressor. Thus, stress was related to increased carbohydrate consumption by all participants, but did not differentially affect the consumption of women with bulimic symptoms. The authors concluded with two possible explanations, either women with bulimic symptoms are not differentially vulnerable to eating in response to stress, or that the methodology employed in the study precluded the detection of existing differences in eating behaviour.

Roemmich, Wright, & Epstein (2002) measured snacking in boys and girls (8-11 years), with and without dietary restraint, across a control day (reading children's magazines and/or colouring), and on a stress day (interpersonal stress: giving a videotaped speech). The children were divided into four groups based on dietary restraint (DEBQ median split) and changes in perceived stress as follows: low-restraint/low-reactive, low-restraint/high reactive, high-restraint/high reactive, and high-restraint/low-reactive. Results showed that energy intake of snack foods (i.e., the child's three favourite snack foods based on session one ratings) was influenced differently by dietary restraint and stress reactivity in the stress and control conditions. After being stressed, low-restraint/low-reactive children ate fewer snacks and high-restraint/high-reactive children ate more (total energy, snack grams, total grams of protein and carbohydrates) compared with the control condition. After co-varying for percentage of body fat (body composition, estimated by skinfolds), the interactions remained. Girls consumed less than boys, but gender did not influence eating in control and stress conditions.

**2.7.7 Concept Formation Task.** The concept formation task was first employed in the dietary restraint literature as described by Baucom & Aiken (1981). Participants are presented with a series of 10 cards that differ according to the following features: a large or small letter, the letter A or T, a black or white letter, a circle or square. Cards are presented in pairs, and participants are required to identify which of the features is common to both cards. Correct or false feedback is provided, enabling success or failure respectively. It is commonly found that the failure condition generates negative affect (Baucom & Aiken, 1981; Heatherton, Herman, & Polivy, 1991; Ruderman, 1985). For example, Ruderman (1985) found significant increases in hostility, depressed mood and anxiety scores in the concept formation failure versus success condition. In terms of food consumption, both dieters (Baucom & Aiken, 1981) and high restraint individuals (Heatherton, Herman, & Polivy, 1991; Ruderman, 1985) have been shown to consume significantly more food following the concept formation failure than success condition.

**2.7.8 Velten (1968) Mood Induction Procedure.** This is perhaps one of the most controversial methods of inducing an experimental mood (i.e. elated, depressed, or neutral) in order to assess the way in which emotional states can alter psychological functioning. In this procedure, participants read a series of cards that progress, for example, from mildly happy to absolutely euphoric, or from mildly depressing to clearly depressing. Frost, Goolkasian et al. (1982) employed the Velten procedure to induce an elated, neutral or depressed mood in 55 female undergraduate students. Based on a median split of scores on the RS_R, plus concern for dieting (CD) and weight fluctuation (WF) sub-scales, participants were classified as possessing high versus low restraint. Analyses of pre-post test measures of the Personal Feeling Scale (PFS: Frost et al., 1979, in Frost et al., 1982) and the Multiple Affect Adjective Check List (depression factor only) (MAACL-D: Zuckerman & Lubin, 1985) revealed a significant main effect for mood. Participants in the depressed mood condition were significantly more depressed than those in the neutral and elated conditions, and participants in the elated condition were significantly less depressed than those in the neutral and depressed conditions. There was also a significant main effect of restraint category on the MAACL-D, and a trend towards significance on the PFS, whereby HR participants were more elated than were LR participants across all conditions.

Frost et al. (1982) found that HR participants consumed significantly more in the depressed condition compared to HR in the neutral and elated conditions, and than depressed LR participants. For the sub-scales of the RS_R, a significant restraint x mood interaction effect was evident for the WF sub-scale only. Depressed HR participants consumed significantly more than HR participants in both the neutral and elated conditions. However, in this experiment, participants were invited to eat as much as they wished (M&Ms) *during* the mood induction procedure. This design is confounded by the possibility that the act of eating in itself can affect mood. For example, some researchers suggest that the function of (over) eating is to alleviate feelings of negative affect (e.g., Heatherton & Baumeister, 1991)(see also Section 2.8.3).

In addition, as a mood induction technique, the Velten procedure has been criticized. Several investigators have argued that the mood created by the Velten technique simply represents the participant's compliance to demand characteristics (e.g., Buckwald, Strack & Coyne, 1981; Polivy & Doyle, 1980). This is because the participant is instructed to try to feel the mood expressed in the cards, and because there can be no doubt what that mood is. In other words, contained within the procedure are implicit and explicit cues that convey to the participant what is expected, including the communication of experimenter expectations.

**2.7.9 Generation of Vivid Imagery.** Wright & Mischel (1982) developed a mood induction procedure that required participants to generate vivid images of a past situation or event that provoked negative, neutral, or positive feelings. Participants (N=72) were provided with detailed taped instructions to create the image. Within each group individuals were randomly assigned to a success or failure condition that consisted of five mental rotation tasks. The first was easily solved and individuals were given correct feedback. However the following four trials were impossible to solve in the time given and feedback was manipulated so that those in the success condition believed they had 79% correct, and those in the failure group believed they had 49% correct.

Results from mood and performance assessment questionnaires indicated that the desired moods had been achieved. Mood influenced self-evaluation of performance in the failure group, but not in the success group. Positive affect resulted in higher outcome appraisals, while negative mood led to lower appraisals of outcome. The neutral and positive affect groups matched their expectancies to their actual performance, whereas negative affect significantly reduced performance expectancies in the success condition. Positive affect resulted in significantly higher performance expectancies than neutral and negative affect. Individuals in the positive affect condition reported significantly higher intelligence, attractiveness, self-confidence, successful, and socially skilled ratings than did those in the neutral and negative affect conditions. Negative affect participants rated themselves as less popular, friendly, satisfied with themselves, optimistic, and more selfish, compared to neutral and positive affect groups. Thus, mood can influence performance expectancies.

Telch & Agras (1996) conducted a study to determine whether emotional states influence binge eating. Sixty females (30 with binge-eating disorder, BED: 30 non-eating disordered, NED) who responded to advertisements for a study of eating, participated in the study. Participants who met the DSM-IV criteria for BED were considered for inclusion, as were overweight NED females. The NED females were eligible if they demonstrated no evidence of binge eating, subjective sense of loss of control over eating, purging, and/or any behaviour that would meet the criteria for an eating disorder not otherwise specified. The procedure consisted of the BED participants and weight-matched non-eating disordered participants attending a laboratory experiment during which they were randomly assigned to a neutral or negative mood induction procedure (originally developed by Wright & Mischel, 1982). Afterwards, the participants were served a multi-item buffet. There were no differences between BED and NED females on the demographic data collected. ANOVA results revealed a significant main effect for Mood and for Time, and a significant interaction effect. The results showed post-mood induction that participants in the negative mood condition reported a significantly greater negative mood affect than did participants in the neutral mood condition. There were no significant differences between the groups in the amount of calories consumed at breakfast and lunch.

**2.7.10 Interpersonal or Social Stress.** Tanofsky-Kraff, Wilfley, & Spurrell (2000) examined the impact of different types of stress, one interpersonal (wherein the participant was made to feel socially alienated and interpersonally ill-equipped) and two ego-related (task failure and speech threat) versus a control condition, on the eating behaviour of individuals classified as possessing a high or low degree of dietary restraint based on a median split of the RS_R. Results showed a significant interaction such that stressed high restraint individuals consumed significantly more ice cream than controls. Further, the pattern of consumption based on restraint for the interpersonal group differed from the other three conditions. In the interpersonal group, the greater the restraint, the more participants ate, whereas in the other three conditions, the pattern was reversed although not significantly so.

Oliver, Huon, Zardo, & Williams (2001) investigated the role of interpersonal stress in precipitating eating for 57 females who were categorized as high versus low disinhibitors (using the disinhibition sub-scale of the Three Factor Eating Questionnaire: TFEQ; Stunkard & Messick, 1985). In this study, ostracism and argument were compared separately. A comparison of targets versus sources for the two forms of stress was also made. Results showed no differences between the ostracism and argument conditions for the amount of sweet (chocolate) and savory (crisps) food consumed; nor did high and low disinhibitors differ. There was, however, a significant interaction between level of disinhibition and role (target versus source) for the amount of food eaten. High disinhibitors consumed markedly more and low disinhibitors consumed markedly less sweet food when they were targets than when they were sources; the two groups consumed similar amounts when they were sources.

**2.7.11 Stroop**. Rutledge & Linden (1998) employed an incongruent colour naming Stroop task in conjunction with two other active coping tasks (see Section 4.4.9). Mitchell & Epstein (1996) measured changes in taste and satiety in 32 dietary-restrained and non-restrained women (classified according to the RS) following stress. Physiological (HR and salivation) and subjective (100-mm line VAS: hunger, fullness, food liking and arousal) responses to food (strawberry yogurt) were assessed over eight, repeated taste presentations followed by an *ad libitum* taste test. Between taste trials, half of the restrained and non-restrained eaters performed a card Stroop task, containing forbidden food words (e.g. cake) (preceded by a practice Stroop card, containing incongruent colour words), while the remaining participants sat quietly. Results showed that food-liking ratings for restrained eaters increased over the taste trials whereas ratings for non-restrained eaters increased and then decreased to baseline levels by the last trial. Salivary responses decreased for all groups. A significant interaction of restraint by stress for intake was found; restrainers increased consumption following stress whereas non-restrainers decreased consumption as compared with the control condition. Post hoc analyses revealed that the decrease in consumption by non-restrained eaters was significant ($p$ <0.05). No significant group difference for heart rate reactivity was found, and no main or interaction effects were observed for the subjective measure of arousal.

Lattimore (2001) employed an emotional variation of the Stroop, incorporating ego-threat stimuli, to trigger a significant increase in self-reported anxiety and overeating in dieters classified as binge-eaters according to the Bulimia test (BULIT-R: Smith & Thelan, 1984) in a test-meal paradigm. However, some methodological problems are associated with this study (see Section 2.8.7).

In a study by Lattimore & Maxwell (2004) participants were randomly assigned to one of four experimental conditions, low versus high cognitive load and ego-threat versus colour Stroop. In the low cognitive load conditions, participants undertook either the ego-threat Stroop (ego-self, ego-other, social related ego-threat) or colour-naming Stroop (8 different colour nouns, with the colours red, green, blue, and yellow printed in incongruent colours). The high cognitive load conditions mirrored the low-cognitive load conditions, with the exception that they included a 'cued recall' element, i.e. participants were instructed to memorize the words for later recall (following the taste-test session). Stroop words were displayed on a computer screen in uppercase letters of 86 pt Times New Roman font size, and pre-post self-reported measures of anxiety were obtained. Results showed that restrained eaters (classified using the RS and its subscales, concern for dieting (CD) and weight fluctuation (WF): Herman & Polivy, 1980) consumed significantly more snack food (crisps, chocolate and dried fruit) following the high cognitive load task when it was ego threatening than when it involved processing and memorization of colour nouns, and significantly more than unrestrained eaters in a high cognitive load ego-threat condition.

Wallis & Hetherington (2004) compared a computer driven ego (ego-self, ego-other, and sociotropy) and incongruent colour Stroop task with a control condition (neutral words, matched to the ego-threat words) in a between subjects design with 38 University students and staff. Groups in this study were classified as high restraint/high emotional, high restraint/low emotional, low restraint/high emotional and low/restraint/low emotional. Dietary restraint, as assessed by the Dutch Eating Behaviour Questionnaire (DEBQ: van Strien, Frijters, Bergers & Defares, 1986) was associated with greater intake of chocolate following both stress tasks, compared to the control task. However, emotional eating was associated with greater intake after *only* the ego Stroop task, relative to the control condition.

**2.8 Moderating Variables.** Although dietary restraint moderates the stress-eating relationship, several other variables have been found to further influence the experimental outcome. These include the measurement of restraint, gender, palatability, food class and macronutrients, self-esteem, frequency of dieting, current dieting and weight fluctuation, rigid versus flexible control of eating, regularity of eating patterns, and type of stress.

**2.8.1 The Measurement of Restraint.** Researchers have raised questions about the measurement of the construct of 'restraint' (Heatherton, Herman, Polivy, King & McGree, 1988; Laessle, Tuschl, Kotthaus, & Pirke, 1989). The Restraint Scale (Herman & Polivy, 1975), and its revised version (RS_R: Herman & Polivy, 1980) have been subject to a number of psychometric and theoretical criticisms (e.g., Ruderman, 1983; Wardle, 1987; Westenhoefer, Broeckmann, Munch, & Pudel, 1994). Firstly, the three widely employed measures of restraint, the Restraint Scale (RS: Herman & Polivy, 1975) and its revised version (RS_R: Herman & Polivy, 1980), the Dutch Eating Behaviour Questionnaire (DEBQ: van Strien, et. al., 1986) and the Three-Factor Eating Questionnaire (TFEQ: Stunkard & Messick, 1985) are differentially predictive of disinhibited eating

(Stice, Ozer & Kees, 1997). They are also thought to measure different aspects of dietary restraint, despite the fact that scores on these three scales are often highly correlated (Laessle, et al., 1989).

It has been suggested that the RS_R most commonly predicts overeating in the laboratory because it measures 'failed' dieting attempts (Heatherton et al., 1988), it contains items specifically related to disinhibited eating (Stice et al., 1997), and so is not a 'pure' measure of restraint. The identification of two factors (weight fluctuation and concern with dieting) has led uncertainty about which factor is of primary importance in identifying individuals with regulation failures (Ruderman, 1983; Wardle, 1987). Conversely, the DEBQ and TFEQ are thought to measure 'successful' dieting attempts, and are therefore less strongly related to disinhibited eating in the laboratory (Stice et al., 1997). A further difficulty associated with the RS and the RS_R (Herman & Polivy, 1975; 1980) has been that some participants who are *low* in dietary concern are unable to answer some of the items relating to amount of weight gained or lost (in lbs), due to the fact that they do not regularly weight themselves (Wardle, 1986).

Several solutions to this problem have been suggested. The first is to demonstrate that any effects of criterion confounding of the RS_R remain after the criterion confounding is corrected (Stice et al., 1997). The second is to employ either the DEBQ or TFEQ alongside the RS_R (Stice et al., 1997) in order to classify individuals as restrained eaters. The third is to employ a double classification of participants using sub-scales. For example, Westenhoefer, Broeckmann, Munch & Pudel (1994) utilized the original pre-load paradigm of Herman & Mack (1975) in order to demonstrate that a two-dimensional design (i.e., a double classification of participants using both the TFEQ-restraint and TFEQ-disinhibition sub-scales (Stunkard & Messick, 1985) was more appropriate than a one-dimensional design (i.e., classification of participants as high versus low restraint only). Normal-weight females (N=133) were requested to consume ice cream *ad libitum* during a taste test following a 200-ml milkshake preload or without preload. The results showed that the behavioural disinhibition effect occurs only in participants with simultaneous high scores on *both* TFEQ sub-scales. In addition, participants with high disinhibition scores consumed more ice cream than low disinhibition participants irrespective of their degree of restraint. Participants with a more rigid control of eating behavour did not show a difference in the amount of ice cream consumed with or without pre load, and participants with a more flexible control of eating behaviour reduced their intake following the pre load condition (see also Section 2.8.6). The authors suggested that high scores on the RS_R (Herman & Polivy, 1980) may be due to either higher TFEQ-restraint or higher TFEQ-disinhibition scores (Westenhoefer et al., 1994). Thus, high scores on the TFEQ-disinhibition sub-scale indicate overeating, without the need for prior inhibition, i.e., dietary restraint. The authors conclude that high susceptibility to eating problems may be caused by rigid control of eating behaviour, whereas flexible control of eating behaviour may be a less problematic strategy of long-term weight control (Westenhoefer et al., 1994). However, it should be noted that several problems are associated with the dichotomization or trichotomization of one or more scales prior to analyses in order to achieve more homogenous sample groupings (see Section 6.13).

**2.8.2 Gender.** An assessment of the role of gender as a moderator of the stress-eating relationship is made difficult because of a lack of studies employing mixed gender samples. Male participants seldom have been recruited because the focus of stress-induced eating studies has been placed upon the differences between restrained and unrestrained eaters. Restrained individuals are much more likely to be women than men (Wardle, 1980), and females are more prone to eating disorders (eg. Bennett & Cooper, 1999).

Naturalistic studies that have undertaken gender comparisons have found that women tend to report eating more under stress (eg. McCann, Warnick & Knopp, 1990; Rosenfield & Stevenson, 1988; Warr & Payne, 1982). Some studies using male participants have reported hypophagic responses to stress (Popper, Smits, Meiselman & Hirsch, 1989). Bradley (1985) reported that stress was associated with weight gain in women but not in men. However, Spillman (1990) examined gender differences and found an increase of food intake by both men and women during a period of stress. This finding suggests that gender does not moderate the stress-eating relationship. Other studies have found no significant differences of food consumption between men and women in stressful situations (Oliver & Wardle, 1999; Weinstein, Shide & Rolls, 1997). Stone & Brownell (1994) found that both sexes decreased their food intake following stress and that this decrease became more prominent as the severity of the stress increased.

In the laboratory, Grunberg & Straub (1992) examined differences in consumption of sweet, salty and bland-tasting foods following exposure to a stressful film. They found that stressed men significantly decreased their consumption of all foods presented; women increased their consumption of sweet and bland foods, but not significantly so. However, total food intake was extremely low for most individuals, with several people eating nothing at all. In addition, no measure of dietary restraint was employed, and so one must consider the possibility that the apparent sex difference was actually the consequence of differences in dietary restraint.

Moderate stress seems to increase the eating of specific foods by women, whereas stress generally decreases eating by men (Grunberg & Straub, 1992; Klein, Faraday & Grunberg, 1996).

The experimental studies contained within this thesis have been conducted with females only for the following reasons: a) although the incidence of eating disorders amongst males is increasing, problems with eating and weight remain predominantly a feminine affair. As restraint appears to model clinical eating disorders, it was considered more appropriate to study females than males, b) it was considered important that the participant pool be as homogenous as possible.

**2.8.3 Palatability, Food Class and Macronutrients.** There is much evidence to suggest that the intake of different foods affects mood and emotions. Predictions of food-induced changes of emotions based on the nutritional consequences of the food may contrast with predictions based on its psychological properties (Benton, 2002). For example, the consumption of highly palatable foods seems to be related to the experience of stress in both animals (Boggiano et al., 2005; Hagan et al., 2003) and humans (McKenna, 1972; Tataranni et al., 1996), and palatable foods are often high in both fat and carbohydrate (Drenowski, 1997). Both the consumption of chocolate and spontaneous eating have been associated with an increase in the release of beta-endorphin (Dum, Gramsch, & Herz, 1983; Davis, Lowy, Yim et al., 1983), and sweet foods, such as chocolate have been shown to be associated with improved mood (Benton & Donohoe, 1999). Females with high disinhibition scores (TFEQ: Stunkard & Messick, 1985) who overeat in response to stress, with a preference for sweet food items (Haynes et al., 2003) have also been found to be over-responsive to manipulated palatability (Yeomans et al., 2004). Thus, it has been suggested that stress-induced eating is mediated through endogenous opiates (Morley & Levine, 1980) (see also Section 4.4.7). Therefore, the consumption of highly palatable foods should, due to their nutritional consequences, elicit positive emotional changes.

However, the ability of a food to alter an individual's emotional state is dependent not only on the effects of nutrients on the brain, but also on the psychological features of the food; food-related perceptions, cognitions and attributions (Macht, Gerer & Ellgring, 2003). Many psychological features of a particular food arise from individual experiences prior to, during and following consumption of that food (Macht et al., 2003; Rogers, 1995), as well as from sociocultural influences (Rozin, 1996). Psychologically mediated emotional changes may be accompanied by physiological responses (e.g., salivation and increases in heart rate, blood pressure, and gastric activity), and images, thoughts and ideas evoked by foods can be sufficient to elicit a physiological reaction even if the food itself is not presented (Fioravanti, Polzonetti, Nocca et al., 2004).

Although foods high in fat and sweet carbohydrate should evoke a rise in positive mood state, such foods are also considered a threat to physical attractiveness for some individuals. For example, King, Herman & Polivy (1987) asked restrained and unrestrained eaters to categorise a list of fifty-seven foods encompassing nine food types (fruits, vegetables, junk foods, dairy products, meats, fish and seafood, nuts and processed foods or condiments). The words were selected to be commonly consumed foods and included items such as `chocolates`, `nectarines`, and `salmon`. The groups used similar descriptors for the foods, but differed in one respect; the restrained eaters tended to categorise the foods in terms of 'absence of guilt'. That is, they defined them as either 'legal' or 'illegal' food items. They were also more likely to use labels expressing the nutritional content of the food. Restrained eaters indicated that they experienced guilt in response to sweet or salty snacks, whilst this was restricted to sweet foods by unrestrained eaters.

It is reasonable to assume therefore that the experience of negative emotions related to high-energy food may be common in many women in Western cultures, and that this is particularly pronounced in restrained eaters and bulimics (Bulik, Lawson & Carter, 1996; Staiger, Dawe & McCarthy, 2000). In Macht et al's (2003) study, the overweight women showed higher scores of the TFEQ scales cognitive restraint and disinhibition than normal-weight women and also showed higher emotional reactions to foods. Macht et al. (2003) also found that the higher the energy content of a food stimulus, the more it was viewed as 'unhealthy' and 'dangerous'. As energy in foods increased, females expressed an increase in negative emotions and sleepiness as well as a parallel decrease in feelings of happiness.

One of the primary diagnostic characteristics of bulimia includes binge eating (APA, 1987). A number of studies have revealed that bingeing episodes revolve around the consumption of high fat and carbohydrate foods characteristic of many sweets and desserts (see Christensen, 1993). The fact that negative moods precipitate bingeing episodes has led to the suggestion that bulimics may be attempting to control or self-regulate their dysphoric mood with food (e.g., Johnson & Larson, 1982), which would also suggest that the negative mood state may not only precipitate but it may also maintain the binge eating. Schuman, Gitlin & Fairbanks (1987) have revealed that depressed individuals increase their preference for carbohydrates, particularly sweets, during a depressive episode. Rosenthal, Genhart, Caballero et al., (1989) have demonstrated that consumption of carbohydrates can improve a depressed mood. Evidence that bulimics binge on carbohydrate-rich foods has led to the suggestion that bingeing may represent a self-regulatory attempt to improve a dysphoric mood state through the ingestion of food (Deaver, Miltenberger, Smyth et al., 2003; for review see Christensen, 1992).

In times of emotional distress studies typically report an increased intake of both fat and carbohydrate (Liberman, Wurtman, & Chew, 1986; Vlitos & Davies, 1996; Wurtman, Brzezinzki, Wurtman, & Laferrere, 1989). This combination of fat and carbohydrate intake raises the possibility that palatability is the critical factor and should therefore be considered in studies of human-feeding behaviour. More direct evidence for this comes from a study undertaken by Yeomans, Tovey, Tinley & Haynes (2004). These researchers examined the effects of manipulated palatability on appetite in 40 normal weight females, classified according to their scores on *both* the restraint and disinhibition sub-scales of the TFEQ (Stunkard & Messick, 1985). Participants were served a bland and palatable version of a simple food (within subject). Results showed that all four groups consumed similar amounts of the bland food, but the LR-HD group ate significantly more of the palatable version than the other groups, whereas the HR/LD group did not increase intake in response to palatability. Hunger increased on tasting the palatable food in all but the HR/LD group, and this group ended both meals more hungry/less full than the others. The authors conclude that women classified as HR/LD were *unresponsive* to manipulated palatability, whereas those classified as LR/HD were *over responsive.* This implies that some individuals are prone to over-respond to palatability and so are at greater risk of developing obesity. It is reasonable to speculate that restrained eaters, with and without bulimic symptoms, will display elevated psychophysiological anxiety responses to highly palatable food items, compared to unrestrained eaters.

**2.8.4 Self-esteem.** A study conducted by Paa & Larson (1998) showed a negative correlation between restraint score (RS_R) and self-esteem (Positive and Negative Affect Scale (negative scale only) (i.e., self-esteem *decreased* as restraint level *increased*).

The study by Heatherton et al. (1991) (reviewed in Section 2.7.6), designed to compare physical versus ego threat manipulations, also included a measure of self-esteem. Only the individuals classified as high restraint, low self-esteem consumed significantly more in the ego conditions (failure on the concept formation task and anticipatory speech). For low restraint individuals the results were more complex; only low restraint individuals with high self-esteem consumed significantly less in the shock condition. However these results should be interpreted with caution, given the ratio of participant numbers (7 high versus 3 low self-esteem). Thus, self-esteem further moderates the restraint level-stress-eating relationship and a self-report measure of self-esteem should be included in any research investigations.

**2.8.5 Frequency of Dieting, Current Dieting, and Weight Fluctuation.** Lowe (1993, 1994, 1995) attempted to account for many of the inconsistencies in the literature on restraint. He identified three critical variables relating to success and failure in eating behaviour and weight control. Lowe argued that "frequency of dieting" causes a tendency *toward* disinhibited eating. Difficulties of food intake control are seen as related to a history of dieting, bouts of overeating, and weight fluctuations, rather than to a current state of eating restraint.

"Current dieting" distinguishes a general perceived restraint status from active efforts towards dieting and weight loss. Most, if not all, current dieters are found to have high scores on restrained eating scales, but at any one time, not all restrained eaters report that they are currently dieting. Some researchers report that on average only 40% of restrained eaters identified by the RS (Herman & Polivy, 1980) are actively dieting, although others report somewhat higher percentages, for example Rand & Kuldau (1991) and Israel & Stewart (2001) report 81% and 76% respectively.

Restrained dieters behave differently from restrained non-dieters, and seem to be less susceptible to disinhibition (Lowe, 1995). Finally "weight suppression" describes individuals who may have a history of dieting but are now maintaining control over eating and weight, i.e., successful dieters. These individuals seem to be resistant to experimental situations intended to prompt (over) eating (Lowe, 1995). Westenhoefer et al. (1990) also report that permanent dieting (which may perhaps be seen as a long-term state of weight suppression) was associated with fewer problems of control over eating than infrequent or regular dieting.

**2.8.6 Rigid/Flexible Control of Eating and Regular Eating Patterns.** Westenhoefer, Pudel & Maus (1990) proposed that dietary restraint can be characterized as rigid or flexible in nature, and these characteristics might be important underlying determinants of disinhibition and success or failure in dieting. Rigid control is associated with stringent calorie counting, strict rules for food avoidance, and frequent dieting. An all-or-nothing approach to dieting arguably makes individuals more prone to disinhibited eating (Herman & Polivy, 1984; Kirschenbaum & Dykman (1991). In contrast, flexible control reflects more general behavioural modification, such as better forward planning, limiting portion sizes, eating slowly, and less stringent restraint of intake. Those with a more flexible dieting approach tend to accept that transgressions can occur and deal with them appropriately by compensating later in some way. Problems of weight control and eating (e.g., snacking) have been found to be associated with a more rigid and less flexible pattern (Westenhoefer et al., 1990; Westenhoefer et al., 1994; Smith, Williamson, Bray & Ryan, 1999). Although there are scales for measuring these different styles of restraint (Westenhoefer et al., 1994), the defining features of flexible and rigid strategies require clearer delineation (Mela, 2001)(see also Section 2.8.1).

Recent data suggest that more regular eating patterns may be associated with successful dieting (Kirk & Hill, 1997; Tucker & Peterson, 2000; Shigeta, Shigeta, Nakazawa, & Yoshikawa, 2001). It has been suggested that a regular, structured daily eating plan may help to reduce opportunistic or emotion-driven breakdown in dietary restraint (Costanzo, Reichmann, Friedman, & Musante, 2000). Thus, it appears that repeated dieting and a rigid all-or-nothing style and an erratic pattern of food intake may contribute to increasing susceptibility to breakdown of dietary restraint (Mela, 2001).

**2.8.7 Type of Stress.** Studies investigating the influence of dietary restraint as a moderating influence in the stress-eating relationship have generally revealed a hyperphagic response (disinhibited eating) in stressed restrained eaters, and no change or a decrease in food intake in stressed, unrestrained eaters. However, although many studies have replicated the differential eating pattern displayed by restrained and unrestrained eaters following stress, the disinhibition effect is not always observed in restrained eaters (Heatherton et al., 1991; Herman, Polivy, Lank & Heatherton, 1987; Mitchell & Epstein, 1966). The 'type' of stress encountered by restrained (or obese) individuals has been shown to play a crucial moderating role in the effects of stress on eating (see Table 1 for a summary of studies of stress and eating behaviour). It is often found that physical stressors (i.e., threats involving pain or physical discomfort) significantly reduce eating in non-dieting, normal weight individuals, but do not appreciably increase eating in restrained individuals (Heatherton, Herman & Polivy, 1991; Herman & Polivy, 1975; Pine, 1985).

In contrast, manipulations containing a threat to the ego such as task failure or negative evaluation do not significantly decrease the eating of normal weight non-dieters but do produce the 'disinhibition' effect in restrained individuals (Baucom & Aiken, 1981; Heatherton et al., 1991; Herman et al., 1987; Lattimore, 2001; Ruderman, 1985).

The methodology used to induce ego-threatening stress in the laboratory has been difficult to replicate and is prone to biases that cannot be controlled. Firstly, the distinction between stress manipulations that are *intended* to be ego-threatening, and general anxiety stressors, for example, exposure to a frightening film, or physical threat manipulations (for example, the cold pressor task) is not always clear (Heatherton, Herman & Polivy, 1992; Schotte, 1992). A further problem is that manipulations assumed as ego threatening employed to date are prone to uncontrollable biases. For example, it is difficult to standardize feedback that is humiliating (Lattimore, 2001).

In an attempt to overcome these limitations, Lattimore (2001) employed an emotional variation of the Stroop task, incorporating ego-threat stimuli, to trigger a significant increase in self-reported anxiety and overeating in dieters (i.e., individuals currently dieting to lose weight) classified as binge-eaters or non-binge-eaters, in a test-meal paradigm. However, several limitations exist in relation to this study. Firstly, the two manipulations employed were not comparable in that one involved an *active* behavioural response (computer keyboard manipulation), wherein the outcome of the task could be influenced by the participant, and the other involved *passive* sensory intake (exposure to a frightening film), where the outcome could not be influenced (see Section 4.5.3 for a discussion of the differential physiological patterning of response provoked by active versus passive coping tasks).

Secondly, in Lattimore's (2001) study, female dieters, classified as binge-eaters (using a cut-off point of 102 on the BULIT-R) were found to eat significantly more ice cream following exposure to the card ego Stroop task (containing 5 categories of threat – see Waller et al., 1996) than following the fearful film condition. Although a similar trend was observed for non-binge-eaters, the comparison did not attain significance. However, it should be noted that the sample size was very small (N = 11, binge eaters; N=9, non-binge-eaters), possibly resulting in a loss of power to attain statistical significance. In addition, the non-binge group showed a large individual variation in the amount of ice cream consumed, and no measure of food preference was included. Further, although no measure of restraint status was employed, presumably the former group could be described as restrained eaters, with bulimic symptoms, and the latter group could be described as restrained eaters, without bulimic symptoms. Although the binge-eaters consumed more ice cream than the non-binge-eaters following exposure to the ego Stroop task (Mean = 217.51 v 188.51), no test was undertaken to ascertain whether this difference was statistically significant.

**2.9 Why does ego stress disinhibit?** The 'escape' theory (Heatherton & Baumeister, 1991) maintains that disinhibited eating occurs in response to ego threat as a motivated attempt to escape negative self-perceptions and emotional distress. Ego threat is assumed to undermine dietary restraint as attention is narrowed to salient features of the immediate stimulus environment at the expense of dietary monitoring. As a result, disinhibition is increased, as inhibition requires an uninterrupted focus on internal standards (Diener, 1979). In support of this theory, studies show that ego-threatening distress does provoke a significant increase in the eating of restrained eaters, but does not appreciably decrease the eating of unrestrained eaters (Heatherton et al., 1991; Lattimore, 2001; Oliver, Wardle, & Gibson, 2000; Tanofsky-Kraff, Wilfley & Spurrell, 2000). Further, a study by Heatherton, Polivy, Herman, & Baumeister (1993) showed that disinhibition of restraint was observed under conditions of ego threat when self-awareness was low, but not when it was high. Related research indicates that women with bulimic attitudes show an attentional bias towards self-directed ego threat information (see Section 3.4.5).

However, two problems arise for the 'escape' theory: a) positive mood induction procedures also induce disinhibition in restrained eaters (Schotte et al., 1990), and b) disinhibited eating can arise from "emotionally neutral" distraction, independent of anxiety (Boon, Stroebe, Schut, & Ijntema (2002). Researchers have explained this in terms of a limited cognitive processing capacity (Boon et al., 2002; Ward & Mann, 2000).

It is suggested that persistent dietary monitoring places high demands on cognitive processing resources (Green & Rogers, 1998), and that any task that is sufficiently high in cognitive demand will compete for these resources, thus compromising cognitive control over eating behaviour and leading to disinhibition of dietary restraint. Boon et al. (2002) found that restrained eaters consumed significantly more ice cream than unrestrained eaters under conditions of cognitive distraction. Two studies undertaken by Bellisle and colleagues revealed conflicting results. Bellisle & Dalix (2001) found that, under conditions of distraction (i.e., listening to a detective story), restraint status predicted the amount of food consumed. However, in a more recent study (Bellisle, Dalix, & Slama, 2004) although two non food-related environmental stimuli (television viewing and listening to a detective story) stimulated food intake [compared to baseline meausres] no significant associations between restraint and disinhibition (sub-scales of the TFEQ) and intake during either condition.

Several other researchers, however, have also concluded that *non-stressful* cognitive load manipulations interact with restraint status to produce overeating in restrained and emotional eaters (Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004). Ward & Mann (2000) reported that a task involving high cognitive demand (but neither negative mood nor ego threat) caused restrained eaters to eat more than did a task low in cognitive demand, independent of self-reported anxiety levels. However, although no significant increase in self-reported anxiety levels was obtained, it should be noted that pre-test instructions to participants included the explicit suggestion that the tasks about to be undertaken were "not intended to be stressful". Therefore, the possibility that participants were *primed* to complete self-report measures as if they were *not* in a stressed state cannot be ruled out.

Based on the above studies, Lowe & Kral (2006) have recently suggested that 'stress-induced' eating in restrained eaters may not be caused by stress *per se*, and that the negative emotional arousal that is usually produced by stressors is not a necessary part of the disinhibition effect. However, in the above studies, either self-report measures of the 'arousal' response only have been obtained, or no measure of emotional arousal has been obtained. A direct test of the two theories ('escape' versus limited cognitive capacity) is now required that includes the direct manipulation of both ego-threat and cognitive load, together with more objective measures of anxiety than self-report (i.e., physiological and biological measurement)(see also Section 4.5).

### 2.10 Chapter summary

Researchers investigating the stress-eating relationship most commonly favour an Individual Difference model for humans. Individual difference theories addressing the relationship between emotions and eating behaviours have their origin in the literature on obesity. The psychosomatic theory of obesity attributes overeating to confusion between internal arousal states and physiological states of hunger and satiety. Eating is hypothesized to bring about 'comfort' and a reduction in anxiety levels. The internal/external theory of obesity hypothesizes that overweight individuals do not recognize internal physiological cues of hunger. Rather, eating behaviour is 'cued' by external factors, such as the availability, sight or smell of appetizing food. Thus, this theory predicts that normal weight individuals will adjust their eating when stressed in accordance with physiological responsiveness, whilst obese people will eat regardless of their physiological state. Thus, the psychosomatic theory emphasizes *internal* instigation of overeating, whereas the externality theory focuses on *external* instigation of overeating. Both theories concur that dieting *results from* overeating and weight gain.

Whilst these early theories attempted to explain overeating in obese individuals, more recent theories addressing the development and maintenance of human obesity aim to explain eating behaviour in a normal weight population. In contrast to both the psychosomatic and internal/external theories, restraint theory proposes that dieting may *lead to* overeating, weight gain and obesity. The restraint hypothesis postulates that individuals who chronically restrict their food intake overeat in the presence of certain disinhibitors. One such trigger of 'disinhibition' of dietary restraint is a negative mood state or stress. Thus, dietary restraint is an individual difference variable that has been found to moderate the stress-eating relationship. However, other variables have been found to further influence the experimental outcome. These include the measurement of restraint, gender, palatability, self-esteem, frequency of dieting, current dieting and weight fluctuation, rigid versus flexible control over eating, regular eating patterns, and stressor type.

Laboratory manipulations that contain an ego-threat induce overeating in restrained eaters, whereas physical tasks do not. However, the tasks commonly employed to induce ego-threat are difficult to replicate and are prone to uncontrollable biases. A study by Lattimore (2001) indicates one potential solution to this problem – an emotional Stroop task incorporating ego-threat words. Although this study was methodologically flawed, further studies *have* successfully demonstrated the utility of this stress manipulation to induce 'disinhibition' in the laboratory with restrained and emotional eaters (e.g., Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004). Related research indicates that women with bulimic symptoms also display an attentional bias towards and cognitive avoidance of ego-threat information that is self-directed (see Chapter 3), suggesting that 'threat' information, that is unrelated to eating, is particularly salient to women with bulimic attitudes and behaviours. To date, no studies have been undertaken in the laboratory investigating the simultaneous measurement of the cognitive, physiological and behavioural effects of the ego-threat Stroop task with women high in dietary restraint and bulimic symptoms.

The 'escape' theory proposes that ego-threat is required in order to induce disinhibition, and that this should be accompanied by anxiety (Heatherton & Baumeister, 1991). Conversely, the limited capacity model suggests that disinhibition can occur without anxiety *or* ego threat, so long as the task is high in terms of the cognitive demand required (Ward & Mann, 2000). A direct test of these theories is required, incorporating a more stringent psychophysiological measurement of the stress response.

# Chapter 3. Eating Pathology

## 3.1 Introduction

Binge eating is characterized by eating a large amount of food in a short period of time, accompanied by a sense of loss of control over eating (APA: American Psychiatric Association, 1994). Binge eating is a symptom of bulimia nervosa (BN), binge eating disorder (BED) and anorexia nervosa (AN) (binge/purging types) and may contribute to obesity (APA, 1994). Although binge eating plays an important role in the eating disorders, there is also a high prevalence of pathological eating behaviours (e.g., bingeing and purging) and attitudes in the general population (e.g., Cooper & Fairburn, 1983; King, 1986; McManus & Waller, 1995; Oliver & Wardle, 1999; Pope, Hudson, Yurgelun-Todd, & Hudson, 1984; Stone & Brownell, 1994; Weinstein, Shide & Rolls, 1997; Whitehouse, Cooper, Vise et al., 1992). Some empirical evidence in support of this claim is derived from the studies reviewed in Chapter 2 of this thesis.

Chapter 2 of this thesis provided a critical review of studies demonstrating the phenomenon of counter-regulation and disinhibition of dietary restraint - a phenomenon likened to binge eating. Findings from studies employing a 'pre-load' in order to demonstrate counter-regulation provide evidence for a link between dietary restraint and binge eating in non-clinical populations. Evidence from studies involving the manipulation of mood and exposure to stress in order to demonstrate the disinhibition of dietary restraint provides a strong argument for the proposition that negative emotions can promote binge-eating behaviours in non-clinical samples. Negative emotional states have also been implicated in the aetiology (Grissett & Norvell, 1992; Lacey, Cocker, & Birtchnell, 1986; Troop, Holbrey, Trowler, & Treasure, 1994) and maintenance (Cattanach, Malley, & Rodin, 1988; Striegel-Moore, Silberstein & Rodin, 1986) of the eating disorders (for reviews see Kaye, Gendall & Kye, 1998; Leon, Keel, Klump, & Fulkerson, 1997; Nagel & Jones, 1992; Polivy & Herman, 2002; Stice, 2002; Stice & Shaw, 2002; Wonderlich & Mitchell, 1997).

The laboratory studies reviewed in Chapter 2, employing restrained eaters, have therefore been used to advance our understanding of the processes involved in clinically significant episodes of binge eating. The disinhibition effect has been described as an experimental analogue of binge eating in BN (Wardle & Beinart, 1981). Based on the evidence derived from these studies restraint theorists have asserted that BN may develop when a person shows the more extreme manifestations of weight and dieting concerns (e.g., self-induced vomiting, laxative and diuretic use) (the continuum model of bulimia: Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987).

### 3.2 Chapter Overview

Chapter 3 provides firstly a description of the *continuum* of eating psychopathology that includes *both* the clinical and non-clinical spectrums. Secondly, Chapter 3 provides an overview of the cognitive-behavioural models of eating psychopathology, with a focus on the most influential of these – the starvation model. A critical appraisal of this model follows. The review highlights deficits in the *range* and *focus* of cognitions included within the starvation model – specifically the omission of emotion-related cognitions. Thirdly, more recent models of eating psychopathology are outlined. Focus is given to the role of attentional bias towards and schema avoidance of specific '*threat*' information, unrelated to eating, in the aetiology and maintenance of eating pathology.

### 3.3 The *Continuum* of Eating Psychopathology

The spectrum of human eating disorders has been described as a 'moving target' as the clinical conceptualization has changed rapidly over time (Owen, Treasure & Collier, 2001). The eating disorders are classified within psychiatry and therefore represent an impairment of mental health. The underlying assumption is that psychological or psychiatric factors play a role in the development and/or maintenance of the disorders. The issue of mental health also incorporates the concept of psychological resource, or the *coping abilities* of the individual (see also Section 4.3.3).

Although the psychiatric diagnostic systems (e.g., DSM-IV: Diagnostic and Statistical Manual of Mental Disorders-IV, APA, 1994) classify the eating disorders categorically, it is argued that the borderlines between categories in the overeating ranges are fuzzy, with some risk factors being common to more than one disorder. For example, emotional factors are a core implicit component of *all* of the eating disorders. It has therefore been suggested that human eating disorders may best be regarded as forming a spectrum or continuum (e.g., Owen, Treasure & Collier, 2001), and that this continuum should also include symptomatic females within the general population. The following section provides a description of the eating disorders.

**3.3.1 Anorexia Nervosa (AN)**. The DSM-IV subtypes AN by the presence or absence of bulimic symptoms as either restricting or binge/purging types (Herzog, Field, Keller et al., 1996). The *restrictive* type has no regular binge eating or purging behaviours (i.e., the use of self-induced vomiting, laxatives, diuretics, or enemas), whereas the *binge-eating/purging* type involves regular use of these behaviours. AN involves emaciation, fear of becoming fat, disturbed perception of body shape, undue influence of shape on self-evaluation, denial of the seriousness of low body weight, and amenorrhea (Stice, 2002).

**3.3.2 Bulimia Nervosa (BN)**. Diagnostically, two subtypes also exist in respect of BN - purging and non-purging. Individuals in the former type engage in behaviours such as self-induced vomiting and laxative abuse in order to compensate for binges. Individuals with the latter type employ methods of weight control, such as fasting or excessive exercise. Of patients who present for treatment in clinics, 80-90% use vomiting as a means of weight control (APA, 1994). Many of the clinical features of AN are also characteristic of BN, for example concerns over shape and weight, binge eating behaviour and the use of methods of weight control such as fasting, vomiting or misuse of laxatives or diuretics. However, individuals with AN are characterized by a weight that falls 15% below the expected normal range for age and height (Fairburn & Cooper, 1996), whereas BN individuals tend to fall within the normal weight range. A proportion of individuals with BN have a history of AN. Fairburn & Cooper (1984) found that 25.7% of females with BN had previously fulfilled diagnostic criteria for AN.

**3.3.3 Binge Eating Disorder (BED).** The criteria for what is now known as BN evolved and became more specific over time. This led to an increase in the number of individuals who do not exactly fulfill these diagnostic criteria, otherwise known as **Eating Disorder Not Otherwise Specified (EDNOS).** In 1991 Spitzer, Stunkard, Yanovski, et al. suggested that an additional DSM-IV category of BED be defined from within this group for research purposes, to aid further study (see Spitzer, Stunkard, Yanovski et al., 1993). For this disorder, binge eating is not associated with the regular use of inappropriate compensatory behaviours (e.g., purging, fasting, excessive exercise) as seen in people with BN and AN.

**3.3.4 Non-Eating Disordered Women.** The current diagnostic schemes (e.g., DSM-IV; APA, 1994) reflect the *minimum* criteria required to fulfill 'official' eating disorder cases. However, it has been suggested that a high prevalence of *pathological* eating attitudes (concerns over weight and shape) and behaviours appear to be widespread in the general population, with bulimic behaviours (e.g., bingeing and purging) seeming prevalent (e.g., Cooper & Fairburn, 1983; King, 1986; McManus & Waller, 1995; Oliver & Wardle, 1999; Pope et al., 1984; Stone & Brownell, 1994; Weinstein et al., 1997; Whitehouse et al., 1992). It has also been suggested that many individuals with such tendencies are never referred for services (McManus & Waller, 1995).

Some have argued that a *continuum* of eating psychopathology exists within the general population, with different degrees of severity across individuals despite their non-clinical status (e.g., Herman & Polivy, 1988; Polivy & Herman, 1985, 1987; Scarano & Kalodner-Martin, 1994), and with the clinical eating disorders continuum lying at the extreme end of this non-clinical continuum (e.g., Nylander, 1971). The continuum model of bulimia (Herman & Polivy, 1988; Polivy & Herman, 1985, 1987) suggests that restrained eaters occupy an intermediate position between unrestrained eaters and individuals with bulimia in terms of bulimic risk factors and bulimic symptoms. The continuum model also suggests that vulnerable individuals can progress along the continuum from a non-clinical to a clinical eating pathology status, and there is now general agreement that dieting *is* a contributing factor to the development of BN (Hsu, 1990, Polivy & Herman, 1985; Stice, 2002). Indeed, although restraint theory was originally devised to explain the development and maintenance of human obesity, the boundary model of restraint theory (see Section 2.6.2) was once one of the most influential models explaining the mechanisms of overeating in BN (Polivy & Herman, 1985), and underpinned the cognitive-behavioural model used in the treatment of this disorder (Wilson & Fairburn, 1993).

In support of the continuum model of BN, there is evidence to suggest a causal link between dietary restriction and binge eating. For example, researchers have reported that high scores on the RS_R (Herman & Polivy, 1980) are predictive of the future onset of binge eating (Stice & Agras, 1999; Stice, Killen, Hayward & Taylor, 1998; Stice, Presnell & Spangler, 2002), bulimic pathology (Killen, Hayward, Wilson et al., 1994), and increases in bulimic symptoms (Kendler, MacLean, Neale et al., 1991; Stice, Ozer & Kees, 1997; Stice, 2002). Dietary restraint scales also predict the onset of general eating disorder symptoms (Leon, Fulkerson, Perry, Keel, & Klump, 1999; Santonastaso, Friederici, & Favaro, 1999), and bulimics also score higher on restraint scales than controls (Jansen, van den Hout, & Griez, 1990; Ruderman & Besbeas, 1992). In addition, binge eating was also reported as a result of the starvation regimen in the Minnesota study (see Keys, Brozek, Henschel et al., 1950).

To summarise, a review of the continuum of eating psychopathology suggests that a substantial proportion of females binge eat. It is important therefore to elucidate the factors associated with this behaviour. Two important factors appear to be dieting and the experience of negative emotional affect. The following section presents an overview of the various models of eating psychopathology that have been developed to explain the aetiology and maintenance of disordered eating attitudes and behaviours. However, the focus is on *cognitive* information-processing models of eating psychopathology.

### 3.4 Models of Eating Psychopathology.

Numerous perspectives from various fields of research have been advanced to explain the aetiology and maintenance of disordered eating attitudes and behaviours. These are diverse and include both single factor and multidimensional models. Single factor models have implicated genetic, biological, family, feminist, psychodynamic, and sociocultural factors in the development and maintenance of eating disorders. Whilst these factors have independently received a substantial amount of attention, other models suggest an *interaction* between several of these factors and the potential of this interaction to predispose, precipitate and maintain eating pathology. It is suggested that within each individual sufferer, it is likely that an interplay occurs between genetic, biological, dispositional and socio-environmental factors. Therefore, the eating disorders are best considered from a multidimensional perspective (e.g., Garfinkel & Garner, 1982; Halmi, 1997; Lacey, 1986; Schwartz & Barrett, 1987; Raphael & Lacey, 1994). However, many of these models are limited because: a) they often fail to specify how these factors result in the development of eating disorders in only some women, b) they often ignore the issue of which thoughts and processes lead to the development of eating problems in only some women, and c) they do not take account of the individual's ability to cope with negative affect as a potential mediator of eating pathology. These factors are taken into consideration by the more recently developed cognitive models of eating psychopathology.

**3.4.1 Cognitive Models.** Cognitive models of both AN and BN emphasize the importance of cognitions, with maladaptive and dysfunctional cognitions as key determinants of behaviour (e.g., AN: Garner & Bemis, 1982; Williamson, Davis, Duchmann, McKenzie & Watkins, 1990; Guidano & Liotti, 1983; Vitousek & Hollon, 1990; Wolff & Serpell, 1998; BN: Fairburn, Cooper, & Cooper, 1986; Fairburn & Cooper, 1989; Wilson, 1999). In line with restraint theorists (Polivy & Herman, 1985), several cognitive models regard bingeing as a consequence of restricting eating behaviour, either directly through physiological mechanisms (Slade, 1982) or indirectly through psychological mechanisms such as self-esteem (Fairburn & Cooper, 1989). Other models propose that bingeing is a consequence of the experience of negative emotional affect, either via *externally* derived triggers, such as loss experiences, major life changes and sexual conflicts (e.g., Lacey, 1986; Root & Fallon, 1989), or via *internally* derived triggers (ego-threats) (Heatherton & Baumeister, 1991)(see also Section 2.9).

Cognitive models are strongly influenced by the information-processing models that were originally developed in relation to other psychiatric disorders (i.e., anxiety, depression) (e.g., Beck & Clark, 1997), and the majority of supporting empirical evidence for cognitive models of AN and BN is derived from studies that have employed various information-processing methodologies originating from cognitive psychology (e.g., dichotic listening, lexical decision tasks, memory and recall bias, thought sampling, ambiguous scenarios/stimuli, visual dot probe task, subliminal processing, thought suppression, repertory grids, and Stroop tasks).

Earlier cognitive-information models place emphasis on maladaptive cognitions relating to food, shape and weight (e.g., AN: Garner & Bemis, 1982; Williamson, Davis, Duchmann, McKenzie & Watkins, 1990; Guidano & Liotti, 1983; Vitousek & Hollon, 1990; Wolff & Serpell, 1998; BN: Fairburn, Cooper, & Cooper, 1986; Fairburn & Cooper, 1989; Wilson, 1999). However, more recently theorists have suggested the need to include other concerns, such as those relating to "ego-dysfunction" characteristics (e.g., perfectionism, self-esteem), abandonment schemata, attentional bias towards and cognitive avoidance of threat, and schemata concerning self-criticism (Ainsworth, Waller, & Kennedy, 2002, McManus, Waller, Shuck, Watkins & Chadwick, 1995; McManus, Waller & Chadwick, 1996; Meyer, Serpell, Waller et al. 2005, Waller et al., 1996; Waller, Dickson, & Ohanian, 2002; Waller, Ohanian, Meyer & Osman, 2000). It has been suggested that the type of emotional material and the way in which it is processed is crucial to the aetiology, maintenance and treatment of psychiatric disorders, such as AN and BN (also anxiety, depression, and substance abuse) (Beck, Emery & Greenberg, 1985; Eysenck, 1992; Wells & Mathews, 1994; Williams, Watts, MacLeod & Mathews, 1988). Therefore, in order to fully understand cognitive models of eating psychopathology, and particularly the more recently advanced 'emotional' models, it is necessary to first provide an overview of Beck's (1997) cognitive model of anxiety.

**3.4.2 Beck's Model of Cognitive-Behavioural Therapy (CBT).** CBT is the amalgamation of behaviour therapy and cognitive therapy. Cognitive therapy as we know it now began its development with figures such as Aaron Beck, whose original formulations were derived mainly from his work on depression. Three critical concepts form the basis of Beck's Model: the cognitive triad, the cognitive schemas and the cognitive distortions (Beck & Weishaar, 1989). The cognitive triad includes the way the individual views him/herself, the world and the future. A cognitive schema can be thought of generally as any broad organizing principle for making sense of one's life experience. An important concept with relevance to psychopathology and therapy is the notion that schemas, once formed, continue to be elaborated and then superimposed on later life experiences, even when they are no longer applicable. This is sometimes referred to as "cognitive consistency" – a need to maintain a stable view of oneself and the world, even if it is, in reality, inaccurate or distorted. Thus, schemas can be positive or negative, adaptive or maladaptive, and they can be formed in childhood or later in life.

In 1985 Beck, Emery, & Greenberg proposed a cognitive model of anxiety. A core tenet of this, and other information processing models, is that the type of emotional information and the manner in which it is processed are crucial factors in the etiology, maintenance and treatment of anxiety disorders. Beck et al.'s (1985) schema-based model proposes that cognitive distortions, or the erroneous or biased interpretation of stimuli as dangerous or threatening to an individual's physical or psychological wellbeing, are a core feature of anxiety disorders. Alongside of this, there is also a tendency for the anxious individual to underestimate personal coping resources and the safety and rescue features of the environment. The distinction between normal and pathological anxiety is said to be one of degree rather than kind. The distinguishing feature is that in non-clinical anxiety the estimation of threat corresponds more closely to the objective dangers in the environment, whereas in pathological anxiety the perception of danger is biased and tends to be overestimated (Beck & Clark, 1997). According to the model, anxiety consists of a complex pattern of cognitive, affective, physiological and behavioural changes (Beck et al., 1985).

Beck & Clark (1997) propose that this complex cognitive-affective-physiological-behavioural pattern of response involves the inappropriate interpretation of innocuous stimuli as threatening, and that such cognitive distortions lie at the heart of the state that we call anxiety. Beck & Clark (1997) propose that the process of processing information as threatening involves three stages:

*Stage I. Initial registration.* The first stage involves the recognition of the stimulus. This recognition is said to be very rapid, automatic, involuntary, generally outside of conscious awareness, and involves no strategic or elaborative processing at all. Beck (1996) referred to this as the 'orienting mode' (Beck et al., 1985). The function of this "early warning detection system" is to identify stimuli and thereafter assign processing priority to the stimuli, through the allocation of attentional resources. This is especially true if the stimuli or situation is one that may threaten the survival of the organism. It is thought that this early (pre-attentive) analysis is biased towards negative, personally relevant information for anxious individuals. However, although this may serve evolutionary value, the problem in anxiety is that the orienting mode is excessively tuned to detect negative stimuli, and thereafter to allocate attentional resources to them. This triggers the activation of more elaborative maladaptive processing.

*Stage II. Immediate preparation.* The detection of negative and personally relevant stimulus leads to activation of the next stage of threat processing – *immediate preparation*. The *primal mode* (a cluster of interrelated schemas embodying more primitive and immediate cognitive, affective, behavioural, and physiological patterns) is activated. Primal responses include a) autonomic arousal – preparation for enacting defensive behaviours such as fight or flight; b) behavioural mobilization or inhibition – escape and avoidance behaviour aimed at reducing risk and danger; c) primal thinking – a narrowing or constriction of cognitive processing onto the threat stimulus as well as the production of repetitive, involuntary automatic thoughts and images involving possible threat or danger; d) a feeling or fear – which primes the individual for action, and e) hypervigilance for threat cues. The aim of the activation of the 'threat' primal mode is to fulfill basic evolutionary goals - ensure the individual's survival by maximizing safety and minimizing danger. Primal modes are said to be rigid, inflexible and reflexive. Once activated, they dominate much of the information processing system and therefore the attentional resources of the individual, thereby reducing or eliminating the capacity for more constructive or reflective modes of thinking.

Primal processing is said to involve a mixture of both automatic and more elaborative or strategic processing. It is automatic because it is rapid, involuntary, inflexible and primarily stimulus-driven, but also consists of more elaborative, controlled processing – the beginning of primary threat appraisal or the (higher level) semantic analysis of the threat stimulus. Two products of primal threat appraisal are said to be significant in the experience of anxiety. The first is a constriction or narrowing of cognitive processing that leads to certain biases and inaccuracies – the individual becomes hypersensitive to the potentially harmful aspects of the situation or stimuli, whilst ignoring any positive features. There is generally intolerance for uncertainty or ambiguity, and a propensity for catastrophic thinking. The second product of primal threat appraisal is the occurrence of negative automatic thoughts involving themes of threat and danger. The activation of the primal mode leads to the final stage of threat processing – that of *secondary elaboration*.

*Stage III. Secondary elaboration.* The final stage in the cognitive model of anxiety involves activation of elaborative, semantic information processing that is slow, effortful and schema driven. Existing schemas, representing the individual's current concerns and personal issues are triggered, and the person engages in a deeper analysis of the threatening situation or stimuli. A *secondary appraisal* process occurs as the *meta-cognitive mode* (i.e., thinking about thinking) is activated, in which the anxious individual evaluates the availability and effectiveness of their coping resources to deal with the perceived threat (Beck et al., 1985). It has been suggested that the avoidance or failure to elaborate and process the attributes or features of the threatening stimulus at the strategic level may be crucial to the maintenance of a clinical state of anxiety (Mathews, 1990; Zinbarg, Barlow, Brown, & Herts, 1992 – in Beck & Clark, 1997). Three possible outcomes can occur as a result of this 'failure to reflect'; a) the blocking of a more realistic, constructive reappraisal of the situation or stimulus allows the more automatic, primal threat mode to remain dominant, resulting in a further escalation of feelings of anxiety, b) alternatively, anxiety may decline because the individual may simultaneously 'downgrade' the likelihood or severity of the threat and 'upgrade' perceptions of their ability to cope, or c) the anxiety may subside because the individual has engaged in some defensive behaviour such as escape or avoidance, prompted by the primal mode. Cognitive models of eating psychopathology draw heavily on Beck & Clark's (1997) information processing model in an attempt to explain the processes involved in the aetiology and maintenance of eating disorders.

Several cognitive models of AN and BN have assigned a central role to the meaning of eating, weight and shape to the eating disordered individual (e.g., Cooper & Fairburn, 1998; Garner & Bemis, 1982; Vitousek & Hollon, 1990). Despite differing on a number of dimensions, the models have one important commonality; they hold that anorexics and bulimics endow weight and shape with rich connotations, equate their self-worth with an evaluation of their shape and weight, and use the regulation of weight to fulfill several functions in their lives (Vitousek & Hollon, 1990). Specifically, it is the extent of the influence of weight and shape on self-worth that has been described as the fundamental maladaptive cognitive feature of disordered eating (Cooper & Fairburn, 1993; Garner & Bemin, 1982; Vitousek & Hollon, 1990). The link between weight and shape and self-esteem in eating disorders is recognized in the DSM-IV (APA, 1994) and is reflected in current diagnostic criteria as a central component of the diagnostic criteria for bulimia nervosa, and as one of three alternative criteria for AN (APA, 1994).

According to Cooper (1997), most clinical theories that have attempted to explain the role of cognition in the eating disorders can be traced to Garner & Bemis's (1982) cognitive-behavioural model of AN, which in turn was based on Beck's (Beck, Rush, Shaw, & Emery, 1979) cognitive theory of depression. Garner & Bemis's (1982) model asserted that AN is maintained by distorted automatic thoughts, core beliefs, and underlying assumptions about weight, shape, food, and eating. Fairburn and colleagues (Fairburn, 1981; 1997; Fairburn & Cooper, 1989; Fairburn, Cooper, & Cooper, 1986) extended Garner & Bemis's (1982) AN model to an analysis of BN, taking the view that preoccupations with shape and weight are central to bulimia. The 'starvation' model is one of the most influential cognitive-behavioural models of BN, and cognitive-behavioural treatments based on this model are currently the most common approach employed (e.g., Wilson, 1996). According to this model, low self-esteem results in over-concern with body weight and shape issues, resulting in excessive dietary restriction. This restriction leads to binge eating via psychological and physiological mechanisms. Purging behaviours are used to counteract the effects of bingeing, and a starvation-binge-purge cycle is developed.

Vitousek and colleagues (Vitousek, 1996; Vitousek & Hollon, 1990) built upon the starvation model. They proposed a schema-based account of cognition's role in the eating disorders. In their model, symptomatic behaviour is maintained by "*organized cognitive structures (schemata)* based around the issues of *weight* and its *implications for the self* that influence.....perceptions, thoughts, affect, and behaviour" (Vitousek & Hollon, 1990, p.192). Self- and weight-related schemata (and their interactions) are assumed to serve organizing and simplifying functions for the individual. Symptoms are maintained through schema-consistent processing of information, which guides the individual's attention towards shape-, weight-, and eating related information.

**3.4.3 Support for Cognitive Models of Eating Psychopathology.** In support of the cognitive-behavioural models, cognitive distortions, irrational thoughts and beliefs in AN and BN women in relation to food, body shape and weight are well documented (e.g., Woods & Heretick, 1983; 1984; Mizes, 1988; Bauer & Anderson, 1989; Ruderman, 1986; Poulakis & Wertheim, 1993). Using a variety of paradigms from cognitive psychology, researchers have revealed information-processing biases for information *specific* to eating psychopathology (e.g., food, eating, weight) in both anorexic and bulimic women (Cooper, 1997; Cooper & Fairburn, 1992; Fransella & Crisp, 1979; Newman et al., 1993; Rieger et al., 1998; Serpell, Treasure, Teasdale & Sullivan, 1999; Schotte, McNally & Turner, 1990; Vitousek, Ewald, Yim & Manke, 1995 - in Vitousek, 1996; Zotter & Crowther, 1991- see also Dobson & Dozios, 2004; Lee & Shafran, 2004 for reviews). This evidence supports the accuracy of the models in pinpointing underlying dysfunctional cognitions relating to the activation of *disorder specific schemata*. Another important schema driven process is that of enhanced *recall* for disorder salient information. Only a few studies have examined memory recall biases in people with clinical eating disorders. These studies have also focused on disorder specific information, and will now be reviewed.

**3.4.4 Memory Bias for Disorder-Specific Information: Eating Disordered Women.** Channon, Hemsley & De Silva (1988) found that recognition memory for previously presented food- or weight-related words *did not* differ for patients with AN and controls. A study by King, Polivy, & Herman

(1991) required participants to read an essay and later recall it. In this study, restrained eaters, obese females, and eating disorder patients recalled more food and weight-related information than appearance-related information on a free-recall task. These findings are limited by a small sample of people with AN (N=6), the subjective judgment of accuracy of recall, and the failure to include a control population.

Sebastian, Williamson, & Blouin (1996) found that 30 patients with a range of eating disorders recalled more 'fatness' related words than control words, and recalled more of these words than women without a clinical eating disorder. However, this study did not control for the valence of the words. Hence, it may be the case that the clinical participants were demonstrating a bias for negative words in general, rather than for stimuli relevant to their concerns (Lee & Shafran, 2004).

Hermans, Pieters, & Eelen (1998) examined *implicit* memory using a word completion task with 12 patients with AN and 12 non-dieting controls. The words in this study *were* matched for valence. It was hypothesized that if AN was associated with higher accessibility of AN-related words, then more word stem completions would be found for AN-related words compared with AN-unrelated words. Results showed that patients with AN completed more word stems for primed AN-related words than for primed neutral control words. However, the same trend existed for unprimed words and there was no significant benefit of recent exposure for AN-related words compared with neutral words. The authors concluded that AN participants were unable to detect an implicit memory bias for AN-related materials. In contrast, when they used a cued recall test of explicit memory, they found an explicit memory bias for AN-related words. This explicit bias was specific to AN words and not found for negative words unrelated to AN.

In a study by Williamson, Perrin, Blouin, & Barbin (2000) three groups of women: eating disorder, body dysmorphic controls, and nonsymptomatic controls were recruited. In phase 1, participants encoded ambiguous information via instructions to imagine themselves in a variety of ambiguous situations that involved two types of information: body-related or health-related. On a subsequent memory task, participants in the eating disorder group and the body dysmorphic control group recalled imagery of the body-related situations with a fatness interpretation and participants in the nonsymptomatic control group recalled imagery with a thinness interpretation. The three groups did not differ in their interpretation of the health-related situations. In phase 2, participants were instructed to imagine themselves in each body-related situation, but were explicitly instructed to imagine the scenes with either a positive or negative interpretation. Results indicated that the eating disorder and body dysmorphic groups were able to change their interpretation of body-related information when instructed to do so.

Hunt & Cooper (2001) investigated memory bias for weight and shape, and for food related words, in women with a primary diagnosis of BN (N=12), women with a primary diagnosis of depression (N=12) and female non-clinical controls (N=18). The aim of this study was to investigate whether women with BN demonstrate memory biases congruent with their primary concerns. Participants listened to target and control words. They performed a self-reference encoding task, where they were required to imagine a scene involving the word and themselves, and recall memory was assessed. The results indicated that women with BN demonstrated a bias to recall positive and negative weight and shape related words compared to emotional words, but not compared to neutral nouns and body words. Memory biases for food related words were not found to be specific to women with BN, but were also found in women with depression. The recall bias for food related words was related to levels of hunger in both groups. The findings provide partial support for memory biases for weight and shape, but not food related information in BN.

Kersting, Ohrmann, Lalee-Mentzel et al. (2005) investigated the incidental learning of food and emotional words in women with AN. The authors specifically examined whether AN participants exhibited a bias for fattening foods when they are presented as task-irrelevant distracter stimuli, rather than when they are processed in depth or with reference to the self. The authors also tested whether AN patients pay less attention to emotion stimuli. A sequential word-word evaluation task was administered to 11 inpatients with AN and 11 non-dieting normal participants. There were four types of distracter words: high caloric foods, positive, negative, and neutral. AN patients recalled no more food words but fewer neutral and positive words than normal participants. The data suggest that, compared to healthy young women, AN patients show no memory bias for fattening foods when these data are presented as peripheral environmental information. The authors conclude that AN patients are perceptually no less sensitive to negative emotional information than normal participants.

To summarise, studies that have examined the existence of a memory bias for disorder salient information in eating disordered populations in an attempt to provide support for hypotheses derived from cognitive-behavioural theories of the eating disorders have provided mixed results. There is some evidence that an explicit, but not an implicit, memory bias exists for such information. However, although the existence of a memory bias is consistent with schema models of the eating disorders (e.g., Vitousek & Hollon, 1990) it is inconsistent with the parallel argument that schema representations should exert 'automatic' effects on information processing (i.e., implicit memory biases for food, body-shape and weight information) (Vitousek & Hollon, 1990). However, only a few studies have been undertaken, and existing studies have mainly employed an inadequate number of patient participants.

**3.4.5 Limitations of Cognitive Models of Eating Psychopathology.** Although information-processing and memory biases have been found in eating disordered individuals for disorder specific information, similar effects also occur in non-clinical women according to their level of eating psychopathology (Cooper & Fairburn, 1992; Eldredge, Wilson & Whaley, 1990; Huon & Brown, 1996; Rogers, 1995; Schotte et al., 1990 - see also Dobson & Dozios, 2004; Lee & Shafran, 2004 for reviews) suggesting that they share concerns about food, shape, and weight with clinical women (e.g., Green & Rogers, 1993). For example, researchers exploring the relationship between cognition and disordered eating behaviour have mostly employed the 'emotional' Stroop task. In a typical 'emotional' Stroop test, participants are presented with words of varying emotional significance, written in different coloured inks. They are required to name the colour of the word, whilst ignoring the word meaning. The longer the delay in colour-naming (i.e., Stroop interference), the (presumed) greater salience or concern to the target population of interest (MacLeod & Rutherford, 1992; McNally, Riemann & Kim, 1990). Stroop interference is obtained by selecting words relevant to the current concern of the individual(s) and matching them with neutral words. The response latency to each word or category of words indicates the degree to which the individual is attending to the word or category content, rather than the colour. An information processing bias is deemed to occur if a *slowing* of responding is observed for salient words when compared to matched neutral words, and when compared to a control population. Recent reviews of the Stroop literature have revealed considerable overlap between the concerns of clinical and non-clinical women (see Dobson & Dozios, 2004; Lee & Shafran, 2004). This is particularly important in light of the suggestion that eating psychopathology exists on a continuum, with both high and low psychopathology possible in the absence of clinical status (e.g., Herman & Polivy, 1988; Polivy & Herman, 1985, 1987; Scarano & Kalodner-Martin, 1994). However, it does call into question the utility of the emotional Stroop procedure with disorder specific content as an objective measure of cognitive disturbance with eating disordered individuals, and as a potential index of therapeutic change (Waller et al., 1996). Information-processing and memory biases in non-eating disordered women will now be reviewed.

**3.4.6 Information Processing of Disorder-Specific Information: Non-Eating-Disordered Women.** Green, Elleman, Rogers & Welch (1997) assessed information processing bias for food and body shape information in non-clinical women of high and low Drive for Thinness (DFT) (a sub-scale of the EDI-2; Garner, 1991), under one of three conditions: a photograph of chocolate, the actual presence of chocolate, and a control condition. High DFT women demonstrated an interference in the colour-naming of body shape compared to neutral stimuli when in the photograph condition. However, both high and low DFT women showed no effect for colour-naming when the chocolate was present or when in the control condition. Green et al. (1997) suggested that this lack of interference in the high DFT women may be due to anxiety aroused by the presence of a fear stimulus (i.e., chocolate) with a consequent change in processing priorities. In addition, food words were also colour-named more slowly than neutral words, but with no significant effect for condition or DFT. It was suggested that these different patterns for food and body words may reflect separable and distinct affective states.

Perpina, Hemsley, Treasure & de Silva (1993) compared anorexic, bulimic and control women for information processing on both categorical (i.e., diagnosis) and dimensional (i.e., restraint and DFT) criteria. Categorically, compared to controls, the bulimic women were slower when colour-naming body words, but the anorexic women were slower for food words. Dimensionally, when the women were classified into high and low DFT groups, the high DFT women were slower than the low DFT women when colour-naming body words. When split according to level of restraint, the high restraint women were significantly slower than the low restraint women when colour-naming food words. The different effects for DFT and restraint were thought to reflect different body and food concerns. The authors concluded that Stroop interference is not exclusive to eating-disordered women. Eating-disordered and control women who are restrained eaters with a high DFT have a similar information-processing bias for shape and eating information. Similarly, Wilson (1989) was unable to differentiate restrained eater control women from bulimic women on Stroop interference for body weight and parts, bingeing, and purging information. Long, Hinton, & Gillespie (1994) found that obese restrained eaters could not be differentiated from anorexic women on the food and body Stroop, suggesting that preoccupation with food and body size reflects a conflict within the individual, unrelated to weight or nutritional status.

Cooper & Fairburn (1992) have also suggested that attentional bias in dieting women is a function of their level of eating psychopathology or eating disorder symptomatology. Symptomatic dieters who displayed either current or prior diagnostic features of an eating disorder (AN or BN) but who failed to fulfill clinical diagnosis for an eating disorder, had a bias for weight and shape information similar to that shown by anorexic and bulimic women. In contrast, no effect occurred in normal dieters who did not display eating disorder symptomatology.

Green & Rogers (1993) have suggested that attentional bias in dieting women may be a function of dietary restraint, rather than actual dieting behaviour. These authors found significant colour-naming disruptions for food and body shape information in women with high restraint, irrespective of whether or not they were currently dieting. In contrast, there were no significant differences for low to medium restraint women.

Some researchers have suggested a *developmental onset* for interference in the food and body shape Stroop. For example, Green & McKenna (1993) found that, compared to neutral information, both food and body shape interference occurred in their sample of 14-year-old girls. In the 11-year-old girls a possible interference effect occurred for food, but not for shape information. In the 9-year-old girls no interference for either type of information occurred. However, it is not known whether the attentional changes in the girls corresponded with a change in eating attitudes, or whether any subsequent eating psychopathology developed. In a similar study, undertaken by Lattimore, Thompson & Halford (2000), significant colour-naming impairments were observed for food-related words in 12- and 14-year-old girls, in 14-year-old restrained eaters, and in 12-year-old unrestrained eaters. Participants scoring high on the DFT subscale showed significant impairments for food-related words, but did not differ significantly from those scoring low on the DFT. Therefore, in this study, restraint status influenced Stroop performance times.

The Stroop task has also been used to investigate the effects of fasting on non-clinical participants, to determine whether hunger (as a motivational state) has an effect on attentional bias and the processing of relevant information (i.e., food words). For example, Channon & Hayward (1990) found a delay in the colour-naming of food compared to control information in both males and females after 24 hours of fasting. This 'slowing' in the processing of food words was also positively correlated with subjective hunger. However, there was no effect for food words in the non-fasting state, nor for body size in both the fasting and non-fasting conditions. Lavy & Van den Hout (1993) found a similar effect after 24 hours fasting with an attentional bias for positively evaluated food stimuli. In contrast, Stewart & Samouluk (1997) found *no effect* on the food Stoop after 6 hours of fasting. Bias was associated with a high level of dietary restraint only. It was suggested that this may reflect the relatively short period of food restriction compared to those studies with longer periods of restriction (i.e., 24 hours).

The effect of dietary pre-load (e.g., high or low calorie) has also been considered using the Stroop task in non-clinical women. Evidence appears to be contradictory – with slowing effects occurring both with and without pre-load. For example, Overduin, Jansen & Louwerse (1995) have suggested that an 'appetizer' results in attentional bias for food information in unrestrained women, but in restrained women this bias occurred in both 'appetizer' and 'no appetizer' conditions. However neither condition (i.e., 'appetizer' or 'no appetizer') nor level of restraint (restrained or unrestrained) had an effect on body shape information. In contrast, Mahamedi & Heatherton (1993) found a pre-load to result in increased interference for body shape words, in both unrestrained (non-dieters) and restrained (dieters) eaters, although the effect was particularly pronounced in restrained eaters. In addition, there was no difference between the two groups of women whether pre-loaded or not for interference for either common (e.g., food, meal) or 'forbidden' (e.g., cookies, chips) food words. However, Ogden & Greville (1993) found restrained eaters (dieters) to be slower when colour-naming *both* body size and food words following a high calorie pre-load, with this slowing greater than that observed in unrestrained eaters. It was suggested that consumption of what is considered a forbidden food may increase the dieter's concern about food, shape and weight. Finally, Green, Ellman & Rogers (1996) have suggested that both restriction (18 hours deprivation) and caloric density of the pre-load (high calorie, low-calorie or water) have *no effect* on the colour-naming of food words. Rather, high self-reported hunger was associated with a smaller impairment in colour naming this information.

To summarise, the Stroop methodology has been applied with both clinical and non-clinical women. Attentional bias towards disorder salient information (e.g., food, eating, weight) has been demonstrated in both anorexic and bulimic females. Similar effects occur also in non-clinical women, according to their level of eating psychopathology. This suggests that they share concerns with clinical women. Food deprivation (i.e., short-term fasting) also appears to promote attentional bias for relevant information. Although findings in relation to pre-loading are mixed, other studies do suggest that restraint status can influence response times for relevant information. For example, conclusions arising from a very recent meta-analytic review undertaken by Dobson & Dozois (2004) suggest that patients with bulimia demonstrate an interference effect with the *food* Stroop task, relative to normal controls. However, in line with the continuum model of bulimia, when samples of dieters or restrained eaters are included, along with bulimic patients and control participants, results show a progressively shorter latency (i.e., less interference) with decreasing symptom severity, such that the difference between dieting and control groups on the food Stroop was not significant (e.g., Green & Rogers, 1993; Mahamedi & Heatherton, 1993). Whether the decreasing effects from bulimia to dieting is an effect specific to eating disorders or is a simple effect of lower symptomatology in the dieting group cannot be deduced from the existing literature. Research is required to examine the effects in different participant groups as a function of number of symptoms as a way of addressing this issue (Dobson & Dozois, 2004). As well as demonstrating commonalities between clinical and non-clinical populations in relation to attentional bias towards disorder salient information, studies also demonstrated that non-clinical women also possess memory biases for disorder relevant information similar to those observed in clinical women. This literature will now be reviewed.

**3.4.7 Memory Bias for Disorder-Specific Information: Non-Eating-Disordered Women.** King, Polivy & Herman (1991) found that restrained eaters, obese females, and women with AN recalled more food and weight-related information than appearance-related information on a free-recall task.

Also employing a non-clinical population, Barker, Williamson, & Sylve (1995) investigated recall bias for fat words, thin words, words with 'depressed' content and neutral words, in participants classified as high and low in terms of body dysmorphia. The high body-dysmorphic group demonstrated a recall bias for 'fat' words and the low dysmorphic group showed a bias for 'thin' words. In this study half of the participants were exposed to a negative mood induction procedure. This served to increase recall bias for 'depressed' words, but not for fat words in all participants. The manipulation also produced an increased body size overestimation in the high-dysmorphic group. The authors concluded that individuals with high body dysmorphia scores have negative body schemata, which allow greater elaboration of fatness words, and therefore, recall. It was further concluded that a depressed mood, induced through exposure to the mood induction procedure, triggered more general negative schemata. This finding remains to be replicated with eating disordered samples. Israeli & Stewart (2001) investigated whether females high in dietary restraint (HR) also show a later stage memory bias for forbidden food words. Contrary to prediction, HR females did not remember more forbidden food words than LR females; however, consistent with the hypothesis, females in the HR group remembered more forbidden food words than animal control words.

To summarise, a limited number of studies examining recall biases for disorder specific information have been undertaken with non-clinical populations. For participants classified as restrained eaters, results generally show enhanced recall of food, weight, and forbidden words in comparison to a control population or control stimuli. This suggests greater elaboration of these words, allowing greater recall.

The studies reviewed so far, relating to information processing and memory biases in both clinical and non-eating disordered women have focused on information *specifically* related to eating psychopathology (i.e., weight, shape). However, there is also a considerable amount of evidence to suggest that other types of information considered 'threatening' but *not* directly related to eating may require consideration in order to fully explain bulimic psychopathology (e.g. McManus & Waller, 1995). This evidence suggests that models of eating psychopathology that focus solely on maladaptive cognitions relating to food-, shape-, and weight-related information are not sufficient. Therefore this evidence will now be presented, along with additional evidence to highlight the limitations of the most influential of these models – the starvation model of bulimia

**3.4.8 Limitations of the Starvation Model of Bulimia.** Several strands of evidence exist to suggest that the starvation model is inadequate. Firstly, clinical observations have noted that bulimic behaviours can exist without starvation or purging, for example in BED (DSM-IV: APA, 1994; Pederson-Mussell, Mitchell, Fenna et al. 1997). Secondly, studies have shown that many binge eating disorder patients report that bingeing *preceded* their first attempts at dieting (e.g., Borman, Spurrell, Wilfley et al., 1997; Mussel, Mitchell, Weller et al., 1995; Spitzer, Yanovski, Wadden et al., 1993; Wilson, Nonas & Rosenblum, 1993). Thirdly, the model fails to account for the impact of other factors that have been associated within bingeing, such as dissociation[2] (McManus & Waller, 1995). Fourthly, the model fails to account for why some individuals who restrict their dietary intake go on to develop AN rather than BN. Finally, although cognitive-behavioural therapies based on this model are the most common approach to treatment (e.g., Roth & Fonagy, 1996; Wilson, 1996), treatment outcome studies suggest that the remission rates for BN are only moderate (e.g., Craighead & Agras, 1991; Fairburn, Jones, Peveler et al., 1993; Garner, Rockert, Davis et al., 1993; Keele & Mitchell, 1997; Wilson, 1999), suggesting the need for a revision of this model. For example, reviewers have found, on average, only a 50% remission rate in symptoms following a full CBT programme (e.g., Craighead & Agras, 1991; Wilson, 1995; see also Young, 1999).

Some have suggested that the effectiveness of CBT could be improved by redirecting the focus of the cognitive restructuring component of the therapy (e.g., Hollon & Beck, 1994). For example, Hollon & Beck (1994) have suggested that currently the cognitive aspect of CBT is overly restricted to specific beliefs about weight and food, and that it should be extended to consider other core concerns relating to the individual's self-worth or interpersonal problems.

In line with this suggestion, a large amount of evidence has now accumulated to suggest that emotion and threat processing (e.g. the way in which threats to the self-esteem are processed) might also be important factors in the understanding bulimic behaviours (e.g., McManus et al., 1996; Waller et al., 1995). For example, clinical accounts of the reasons for engaging in bingeing behaviours often include *emotional* antecedents, rather than appetitive ones (e.g. Cooper & Bowskill, 1986; Davis, Freeman & Solyom, 1985; Grilks, Shiffman & Carter-Campbell, 1994). Emotional antecedents to bingeing have also been reported in non-clinical populations (e.g. Lingswiler, Crowther & Stephens,

---

[2] Dissociation has been described as "a disruption in the usually integrated functions of consciousness, memory, identity or perception of the environment" (DSM-IV:APA, 1994).

1987; Ondercin, 1979; Johnson, Schlundt et al., 1995; Grilo, Shiffman & Wing, 1989; Hill, Weaver & Blundell, 1991). In addition, experimental research paradigms have identified the elaboration of emotion- and threat-related schemata in both clinical and non-clinical populations of females who binge eat (e.g., McManus et al., 1996; Waller, Quinton & Watson, 1995; Waller et al., 1996; Meyer et al. 2005). The following section reviews the evidence to suggest a role for emotion in eating psychopathology.

**3.4.9 Evidence for the Role of Emotion in Eating Psychopathology.** The association between negative mood and bingeing has been noted in clinically eating-disordered women with BN (e.g., Schlundt, Johnson, & Jarrell, 1985; Abraham & Beumont, 1982; Cooper, Morrison, Bigman et al., 1988; Lingswiler, Crowther, & Stephens, 1989; Johnson & Larson, 1982; Davis, Freeman & Garner, 1988; Mitchell, Davis & Goff, 1985; Orleans & Barnett, 1984; Powell & Thelan, 1996; Stice, 2002), and in women with BED (e.g., Kuehnel & Wadden, 1994; Johnson et al., 1995). An association between negative mood and bingeing has also been noted in *non-eating-disordered* women who self-report bingeing (e.g., Lingswiler, Crowther & Stephens, 1987; Ondercin, 1979; Johnson, Schlundt et al., 1995), in overweight or *obese binge eaters* (e.g., Schlundt et al., 1985; Arnow, Kenardy & Agras, 1992; Lingswiler et al., 1987; Webber, 1993; Werrij, Mulkens, Hospers, & Jansen, 2005), in *dieters* and *restrained eaters* (e.g., Grilo, Shiffman & Wing, 1989 – see also Chapter 2 of this thesis), and in *food cravers* (e.g. Hill, Weaver & Blundell, 1991).

Although eating has been reported to occur in response to *unlabelled* arousal (Slochower, 1976 - see Section 2.4.3), *specific* negative moods (e.g., depression, boredom, anger, loneliness, anxiety, frustration, tension, irritability and self-disgust) have been reported to trigger a binge episode (e.g., Mizes, 1985; Cooper & Bowskill, 1986; Johnson-Sabine et al., 1984; Johnson, Stuckey, Lewis & Schwartz, 1982; Pyle, Mitchell & Eckert, 1981; Ondercin, 1979; Mitchell et al., 1985; Abraham & Beumont, 1982; Johnson & Larson, 1982; Leon, Carroll, Chernyk & Finn, 1985). Further, Waller, Babbs, Milligan et al. (2003) have reported a relationship between anger and unhealthy core beliefs and eating pathology in clinical women. In this study 140 women who met DSM-IV criteria for eating disorders, and 50 female control participants were compared. Results showed that the eating-disordered women had higher levels of state anger and anger suppression, particularly if the diagnosis included bulimic symptoms. Unhealthy core beliefs were associated with higher levels of trait anger in both groups, but with anger suppression in the clinical group only.

Some have reported that the *intensity* of mood is unrelated to binge severity (e.g., Lingswiler et al., 1987), whereas others have reported that a more severe negative mood state is associated with a greater estimated food intake (e.g., Gleaves, Williamson & Barker, 1993). Mood *change* has been reported to occur both during and after the binge. Kaye, Gwirtsman, George et al. (1986) reported that bingeing alleviated dysphoric mood (anxiety and depression) *temporarily* in bulimic women. Alleviation of anxiety *during* the binge was reported by 50% of the women, and by 67% *after* the binge. However, some women reported remaining depressed during and after both bingeing and purging. These results highlight the existence of individual differences in temporal variability in mood across the binge period.

Support for the effect of food intake on mood is provided by Ondercin (1979). Ondercin (1979) reported that compulsive eating was positively and significantly correlated with the endorsement of the statement 'eating seems to calm me down or make me feel better' ($r$ =.60). However, Macdiarmid & Hetherington (1995) found that, compared to control women, self-identified female chocolate 'addicts' rated depression, guilt and craving as higher, and feeling content and relaxed lower, before consuming chocolate. However, after eating chocolate the 'addicts' reported increased guilt, but no change in feelings of depression or relaxation (see also Section 2.8.3).

**3.4.10 Mood and Bingeing: Eating Disordered Women.** Abraham & Beumont (1982) noted that negative emotions often precipitated periods of what was described as 'out of control, ravenous overeating' in a group of 32 patients with BN. Prior to bingeing, all patients reported feeling anxious and tense. Negative states included: tension (91%), being alone (78%), and feeling bored and lonely (59%). Less frequently cited precipitants were of an interpersonal conflict nature (e.g., arguments with parents, boyfriends, and husbands). Similarly, in a sample of 275 females with BN, Mitchell et al. (1985) reported that reasons for bingeing included feeling tense or anxious (83%) and unhappy (67.3%), with the majority of bulimics reporting a binge to be triggered by *several* mood or appetitive cues.

Emotional triggers to bingeing in BN have also been suggested by Johnson et al. (1982). In a self-selecting sample of 316 females, 40% reported 'difficulty in handling specific emotional' as a precipitant to bingeing. The emotions most frequently reported were: depression, loneliness, boredom, and anger. A prospective study of 15 bulimic patients undertaken by Waters, Hill & Waller (2001) revealed that cravings leading to a binge were associated with higher tension, lower mood and lower hunger than those cravings not leading to a binge. Levels of tension and hunger were found to be critical discriminating variables. Grilo et al. (1994) found that either appetitive or emotional states can account for bingeing in BN. They found little consistency *within* individuals, suggesting that individuals binge for different reasons at different times.

Davis, Freeman & Garner (1988) found that bulimics reported relatively negative mood states prior to bingeing, compared to their affective state prior to consuming a 'normal' meal. Wiseman et al. (1998) asked participants to record *specific* thoughts and emotions on a hand-held computer. They were also asked to record any situational data that might have precipitated or followed a binge at regular recording intervals. Results showed that, prior to bingeing, participants reported an increase in feelings of depression, anger, helplessness, feelings of inadequacy, anxiety and feelings that they were 'put-upon' (relative to matched control times). Bulimics were also found to feel more guilty following a binge, but experienced fewer of the aforementioned negative emotions following a binge. The authors concluded that negative affective states are important factors in triggering *and* maintaining binge-eating behaviour. Steiger, Gauvin, Jabalpurwala et al. (1999) found that binge episodes were preceded by negative social interactions, as well as increased self-criticism and negative mood. Finally, Laberg, Wilson, Eldridge & Nordly (1991) reported both enhanced attention to pictures of food and an increase in cravings in bulimic patients when they experienced negative affect.

Binge eating has also been associated with negative emotions in women with BED (e.g., Kuehnel & Wadden, 1994 Johnson, Schlundt, Barclay et al., 1995; Kenardy, Arnow & Agras, 1996; Grave, Todisco, Olkiosi & Marchi, 1996; de Zwaan, 1997). Kuehnel & Wadden (1994) found women with BED to be significantly more likely to eat when experiencing negative emotions than were non-bingeing women. Eldredge & Agras (1996) have suggested that both obese men and women with BED were more likely to eat in response to negative moods than were controls. Furthermore, women with BED have been shown to be more likely to label *subjectively* an episode of overeating as a binge when in a negative mood (Telch & Agras, 1996). In a naturalistic self-monitoring study, Wiseman, Wilfley, Kenardy & Arnow (1998) found that in women with BED, binge episodes were reported to be triggered by how they felt 50% of the time. Prior to a binge these women also reported feeling significantly more depressed, angry, put-upon, inadequate, helpless and anxious, compared to a non-binge period. Finally, in a study employing females with binge eating disorder (BED), Agras & Telch (1998) found that both negative mood and calorific deprivation each play a role in triggering objective binge-eating episodes in females with binge eating disorder (BED), while negative mood alone was critical in determining self-defined binges.

Werrij, Mulkens, Hospers, & Jansen (2005) investigated whether the presence of depressive symptoms in *overweight* and *obese* people was related to increased specific eating psychopathology and decreased self-esteem. Overweight/obese people seeking dietary treatment were grouped according to their scores on the BDI (Beck, Ward, Mendelson et al., 1961). This resulted in a mildly to moderately depressed group (N = 66 – the symptomatic group) and a non-depressed group (N = 83). Eating psychopathology was measured using the EDE-Q (Fairburn & Beglin, 1994), and self-esteem was assessed with the Rosenberg Self-Esteem Scale (Rosenberg, 1979). Results revealed that the symptomatic group had more shape, weight, and eating concerns; scored higher on restraint, had lower self-esteem, and had a higher BMI than non-depressed people. Furthermore, the percentage of bingers was higher in the symptomatic group. The authors concluded that dieticians treating overweight and obese individuals should identify subgroups with depressive symptoms, as this group was at greater risk for eating psychopathology.

**3.4.11 Mood and Bingeing: Non-Eating Disordered Women.** Negative affect has also been associated with bingeing in non-eating-disordered women. For example, Striegel-Moore, McAvay & Rodin (1986) found that in non-clinical women subjective reporting of 'feeling fat' was associated with eating in response to external stimuli and negative emotions. Crowther, Lingswiler & Stephens (1984) have suggested that amongst binge eating female undergraduate students, negative moods were experienced during a significantly greater proportion of binge episodes than non-binge episodes. Grilo et al. (1994) found that the majority of binges (84%) in normal weight non-purging binge eating women were precipitated by negative affect. Of this negative affect, the most intensely rated moods were frustration and tension. A cluster analysis further revealed the two main bingeing antecedents to be solitary negative affect, and social eating, with solitary negative affect a trigger in 87% of binges. However, it was suggested that negative affect in conjunction with being alone was pivotal in triggering a binge.

Ondercin (1979) has suggested a similar relationship between unpleasant affect (anxiety, depression, boredom, loneliness and anger) and compulsive eating in college women. Items correlating with compulsive eating included: 'I eat when I'm tense or anxious' (r = .35), and 'I eat when I'm sad or depressed' (r = .39). On splitting the women into high, medium and low compulsive eater groups (based on their response to the question 'would you label yourself a compulsive eater?'), the high compulsive eater women were found to eat significantly more frequently in response to unpleasant emotional states than either the medium or low group women. From a slightly different perspective, Wolf & Crowther (1983) have suggested that the amount of stress experienced is a significant predictor of bingeing in both normal weight and overweight women.

Wolff, Crosby, Roberts, & Wittrock (2000) investigated differences between 20 college women who reported binge eating at least two times per week and 20 women who reported no disturbance in their eating. They were asked to self-monitor their daily stress, coping, mood, and eating behaviour for three weeks. Results indicated that the binge group reported more stress and negative mood over the three weeks than the control group. The binge group reported experiencing a similar number of stressful events on binge days compared to non-binge days, however, the impact of those events was much greater on binge days. The binge eaters also reported less positive mood and more episodes of eating on binge days.

Bekker, van de Meerendonk, and Mollerus (2004) demonstrated that negative affect substantially influences self-perceptions in terms of emotional eating. Female college students (N=84) were divided into 2 groups (relatively high or low impulsivity) using a median split on the Barratt Impulsivity Scale (BIS-11). They were thereafter randomly assigned to either a negative (quiz questions with the preceding instruction that it was of extreme importance that they do very well, accompanied by negative feedback post task) and neutral condition (a quiz, with no preceding information and no feedback). The difference between self-perceived emotional eating (a subscale of the DEBQ (van

Strien, Frijters, Bergers, & Defares, 1986) before and after mood induction was assessed as a dependent variable. Results showed that negative affect enhanced the level of self-perceived emotional eating significantly. There was no statistically significant effect of impulsivity. The interaction effect of impulsivity approached significance ($p = 0.08$), suggesting that highly impulsive participants were more strongly influenced by negative affect in self-perceived emotional eating compared to participants low in impulsivity.

Crowther, Sanftner, Bonifazi & Shepherd (2001) investigated the relationship between daily hassles and the frequency and caloric intake of eating episodes among normal-weight women who engage in bingeing and those who do not. Participants self-monitored their food intake during the day and completed the Hassles Scale (DeLongis, Folkman, & Lazarus, 1988) each evening before retiring. Results indicated that women who engage in binge eating rated daily hassles as significantly more stressful than women who do not binge. Also, women who engage in binge eating consumed significantly more calories on those days characterized by higher as opposed to lower levels of stress.

Finally, in a study employing a non-clinical population, Rofey, Corcoran, & Tran (2004) suggest that dysphoric mood may moderate the relationship between high bulimic tendencies and bias towards threat. These researchers employed a computer driven emotional Stroop task containing food-related, neutral and colour words with 165 undergraduate students. Participants were classified as possessing high or low risk for disordered eating using the BULIT-R; Thelen, Farmer, Wonderlich, & Smith, 1991). Their hypotheses were that individuals at (high) risk for disordered eating would remember more food-related words following the Stroop task, and that current mood would function as a moderator of the relationship between bulimic symptoms and Stroop reaction time. Specifically, individuals high in disordered eating symptoms, who also possess a current negative mood state will have *slower* reaction-times to appetitive words than negative-mood females who are low in disordered eating symptoms. A similar relation between bulimic symptoms and reaction time was *not* predicted for individuals with a current *positive* mood.

A statistically significant interaction effect between bulimic symptoms and negative mood was found on food-related reaction time. Post hoc analysis of the interaction showed that females endorsing more bulimic symptoms responded slower to food-related cues than females with fewer bulimic symptoms among individuals who reported negative mood. Thus, the association between bulimic symptomatology and reaction times on the Stroop task was moderated by negative mood state.

Negative affect and *food craving* also appear to be associated (e.g., Weingarten & Elston, 1990) Weingarten & Elston (1990) have suggested that carbohydrate intake has a rewarding effect on anxiety, physical discomfort and subjective mood. Hetherington & Macdiarmid (1993), in a study involving self-identified 'chocoholics', found that craving for chocolate in 52% of cravers was associated with negative mood states (e.g., stress and depression). Hill et al. (1991) reported that food craving was significantly correlated with emotional eating in non-clinical women, with cravers eating in response to negative moods.

In considering whether binge eating occurred a result of hunger or an emotional state in bulimic women, Waters, Hill & Waller (2001) found that cravings which resulted in a binge were characterized by significantly lower hedonic tone (i.e., more feelings of depression, sadness and dissatisfaction) than those cravings that did not lead to a binge episode. Cattanach et al. (1988) found that compared to controls, women with a high level of disordered eating had a significantly greater desire to binge following mood manipulation resulting from stressors related to interpersonal conflict and social interaction in women with eating disorder symptomatology, compared to a control group. It is also possible that the link between emotional eating and eating psychopathology may be relative to Western culture. Waller & Matoba (1998) found emotional eating to occur in British women living in the UK but not in Japanese women living in Japan, although Japanese women living in the UK showed an intermediate pattern.

Dieters have also been found to relapse when experiencing negative moods. Grilo et al. (1989) have suggested that 49.5% of relapses in their sample of dieters occurred in the presence of negative affect (e.g., anxiety, depression and anger), and with crises associated with eating being attributed to negative affective states in 91% of cases. Moreover, this effect may be particularly associated with very low calorie diets (Wing, Shiffman, Drapkin et al., 1995). Hill, Weaver & Blundell (1990) report that in both 10-year-old girls and their mothers, high restraint coupled with negative mood is associated with disinhibited eating. In addition, several naturalistic (see Section 2.7.2) and laboratory studies (see Section 2.7.3) suggest a strong association between stress or negative affective states and overeating when females are classified as restrained eaters. In particular, stress manipulations that threaten the individual's emotional stability or self-esteem (ego-threat) appear to be particularly potent in relation to the disinhibition of dietary restraint.

Other experimental studies have shown a similar association between binge eating and negative emotions in non-clinical women with significant bulimic symptoms. Studies undertaken by Patton (1992) and Waller and colleagues (Waller & Mijatovich, 1998; Meyer & Waller, 1999) have demonstrated that subliminally presented emotional cues can induce greater levels of eating in non-clinical women. It is believed that such eating is a response to the activation of specific core schemata. For example, Patton (1992) demonstrated that women with bulimic attitudes who were exposed to subliminal abandonment cues consumed significantly more in a subsequent taste discrimination task than did those who were exposed to a neutral cue, or those with less pathological eating attitudes.

Waller & Mijatovich (1998) examined the role of different forms of threat cues in generating eating behaviour among non-clinical women with more or less healthy eating attitudes. Sixty non-eating-disordered women, divided into those with relatively high and low Eating Disorder Inventory (EDI) scores were exposed to an ego (self-esteem) threat, a physical threat, or a neutral message. Each message was presented subliminally via a tachistoscope, and the amount eaten subsequently was measured. Results showed that women with healthy eating attitudes ate slightly more after exposure to the ego threat, but not after the physical threat. Women with unhealthy eating attitudes ate more after exposure to both forms of threat, but particularly after the ego threat. These studies suggest that eating can be provoked through the activation of preconscious emotional structures (schemas). Waller & Mijatovich suggested that pre-conscious activation of elaborate threat-related schemata occurs in women with unhealthy eating attitudes causing an 'escape' response (i.e., overeating).

Meyer & Waller (1999) found that women who had avoided food for at least four hours, and who were then exposed to a subliminal abandonment cue ('lonely') consumed significantly more than those exposed to either a neutral ('gallery'), positive emotional ('happy') or appetitive ('hungry') cue. In addition, those women with more unhealthy eating attitudes also consumed more following exposure to a hostile emotion ('angry') than neutral cue. The authors suggested that eating behaviour was due to negative emotional stimulation, rather than general emotional arousal, supporting cognitive models whereby 'threat' facilitates eating (e.g., Heatherton & Baumeister, 1991), as opposed to models that focus primarily on food-related schemata (e.g., Fairburn & Cooper, 1989).

A study by Meyer & Waller (2000) examined whether the presentation of subliminal abandonment and food/shape cues resulted in the activation of abandonment-related or food-related schemata. Eighty-two women were exposed to one of three subliminal cues – an abandonment cue ('lonely'), an appetitive cue ('hungry'), and a neutral cue ('gallery'). They subsequently completed Stroop tasks to measure activation of relevant schemata. Results showed that subliminal presentation of abandonment cues led to the activation of food- and shape-related schemata. In contrast, subliminal appetitive cues led to the activation of abandonment-related schemata. These results suggest an indirect link between subliminal cue type and the activation of eating-related cognitions.

To summarise, negative emotional states (e.g., stress, anxiety, tension, depression) have been associated with bingeing in both eating-disordered and non-eating-disordered women who report binge eating, with these negative states thought to trigger the binge. The association between binge eating and negative emotions has also been demonstrated in both naturalistic studies and in the laboratory by researchers employing mood manipulation procedures with non-clinical individuals (mainly females) classified as restrained eaters. In particular, manipulations that involve the *perception* of ego-threat (i.e., threat to self-esteem and emotional stability) by the participant (e.g., Heatherton et al., 1991; Heatherton, Polivy & Herman, 1991) or that include ego-threat stimuli (Lattimore, 2001; Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004) have been found to be particularly potent in disinhibiting the eating of dieters, restrained and emotional eaters (see also Sections 2.7.11 and 3.8).

This is particularly interesting, when coupled with research evidence suggesting that both bulimic women *and* non-clinical women with significant bulimic symptoms display an *attentional bias towards* self-directed ego threat information (threat information that does not directly reflect eating pathology), when the task employs primarily *automatic processing* (i.e., the 'emotional' Stroop task) (McManus, et al., 1995; McManus, et. al., 1996; Waller et al., 1996). This research evidence simultaneously highlights the inadequacies of the starvation model and provides support for the argument that specific types of 'threat' are important for a more complete understanding of eating psychopathology, and will therefore now be reviewed.

In a series of Stroop task studies, McManus and colleagues (McManus, et al., 1995; McManus, et. al., 1996; Waller et al., 1996) considered the processing of five *specific* types of 'threat' that were considered to be relevant to the eating disorders, but *not* specifically related to food, eating, weight or shape. These words were: autonomy, sociotropy, discomfort anxiety or physical threat, ego threat from self and ego threat from others. These 'threats' were based on theoretical models of psychopathology (e.g., Beck 1983) and subsequently operationalized by McManus and colleagues (McManus et al., 1996; Waller et al., 1996) as follows: autonomy involves threat to personal control (e.g., manipulated, controlled), sociotropy reflects isolation, dislike or rejection by others (e.g., rejected, alone), discomfort anxiety or physical threat infers potential harm or loss of physical integrity (e.g., pain, hurt), ego threat from self reflects self criticism (e.g., failure, ugly) and ego threat from others involves criticism from other people (e.g., insulted, ridiculed).

**3.4.12 Automatic Processing of Non-Eating Related Information: Eating-Disordered Women.** McManus et al. (1995; 1996) found that bulimic women demonstrate an attentional bias and interference in colour naming of all five types of 'threat' (i.e., autonomy, sociotropy, discomfort anxiety, ego threat from self and ego threat from others) compared to matched neutral information. Furthermore, differences between bulimic and non-eating-disordered control women have also been found. For example, McManus et al. (1996) found bulimic women to be significantly slower than control women to respond to 'threats' relating to autonomy, discomfort anxiety and ego threat from self, although no differences occurred between the two groups for sociotropy and ego threat from others. In bulimic women, attentional bias towards ego threat from self has been found to correlate positively with both bingeing and vomiting (McManus et al., 1995, 1996a). A similar relationship has also been shown for bias towards the threat 'autonomy' with bingeing (McManus et al., 1996). Thus, an association appears to exist between bulimic characteristics and self-directed ego threat.

**3.4.13 Automatic Processing of Non-Eating Related Information: Non-Eating-Disordered Women.** Non-eating-disordered women have also demonstrated a *slowing* of response when colour-naming sociotropy, ego threat from self (McManus et al., 1996a) and discomfort anxiety (McManus et al., 1995; Waller et al., 1996) threat stimuli compared to matched neutral information. Greater attentional bias has also been associated with greater levels of eating psychopathology. A high level of bulimic attitudes in non-clinical women has been associated with significantly *slower* colour-naming latency for sociotropy, discomfort anxiety and ego threat from self compared to matched neutral information (Waller et al., 1996). These latter authors also found an attentional bias for ego threat from self to correlate with Bulimia, Social Insecurity and Ineffectiveness sub-scales of the EDI-2 (Garner, 1991). In addition, on splitting the women into high- and low-bulimia groups, the high-bulimia women had a greater attentional bias to self-directed ego threat only. A similar relationship between ego threat from self and the Bulimia sub-scale of the EDI-2 has also been suggested by McManus et al. (1995) in relation to non-eating-disordered women.

Considering a non-clinical population of female dieters and non-dieters, Quinton (1998) tested the prediction that a higher level of bulimic attitudes would be associated with an attentional bias to general 'threat' information, unrelated to eating (e.g., harm, maim, fear). Using a card Stroop task, colour-naming interference times were positively and significantly associated with the level of bulimic attitudes in dieters only.

To summarise, employing a task that demands primarily an automatic processing of information, researchers have demonstrated an attentional bias towards specific 'threat' stimuli that is unrelated to eating in both clinical women with BN and in non-clinical women with more bulimic characteristics, with self-directed ego-threat appearing particularly significant. Researchers have also investigated the processing of specific 'threat' stimuli, unrelated to eating with both clinical and non-clinical populations, when words have been incorporated within tasks that demand more *strategic* processing of information. A slowing of responding obtained for stimuli contained with a task that demands primarily automatic processing is interpreted as an *attentional bias towards* the salient information. A slowing of responding obtained for stimuli contained with a task that demands primarily strategic information processing is interpreted as *cognitive avoidance* away from the salient information.

**3.4.14 Strategic processing of Non-Eating Related Information: Eating-Disordered Women.** A very recent study, conducted by Meyer et al. (2005) demonstrated cognitive avoidance in the strategic processing of ego threats among women with bulimic characteristics. Participants in this study were 50 eating-disordered women and 50 non-clinical women. Of the eating disordered patients, 13 were diagnosed as suffering from restrictive anorexia nervosa, 15 met the criteria for anorexia of the binge/purge subtype, and 22 were diagnosed as having bulimia nervosa. Participants were required to complete 18 anagrams that included food words (cake, corn, rice, beef, milk, and malt), ego threat words (alone, fail, dull, dumb, lonely, and empty) neutral words (your, hole, glow, hope, view, and clip). Results showed no significant difference between groups in the times taken to solve the neutral word and food word anagrams. However, there was a significant difference in the mean solution times for the threat word anagrams. The bulimia nervosa group took substantially longer than the comparison group, whereas the restrictive and bulimic anorexic women scored between these two groups. Post-hoc tests showed that the only significant difference was between the bulimia nervosa and comparison groups. Further, the overall significant difference in speed of threat word processing was a product of significant differences in the women's speed of solving four of the six ego threat anagrams (alone, dull, fail, and dumb). Each of those differences was a specific result of the bulimia nervosa group taking significantly longer than the comparison women to solve the threat words. Moreover, cognitive avoidance was associated with the presence of specific bulimic behaviours.

In the case of bingeing and vomiting, post-hoc tests showed that the women who displayed the symptoms took significantly longer to solve the threat word anagrams than either of the other two groups (with no significant difference in solution times between those other two groups). In the case of laxative abuse, the two groups of eating disordered women were slower to solve the threat anagrams than the comparison group, but there was no significant difference between the clinical women who did or did not display the symptom. Analyses were also undertaken to ascertain whether an association existed between cognitive avoidance and the severity of bulimic symptoms and attitudes. Solution times for the three categories of anagrams were correlated with the three EDI scales (Eating Disorder Inventory: Garner, 1991) reflecting attitudes towards eating, shape, and weight (Drive for Thinness, Body Dissatisfaction, Bulimia) for each group, and with the reported frequency of bingeing and vomiting in the bulimic group (binge/purge anorexics and bulimia nervosa patients). Results showed that among bulimic patients, the following associations were significant: positive associations of the level of bulimic attitudes with the processing of food and threat material;

positive associations of neutral anagram solution times with drive for thinness and binge frequency; and a negative association of threat anagram solution with body dissatisfaction. These findings suggest cognitive avoidance of both threat-related and food-related information where bulimic attitudes are more severe. The association between the processing of neutral material and binge frequency suggests a general slowing of information processing (cognitive-behavioural avoidance) among women who binge more frequently.

**3.4.15 Strategic processing of Non-Eating Related Information: Non-Eating Disordered Women.** In a study undertaken by Waller, Quinton & Watson (1995) non-clinical females with a higher level of bulimic eating attitudes were exposed to either a threat or neutral word, displayed on a computer screen. They were then asked to decide whether the stimulus cue originally shown was present in an array of 16 words displayed subsequently. Results showed that women with more bulimic attitudes were slower to respond to threatening than neutral words, while there was no such effect for the women with less bulimic attitudes.

Another such study, undertaken by Waller & Meyer (1997) found that in non-eating-disordered women, the time taken to solve both food (e.g., cake, milk) and 'threat' (e.g., fall, pain) anagrams was positively correlated with 'ego development' characteristics (i.e., EDI-2 sub-scales Interpersonal Distrust, Interoceptive Awareness, Maturity Fears, Asceticism and Social Insecurity) rather than eating characteristics (e.g., Drive for Thinness). Thus, women with these characteristics appeared to be slower when processing information relating to food and 'threat'. Part two of their study involved both non-eating-disordered males and females. Results showed that the time taken to solve physical threat (e.g., agony, wound) and ego threat from others (e.g., spurned, rejected) anagrams was not correlated with any of the EDI-2 sub-scales. However, the time taken to solve ego threat from self anagrams (e.g., defeated, failure) was positively correlated with 'ego development' characteristics (i.e., EDI-2 sub-scales Ineffectiveness, Interpersonal Distrust, Interoceptive Awareness, Social Insecurity). Therefore, women with these characteristics appeared to be slower when processing information related to self-directed ego threats.

To summarise, employing tasks that demand the strategic processing of information, researchers have demonstrated cognitive avoidance of threat that is unrelated to eating in both clinical women and in non-clinical females with bulimic characteristics. These studies also suggest that self-directed ego threat is important in the understanding of eating psychopathology. Although researchers have demonstrated both attentional bias towards and cognitive avoidance of 'threat' that is unrelated to eating using tasks that demand the primarily automatic versus strategic processing of information respectively, Meyer & Waller (1997) suggest that the two processing types are interconnected.

Drawing on Beck & Clark's (1997) model of information processing in anxiety, Meyer & Waller (1997) hypothesize a temporal pattern of cognitive responding, whereby an initial hyper vigilance and orientation towards threat occurs in the first instance, followed by cognitive avoidance of threat once the threat information enters full conscious awareness. 'Threat' is thought to be reduced by intrapsychic mechanisms (e.g., dissociation). Thus, attentional bias and cognitive avoidance may be dependent upon the specific demands of the task utilized. In a task that demands the fully automatic (i.e., subliminal processing task) or primarily automatic (i.e., the emotional Stroop task), attentional bias or orientation towards threatening information may be evident. However, in tasks requiring the active processing of the threatening stimulus (e.g., anagram solution task), an avoidant coping strategy may be adopted. Support for the assertion that an initial attentional bias towards threat maybe followed by a later avoidance process comes from a study undertaken by Meyer, Waller & Watson (2000), employing a non-clinical sample. This study allowed for temporal factors to be considered. Fifty female students completed a computer-driven threat processing task, that assessed the speed of processing of self-directed ego threat words following different inter-stimulus intervals of 500, 1,000, 1,500 and 2,000 ms. Results showed that the women were significantly slower to process ego-self threat cues following the 2,000-ms interval than following the other intervals. Those women with increased levels of bulimic attitudes (assessed using the EDI) were slower to process threats following the 1,500-ms interval, but not after the longer or shorter intervals. These results suggest a pattern of cognitive avoidance that increases over time, when individuals have a greater length of time to process the information.

Having provided a multitude of evidence to suggest that negative emotional states are associated with bingeing in both clinical and non-clinical women, it is necessary to understand *how* these states may affect (over) eating. The following section therefore provides an outline of models that have described the *function* that bulimic behaviours serve for the individual. Focus will be given to 'escape' models, particularly those suggesting that bingeing results as a consequence of 'cognitive narrowing' in order to reduce awareness of negative emotional states.

**3.5 Functional Models of Binge Eating**. The 'blocking' model (e.g., Lacey, 1986; Root & Fallon, 1989) asserts that bulimic behaviours serve the *direct* function of reducing awareness of uncomfortable affective states. Lacey (1986) implicates three major *external* precipitating traumas in the development of BN: sexual conflict, major life changes, and loss. Maintenance factors involve three possible functional roles for food. Firstly, food may act as an emotional stimulant to relieve a deficient emotional arousal state. Secondly, food may be a physical stimulus. Finally, in an aroused emotional state, bingeing may act as a sedative, reducing or avoiding negative emotions (e.g., anxiety).

Root & Fallon (1989) emphasised the role of past or present victimisation experiences as the external trigger to bulimic behaviours, with food serving as a coping mechanism to alleviate bad feelings. However, neither model specifies the *process* by which this reduction in awareness is achieved (McManus, Waller & Chadwick, 1986).

In contrast to the models proposed by Lacey (1986) and Root & Fallon (1989), the model proposed by Heatherton & Baumeister (1991) (see also Section 2.9) suggests that bingeing *indirectly* moderates the negative affective state via the process of 'cognitive narrowing' (a purposeful shift to low levels of awareness) to reduce awareness of emotional states. *'Escape from self-awareness'* occurs through the blocking of cognitions (negative emotions) and a narrowing of attention to the immediate stimulus environment. The individual's lower level of self-awareness enables avoidance of meaningful thought. The narrowing of attention disengages the normal inhibitions against eating and also allows an uncritical acceptance of irrational beliefs and thoughts. This leads to disinhibition. This lowering of awareness and blocking of cognitions is similar to the concept of *dissociation*. Dissociation is associated with bulimia in both clinical (e.g., McManus, 1995) and non-clinical women (e.g., Everill, Waller & Macdonald, 1995).

To summarise, bulimic behaviours may be an attempt to reduce awareness of intolerable emotional and cognitive states, such as anxiety, anger, interpersonal conflict, and threats to the individual's self-esteem. Such perceived threat may result from internal processes (e.g., negative self-appraisal) or externally from an actual traumatic event (e.g., loss or victimisation). This suggests that individuals with bulimic attitudes use a defensive style of 'escaping from self-awareness'. The cognitive and emotional pattern of reducing awareness whilst under severe perceived threat is similar to the 'primitive' defence mechanism of dissociation that is characterized by a lack of integration of experiences. The use of emotional blocking behaviours (such as bingeing) can be understood as a form of avoidant coping (see also Section 4.3.3) or *cognitive avoidance* (e.g., Neckowitz & Morrison, 1991; Young, 1991; 1999). Evidence for the existence of cognitive avoidance of threat is also in line with the schema-based cognitive-behavioural model of eating psychopathology devised by Young (1990,1999).

**3.6 Young's Model of CBT.** Young and colleagues (1990; 1999) developed schema therapy to treat patients with chronic characterological problems who were not being adequately helped by traditional cognitive-behavioural therapy: the "treatment failures" (see Young, Klosko, & Weishaar, 2003). The model combines cognitive, behavioural, attachment, object relations, and experiential approaches, resulting in an integrative, unifying theory underpinning treatment of Axis I disorders.

Young defined a subset of schemas that he labelled 'early maladaptive schemas', that are developed during childhood or adolescence, and elaborated throughout one's lifetime. According to this model, maladaptive schemas can be described as a broad, pervasive theme or pattern comprised of memories, bodily sensations, emotions and cognitions regarding oneself and one's relationship with others, that are dysfunctional to a significant degree. The patterns are said to be deeply entrenched and central to one's sense of self (usually self-perpetuating). Schemas include Abandonment/Instability, Mistrust/Abuse, Emotional Deprivation, and Defectiveness/Shame. These are dimensional, meaning they have different levels of severity and pervasiveness. The more severe the schema is, the greater the number of situations that activate it. Maladaptive behaviours develop as a response to schemas. Thus, behaviours are driven by schemas, but are not part of the schemas (Young et al., 2003).

Individuals engage in a number of strategies to avoid triggering their maladaptive schemas. Knowing what these strategies are is important, as information-processing models of eating pathology suggest that they play a major role in the maintenance of pathology. Strategies adopted as a common response to threatening stimuli, because of low tolerance of negative emotional states, include cognitive avoidance, escape from awareness and dissociation.

A number of empirical studies have provided evidence to suggest that core beliefs and schema are important cognitions to be considered if a comprehensive understanding of eating disorders is to be developed (for reviews see Cooper, 1997; Cooper, 2005; Waller, Kennerley, & Ohanian, 2005). A newly developed cognitive model of bulimia, introduced by Cooper, Wells, & Todd (2004), acknowledges the role that negative emotions might play in the maintenance of the binge-purge cycle. The model also incorporates more recent developments in cognitive therapy such as the role of core beliefs and schema processes (the content of schema; Beck & Freeman, 1990), including avoidance and compensation (Young, 1990) in the understanding of eating pathology.

A very recently developed schema-based model of the eating disorders (Waller, submitted for publication – see Mountford, Waller, Watson & Scragg, 2004) suggests that similar dysfunctional core beliefs (developed from early life experiences) exist across different eating disorders, but that restrictive and bulimic pathologies differ in the schema *processes* involved. It is suggested that *restriction* is characterized by the use of cognitive and behavioural strategies to avoid negative emotion being triggered (primary avoidance of affect). Bulimia is characterized by the use of such strategies once the emotion has already been triggered (secondary avoidance of affect).

Preliminary evidence for this model of restrictive pathology comes from studies employing questionnaire methodology. For example, Luck, Waller, Meyer, & Lacey (submitted for publication – see Mountford et al., 2004) have shown that anorexic patients show greater levels of schema compensation (primary avoidance of affect) than do BN patients or non-clinical controls. However, in an attempt to provide causal evidence for the model, Mountford et al. (2004) conducted an experimental study designed to provide support for such an assertion. It was predicted that AN participants (restrictive sub-type) would engage in the compensatory behaviour of oversearching for an absent cue (used as an index of perfectionism) on a computer-based search task following subliminal presentation of threat cues featuring abandonment stimuli, when compared to bulimics and controls. The following cue types were used: neutral (gallery), negative affect (lonely, angry, ashamed), positive affect (happy), and appetitive (hungry). The results did not fully support the hypothesis. Although there was no difference in oversearching times following the different cue types, the groups did differ in their responses to different cues in terms of accuracy rates. The restrictive anorexia group made more errors in searching for the target when it was absent, but only following the abandonment cue ('lonely'). Thus, in this study the results did not fully support the hypothesis, and improvements to the methodology are discussed (Mountford et al., 2004).

### 3.7 Chapter Summary

It has been suggested that existing cognitive models of eating psychopathology, and the therapeutic techniques based on these models, are deficient in that they have focused on the relatively superficial automatic thoughts, cognitive distortions, and underlying assumptions relating to food, shape and weight, resulting in low remission rates. Some authors have argued, therefore, that a more schema-focused approach is necessary in order to target deeper levels of cognition relating to early maladaptive schemas. Some evidence for a schema-based model is derived from research results suggesting that women with bulimic attitudes display a more general bias towards, and a cognitive avoidance of threatening information that is unrelated to eating. In this respect, self-directed ego threat appears to be of particular importance. In addition, the literature reviewed suggests that many aspects of pathology may be shared dimensionally with the normal population. A review of the literature suggests many commonalities between women with BN, non-clinical women with bulimic tendencies, and restrained and emotional eaters who overeat in the laboratory as a consequence of exposure to tasks designed to alter mood and create a stress response. More specifically, experimental studies have revealed information processing and memory recall biases for disorder specific information (food, body shape, weight) in both clinical and non-clinical women. Experimental studies have also revealed an attentional bias towards, and a cognitive avoidance away from 'threat' stimuli that is unrelated to eating.

It has been suggested that newer schema-based models of eating pathology may be relevant not only to understanding the eating pathology of clinical eating-disordered patients, but also to understanding the full spectrum of disordered eating patterns (e.g., Stewart & Samouluk, 1997). This may be especially the case for females classified as restrained eaters. Within the laboratory the 'emotional' Stroop task, incorporating ego-threat stimuli, has been successfully employed to trigger a significant increase in self-reported anxiety and overeating in dieters classified as binge-eaters according to the Bulimia test (BULIT-R: Smith & Thelan, 1984), in comparison to a general stressor (a fearful film) (Lattimore, 2001), and in restrained and emotional eaters (Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004) using test-meal paradigms. However, the designs of existing studies that have employed the ego Stroop task as a laboratory stress manipulation have not allowed for a) a between groups comparison of response times or interference effects for ego-threat stimuli, or b) a within subjects comparison of response times or interference effects for threat and matched neutral words. Neither have existing studies included measures of habituation effects over several trials of the Stroop task, or memory bias for ego-threat stimuli. In addition, measures of physiological and biological reactivity are very rarely obtained in studies that have assessed the relationship between emotion and bingeing, and no studies to date have simultaneously employed the ego-threat Stroop task in conjunction with psychophysiological measurements in non-clinical women with both restrained and bulimic eating attitudes and behaviours. These limitations are addressed within the present research.

# Chapter 4. The Physiology of Stress

## 4.1 Chapter Overview

The most striking limitation of studies undertaken to assess the association between emotional arousal and bingeing to date is that very few studies have integrated both behavioural and physiological models of stress-induced eating. Appetitve behaviour is very complex and multifaceted, and stress is a multilevel phenomenon that is profoundly influenced by cognitions. Therefore a psychophysiological approach to the measurement of both appetitive behaviour and emotional reactivity is required in order for a more complete understanding of the relationship between emotional arousal and bingeing. Although evidence from the dietary restraint literature points towards a cognitive explanation for stress-eating, there is evidence from cardiovascular and stress research literatures that physiological mechanisms may underlie stress-induced eating behaviour. This chapter provides a working definition of "stress", and describes some of the models of stress that attempt to explain the complex physiological systems that are implicated in the physiological 'stress' response to psychological stressors. It also describes how individual differences in response and task specificity can influence patterns of cardiovascular, neuroendocrine and gastrointestinal reactivity, and how these reactivity patterns may relate to food selection, food intake and health.

## 4.2 What is "stress"?

Despite the fact that thousands of research articles have been written about stress and stress-related diseases, a precise globally accepted scientific definition of stress remains elusive (see Goldstein, 1995 for discussion). For instance, some scientists view stress as any factor that activates the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system (SNS) (e.g., see Björntorp, 2001). Others suggest that stress can exist without a significant elevation in hormonal release from the HPA axis (Pacek, Palkovits, Yadid et al., 1998; Vigas, 1985). The following section outlines early and recent models of stress and thereafter proposes a working definition of "stress".

## 4.3 Theoretical Models of Stress and A Working Definition

***The genesis of stress models: From stimulus-based to transactional models.*** Early models of stress used a simple *input-output (or stimulus-response)* approach (i.e., to what extent does exposure to a stressful event predict an outcome such as cardiovascular disease?). Later models focused on how the individual *interacted* or *transacted* (Lazarus & Folkman, 1984) with the stressful event or environment to determine the level of ill health experienced.

**4.3.1 Early Models of Stress.** Cannon (1929a, 1929b, 1939) was the first to introduce the term "homeostasis" to describe the "coordinated physiological processes that maintain most of the steady states in the organism." According to Cannon, the sympathetic nervous system (SNS) is an essential homeostatic system that serves to restore stress-induced disturbed homeostasis to a biologically pre-determined set-point in order to promote survival of the organism. Although Cannon never used the term "stress", he was the first to suggest 'specificity' of (stress) responses. For example, the homeostatic response to cold exposure is virtually the opposite of the reaction observed to resist heat (Selye, 1974). However, unlike Selye, Cannon recognized the importance of *psychological* responses during stress (Cannon, 1914, 1929).

Selye introduced and popularized stress as a medical and scientific idea that originated with a report published as a letter to *Nature* in 1936 (Selye, 1936). Selye's (1956) model was one of the first to link stress to illness via endocrine processes. Selye (1956) suggested that an organism reacts to threat with a *nonspecific* triadic response involving 1) the alarm reaction, wherein the presence of a stressful event is registered and the body is prepared for energy expenditure to respond to the perceived threat; 2) resistance, wherein the body's stress response is fully activated. If the stressor is long lasting or chronic it can lead to phase 3 - exhaustion. At this point stress-related hyperfunctional and dysfunctional conditions such as Addison's disease, cancer, Cushing's disease, hypertension, and adrenal tumors may develop (Selye, 1950, 1974, 1976; Goldstein, 1995; Chrousos, 1998; Chrousos & Gold, 1992). In Selye's view, just about any type of threat would produce much the same physiological stress reaction, and failure to master threat resulted in a *General Adaptation Syndrome* (GAS) that was a potential for the onset of disease.

Selye's nonspecifically elicited stress response hypothesis met with opposition, and several researchers provided a demonstration of response *specificity*. For example, Mason, Maher, Hartley, Mougey et al. (1976) demonstrated that a manipulation of the stimulus context directly influenced stimulus appraisal and stress response. Mason (1975) showed that alternations in stimulus paramaters such as uncertainty produced different endocrine response patterns, and Graham, Kabler

& Graham (1962) showed that different scenarios in a hypnotic attitude suggestion manipulation produced scenario specific response patterns.

Selye (1976) later proposed that most stressful stimuli induce two types of responses: 1) a general stress response, that is common to all stressors and involves the release of adrenocorticotrophic hormone (ACTH) and adrenal corticosterone, and 2) individual stress responses mediated by "conditioning factors" such as genetically determined predispositions.

**4.3.2 Transactional Models of Stress**. The consensus currently is that stress is a dynamic interactional process mediating between a potentially stressful stimulus and a stress response. The transactional model of stress (Cox, 1978; Lazarus & Folkman, 1984) focuses on individual differences in perceptions and appraisals of stressors. Stress is said to vary within the person in different circumstances over time. The model suggests that a transaction between the person and the environment would be perceived as stressful to the extent that the individual evaluates the environment as presenting harm, threats, and challenges that exceed available coping resources (Lazarus & Folkman, 1984). Thus, evaluation is dependent on the individual's appraisal of both the stressor and resources to cope with that stressor, as well as on the 'causes' of the event, as perceived by the individual (i.e. attributions made).

**4.3.3 Appraisal and Coping.** The concept of cognitive appraisal has been defined as having two basic forms: primary and secondary appraisal. Primary appraisal refers to the evaluation of the stressor as irrelevant, benign/positive or stressful. An irrelevant stressor would be an event that is perceived as having no impact on the individual's wellbeing. A benign/positive stressor would be an event that is perceived as having an enhancing effect on the individual's wellbeing. An event that is perceived to involve harm, loss or threat would be perceived as stressful. Secondary appraisal refers to the person's ability to deploy their stress resistance resources to overcome short-term reaction to the immediate stressor. Appraisal processes shape the meaning of any event, whether it is perceived as stressful and how it can be dealt with. Coping responses are initiated in response to primary and secondary appraisal (Folkman, 1984; Lazarus & Folkman, 1984). Several investigators suggest that a deficit in coping skills may render eating-disturbed individuals less able to deal efficiently with stress, resulting in eating-disturbed behaviour (e.g., Soukup, Beiler, & Terrel, 1990; for review see Ball & Lee, 1999). Empirical evidence suggests that bulimic individuals adopt less *active* coping styles (Yager, Rorty, & Rossotto, 1995). In addition, evidence to suggest that individuals with a past or current eating disorder utilize escape avoidance is derived from a study by Ghaderi & Scott (2000). These researchers assessed the use of different coping strategies, measured by the Ways of Coping Questionnaire (Folkman et al., 1988), in females (N = 1952) aged 18 to 30, years who were randomly selected from the general population of Sweden. Participants were clustered into five groups: a) those with a past history of an eating disorder, b) those currently with an eating disorder, c) those with no current eating disorder, but with a past history of dieting, d) participants with no eating disorder but with current dieting, and e) participants with no history of an eating disorder or dieting (controls). Results showed that participants with a past or current eating disorder reported significantly higher levels of escape avoidance compared with controls. Moreover, the pattern concerning relative use of different coping strategies among participants with no eating disorder, but with past and current history of dieting highly resembled the pattern seen among participants with past and current history of eating disorders. The continuous and consistent change in the proportional use of coping strategies with increasing degree of severity ranging from controls to those currently with an eating disorder resembled a linear trend. The authors' propose that the gradual and consequent changes in coping pattern may be associated with corresponding changes in dieting and eating behaviours.

Research also suggests that high restraint is associated with poor coping strategies in response to stressors (e.g., Fryer, Waller, & Kroese, 1997; Mayhew & Edelmann, 1989; Paa & Larson, 1998; Sanftner & Crowther, 1998) suggesting that, compared to low restraint women, high restraint females may exhibit higher levels of post-stress test negative affect and physiological and biological reactivity. Folkman et al. (1986) suggest that coping is not a stable individual trait or disposition but a transactional process that is continually modified by experience. However, the way in which an individual attempts to cope with an event may become an integral part of their vulnerability profile, in that an inappropriate strategy (such as overeating) may add to the original stress experienced. It is also suggested that coping is not only a reaction to stress, but that coping responses (adaptive or maladaptive) may be initiated in *anticipation* of a stressful event.

**4.3.4 Attributions.** The severity of the stress experience is also dependent on attributions. Attribution is the process of interpreting behaviour or assigning causes to events (Jones, Kanouse, Kelley et al., 1972). Researchers have found that disordered eating behaviour (for example, restrained eaters disinhibited by a high calorie pre-load and individuals with EDI symptoms) is associated with an *external* attribution style for indulgent food consumption (i.e., stable, global, and external causes) (Rotenberg & Flood, 1999). The external attribution style for food consumption is regarded as a form of learned helplessness: one that arose from the cyclical patterns of attempts and failures to control weight by dieting (Rotenberg, Carte, & Speirs, 2004). To date, no research has been undertaken to ascertain the attribution style for restrained eaters (with and without bulimic symptoms) who disinhibit in response to stress.

**4.3.5 Allostatic load – Physiological coping**. McEwan (1998) introduced the term "allostasis" into stress research. Allostasis, originally proposed by Sterling & Eyer (1981), can be defined as an ability to maintain stability of the internal milieu through change. Allostasis is the active process of adaptation by production of various mediators such as adrenal steroids, catecholamines, cytokines, and tissue mediators. When exposure to an event is perceived as stressful, physiological responses are initiated, leading to allostatic (adaptive) responses. If allostatic responses are efficient, adaptation occurs and the organism is protected from damage. In situations where allostatic responses are a) prolonged, b) inadequate, c) overstimulated by repeated exposure from multiple stressors, or if a lack of adaptation occurs then allostatic load results, causing damage to various organs (McEwan, 1998; Schulkin, McEwan & Gold 1994).

In contrast to homeostatic mechanisms, allostatic regulations are broader and do not depend on set-point mechanisms. Signals are not constant, and anticipation of need is an important element. Another aspect of this theory is that allostatic load also reflects aspects of lifestyle (e.g., eating a high-fat diet, lack of exercise, etc.), and disturbances of diurnal rhythms (e.g., sleep deprivation) that result from overexposure of various tissues to stress mediators. Allostatic theory also further develops Selye's notion of "conditioning factors" to explain individual differences in stress responses.

**4.3.6 A *heuristic* Model of Stress and Illness.** Cohen and colleagues developed a model to illustrate the potential integration of three major traditions or approaches to the measurement of stress; environmental, psychological and biological (Cohen, Kessler & Gordon, 1995). This model suggests that the individual's *perceptions* of threat may lead to stress resulting in increased risk of physical and psychiatric disease through emotional, physiological or behavioural responses. More specifically, stress is thought to cause negative affective states (e.g., anxiety, low self-esteem or depression). These, in turn exert effects on physiological (cardiovascular and neuroendocrine) processes and behavioural patterns (e.g. engaging in "unhealthy" coping behaviours such as smoking or binge-eating) that influence the risk of disease (Cohen, Evans, Krantz & Stokols, 1986).

### 4.3.7 "Stress": A Working Definition

Grunberg & Singer (1990) suggest that "stress" is the reaction of an organism, human or animal, to impending threats, challenges, or dangers. The stress response is a mixture of an event and/or the perception and appraisals by the individual of its potential harm. The triggering event is called the stressor. This definition of "stress" is adopted for the purposes of this thesis.

Thus, the stress response is essentially adaptive rather than harmful; its function is to re-establish the state of homeostasis. It becomes harmful when repeatedly activated or unduly prolonged, leading to an excess of hormonal release, or when coupled with unhealthy coping behaviours (Grunberg & Singer, 1990).

## 4.4 Physiological Stress Response and the Regulation of Food Intake

The experience of an event perceived as stressful evokes a complex physiological response to enable the individual to cope with impending challenge. There are two physiological response systems to stress under the control of the hypothalamus that can be activated or dysregulated depending on the severity (mild versus severe) and duration (acute versus chronic) of the stressor. These are the *sympathetic adrenal medullary* (SAM) response system and the *hypothalamic-pituitary-adrenal* (HPA) axis. Together these systems regulate cardiovascular reactivity (heart rate and blood pressure), and both are susceptible to the effects of psychological stressors.

**4.4.1 SAM.** Activation of the sympathetic nervous system (SNS) is characterized by the release of the hormones: noradrenaline (also known as norepinepherine) and adrenaline (or epinephrine) into the bloodstream. This prepares the organism for fight or flight (e.g., Cannon, 1915). The system that releases adrenaline into the bloodstream is the SAM. This system is under the influence of both the SNS and the adrenal medulla. The adrenal glands are central to both the SAM and HPA stress response systems.

The SAM system promotes an increase in cardiovascular reactivity; increasing heart rate and blood pressure. During this response, blood flow is directed away from organs less important for the fight/flight response, for example the gastrointestinal tract, and towards more important organs such as the brain and skeletal muscles. Given this response, one would expect a reduction in food intake in all organisms exposed to stress. However, dietary restraint research shows that this general hypophagic response is not always in evidence, suggesting the involvement of cognitive and psychological processes.

**4.4.2 HPA.** The physiological "stress" response also includes activation of the HPA axis. Activating the HPA axis is more difficult to achieve than that of the SNS and SAM system, requiring quite severe perceived threat. A low threshold for HPA activation is considered to contribute to susceptibility or predisposition to negative health consequences arising from stress (Pasquali, Cantobelli, Casimirri et al., 1993). Activation of the HPA response is characterized by the release of corticotrophin releasing hormone (CRF) from an area of the hypothalamus known as the paraventricular nucleus. CRF feeds to the anterior lobe of the pituitary gland that lies beneath the hypothalamus via the bloodstream. At this point, another chemical messenger is released - adrenocorticotrophic hormone (ACTH). The targets for ACTH are the pair of adrenal glands located over the kidneys, and glucocorticoids (primarily cortisol in humans) are released into the general circulatory blood system. Thus, cortisol is referred to as the "stress hormone".

**4.4.3 Cortisol.** In humans, cortisol secretion follows a basic diurnal pattern with the highest levels released in the early morning and lowest in the afternoon and evening. Cortisol levels peak three to five hours after sleep and decline throughout the day.

One important feature of successful coping with stress is that physiological systems are not only turned on efficiently by a particular stressor, but are also turned off again after a stressor has ceased (McEwan, 1997; Sapolski, 1994). Thus, when these systems are not rapidly mobilized and then appropriately reduced, elevated hormone levels become dangerous for the organism (McEwan, 1997). A significant number of health implications are now associated with control and consequences of the release of cortisol, and its sensitivity to psychological stress has given this glucocorticoid hormone much importance in behavioural medicine (Kirschbaum & Hellhammer, 1994). For example, dysfunction of the HPA axis has been implicated in disorders such as major depression (Checkley, 1996), night eating syndrome (Birketvedt, Sundsfjord, & Florholmen (2002), and Cushing's syndrome (Peeke & Chrousos, 1995). In the night eating syndrome, it has been suggested that the nighttime elevation of cortisol might contribute to inducing awakenings to eat (Birkentvedt, Flortholmen, Sundsfojord et al., 1999). Hypercortisolemia[3] in Cushing's syndrome is accompanied by physical symptoms, such as the accumulation of abdominal adipose tissue, together with muscular atrophy of the limbs, providing powerful evidence of the metabolic and nutritional consequences of chronic hypercortisolemia (Peeke & Chrousos, 1995). Cushing's patients with elevated cortisol levels have been found to select high-fat foods twice as often as normal weight individuals and three times as often as overweight controls (Castonguary, 1991). An elevation in cortisol levels has also been linked with obesity and abdominal or central obesity (e.g., Bjorntorp & Rosmond, 2000; Epel, McEwen, Seeman et al., 2000).

**4.4.4 Cortisol, Stress and Central Obesity.** Persistently elevated cortisol levels promote insulin resistance and abdominal obesity (Bjorntorp and Rosmond, 2000). Chronic stress over-activates the HPA axis, promoting insulin release, which in turn encourages abdominal fat storage (e.g., Dallman, Akana, Strack et al., 1995). Researchers have recently suggested that the effects of stress on cortisol may lead directly to the development of abdominal obesity via disruption of the functioning of the HPA axis (Björntorp, 1995; Björntorp & Rosmond, 2000). Abdominal fat distribution has been associated with vulnerability to stress in the laboratory. For example, Epel, McEwen, Seeman et al. (2000) found that women with greater central fat distribution (indexed by a high waist-to-hip ratio: WHR) evaluated laboratory challenge (a modification of the Trier Social Stress Test: TSST; Kirschbaum, Pirke, & Hellhammer, 1993) as more threatening, performed more poorly on them, and reported more chronic stress. These women secreted significantly more cortisol during the first stress session than women with low WHR. Furthermore, lean women with a high WHR lacked

[3] Hypercortisolemia refers to the prolonged exposure of the body's tissues to high levels of cortisol.

habituation to stress in that they continued to secrete significantly more cortisol in response to now familiar challenges (days 2 and 3) than did lean women with a low WHR. Epel et al. (2000) conclude that central fat distribution is related to greater psychological vulnerability to stress and cortisol reactivity, especially among lean women, who did not habituate to repeated stress.

Marin et al. (1992) found a positive correlation between cortisol levels following exposure to the CPT and saggital diameter of the abdomen in overweight women. Gluck, Geliebter & Lorence (2004b) observed a relationship between WHR and cortisol levels following a CPT in women with BED. This relationship persisted even after a 6-week intervention consisting of a liquid diet and cognitive behavioural therapy.

**4.4.5 Cortisol, Cardiovascular Reactivity, Stress and Eating Disorders.** Women with AN (Putignano, Dubibi, Toja et al., 2001), BN (Pirke et al., 1992), BED (Gluck et al., 2004a) and the night eating syndrome (Birkentvedt et al., 1999) have been found to possess higher basal cortisol compared to controls. In addition, exaggerated cortisol responses have been noted in response to the CPT in women with AN (Abell, Malagelada, J.R., Lucas, A.R. et al., 1987), and to both physical (CPT) and mental (colour-word or mathematic) stress tests in premenopausal obese women (Marin, Darin, Amemiya et al., 1992). In respect of women with BN, only one study has failed to observe raised cortisol levels following a mental challenge stressor in women with BN, despite higher levels during a control condition, compared to healthy controls (Pirke, Platte, Laessle et al., 1992). However, Koo-Loeb et al. (1998) found that bulimic women showed significantly lower plasma epinepherine levels during baseline and in response to a speech stressor and a non-significant increase in plasma norepinepherine to the stressor. Conversely, many studies have found exaggerated cortisol responses to stress in women with BN. For example, Grindler et al. (1998) found increased cortisol response to an ischemic pain task in women with BN. The discrepancy in cortisol response to stress between the two studies (Grindler et al., 1998; Pirke et al., 1992) may be a result of differences in neuroendocrine responses to a mental stressor, which elicits *active* coping mechanisms versus a physical stressor which may elicit *passive* coping mechanisms.

A study by Koo-Loeb et al. (2000) obtained cardiovascular, neuroendocrine, and psychosocial profiles of 26 non-clinical women who scored in the highest distribution of the Eating Disorder

Inventory bulimia subscale (HEDI) and 27 women who scored in the lowest distribution of that scale (LEDI). Participants underwent a speech reactivity task, for which measures of blood pressure and heart rate reactivity, and also 24hour ambulatory blood pressure monitoring and urinary neuroendocrine collection was made. Results showed that HEDI women exhibited increased blood pressure and heart rate reactivity to the speech task and increased 24-hour urinary cortisol, but decreased 24-hour ambulatory blood pressure levels. Negative mood and tension were associated with greater systolic blood pressure for all women. HEDI women also reported greater depressive symptoms and anxiety, lower self-esteem and sense of mastery, less social support, poor coping skills, and greater emotional impact of daily stressors, relative to LEDI women. These results indicate that the pattern of neuroendocrine and psychosocial profiles seen in prior studies of BN are also present in non-clinical women with eating disorder tendencies.

Koo-Loeb et al. (2000) reported higher 24-hr urinary cortisol secretions were observed on the day *following* the interpersonal speech task, compared to a control group. However, few studies have examined cortisol reactivity to stress over longer periods. Gluck, Geliebter, Hung & Yahav (2004a) assessed cortisol, hunger, and desire to binge following cold stress in women with BED. Twenty-two females (11 BED and 11 non-BED) completed measures of depression and performed the CPT, wherein participants submerged their hand into ice water for 2 minutes. Ratings of hunger and desire to binge were obtained (over a 60 minute period) prior to blood draws for cortisol and insulin. On a separate day, participants had a 1-mg oral dexamethasone suppression test (DST). The DST is widely used in clinical settings to test for hypercortisolemia and diminished sensitivity to HPA negative feedback, and oral dexamethasone characteristically suppresses the morning rise in cortisol (Walsh, Gladis & Roose, 1987).

Results of a study undertaken by Gluck et al (2004a) revealed that the BED group had higher basal cortisol than the non-BED group, but cortisol did not differ following DST. The BED group had nearly significant cortisol AUC after the CPT, after controlling for insulin AUC and contraceptive use. The BED group also had greater AUC for hunger and desire to binge after exposure to the CPT. The authors conclude that a hyperactive e HPA-axis exists in women with BED, which may contribute to greater hunger and binge eating.

Some researchers have shown that interference on a Stroop task when the content was emotionally salient is accompanied by an increase in autonomic arousal (e.g., Perpina, Leonard, Bond & Banos, 1998). Conversely, no significant group difference in physiological reactivity is observed when stimuli are more general, for example when incongruent colour-words are employed (e.g., Tuschen-Caffier & Vogele, 1999). Perpina, et al., (1998), for example, showed that anorexic patients responded with higher skin conductance to food- and body-related information than did patients with bulimia and controls. A study by Vitousek & Orimoto (1993) used the dot-probe task[4] in an extension of earlier work using a dichotic listening task in which a small sample of women with BN showed enhanced sensitivity and physiological reactivity to information relevant to their concerns.

**4.4.5.1 Cortisol, Cardiovascular Reactivity, Stress and Dietary Restraint.** Restrained eating reflects a struggle to maintain cognitive control over food intake and weight (Heatherton et al., 1988; Lowe, 1993). It has been suggested that this may in itself be a stressor (e.g., Anderson, Shapiro, Lundgren et al. (2002). However, studies of restrained eaters have found an inconsistent relationship between restrained eating and cortisol levels. Pirke, Tuschl, Spyra et al. (1990) found no significant correlation between restrained eating as measured using the Three Factor Eating Questionnaire – Cognitive Restraint Scale (TFEQ-R; Stunkard & Messick, 1985) and plasma cortisol. Conversely, McLean, Barr & Prior (2001) found that restrained eating, also defined using the TFEQ-R was positively correlated with elevated levels of urinary cortisol. Furthermore, previous studies have demonstrated a significant decrease, rather than increase, in cortisol during weight loss, which presumably involves a high level of restraint (Buffenstein, Karklins & Driver, 2000; Hainer, Stich, Kunesova et al., 1992; Scavo, Barletta, Buzzetti & Vagiri, 1988). In an attempt to clarify these inconsistent relationships between restrained eating, dieting, and cortisol, Anderson, Shapiro, Lundgren et al. (2002) employed multiple self-report measures of dietary restraint (RS and TFEQ_R) with 85 college-age women, who provided a saliva sample for analysis of cortisol. Both measures of restraint were positively associated with elevated levels of salivary cortisol, although the TFEQ_R was more strongly associated than the RS.

---

[4] In the dot-probe paradigm, an affective stimulus is presented with a neutral stimulus for a relatively short time (500ms). Afterwards, one of the two stimuli is replaced by a dot. Participants have to press a key as soon as they detect the dot. Participants are able to detect the dot faster, if they are already attending to the location where the dot appears (e.g., Mogg, McNamara, Powys, Rawlinson, Seiffer, & Bradley, 2000).

Taken together, results suggest that whilst a negative energy balance and successful weight loss lead to decreases in cortisol secretion, whereas the unsuccessful struggle to reach a negative energy balance (i.e., restrained eating) leads to increases in cortisol output. This may lead directly to the development of abdominal obesity via a disruption of the functioning of the HPA axis (Björntorp, 1995; 1997; Björntorp & Rosmond, 2000).

Very few studies have investigated stress-induced physiological and neuroendocrine reactivity with restrained eaters. No studies have employed these measures in studies of information processing of 'threat' unrelated to eating in either women with BN, non-clinical women with bulimic symptoms or restrained eaters.

For restrained eaters, studies assessing physiological reactivity have shown mixed results. For example, Tuschen-Caffier & Vogele (1999) showed *dissociation* between emotional responses and physiological activation. These researchers assessed desire to binge, negative mood and hunger in bulimic patients, restrained eaters and controls in response to mental arithmetic task (plus audio distraction noises) and a Stroop test, consisting of incongruent colour words, and interpersonal stress provoking feelings of loneliness and social rejection (film and imagery tasks). Measures of heart rate, blood pressure, respiration-rate and electrodermal activity were also monitored. In this study interpersonal conflict stress appeared to be most effective, with bulimic patients responding to the task with increases in both desire to binge and hunger ratings, whereas restrained eaters and controls showed no such change. In this study, there were no substantial group differences in psychophysiological reactivity.

Conversely, Stroud, Tanofsky-Kraff, Wilfley & Salovey (2000) examined the effects of the Yale Interpersonal Stressor (YIPS) on mood, eating behaviour, blood pressure, and cortisol in two experiments. The YIPS involves one or more interaction(s) between the participant and two same-sex confederates in which the participant is made to feel excluded and isolated. In Experiment 1, 50 female undergraduates were randomly assigned to the YIPS or to a control condition. Participants in the YIPS condition experienced greater negative affect and less positive affect than did those in the control condition. Further, restrained eaters ate more following the YIPS than did unrestrained eaters. In Experiment 2, twenty-five male and female undergraduates completed the YIPS. The

YIPS induced significant increases in tension, systolic blood pressure (SBP), and diastolic blood pressure (DBP) from baseline, while significantly decreasing positive affect. The YIPS appeared particularly relevant for women, resulting in significantly greater increases in cortisol and SBP for women compared to men.

It is evident that further studies are necessary to clarify the complex relationships between restrained eating, stress and cortisol. Particularly in relation to vulnerability to stress in restrained eaters, with and without bulimic tendencies, given that the majority of studies have measured food intake following laboratory stressors *without* measuring biological or physiological correlates. One purpose of the current research, therefore, was to compare physiological and neuroendocrine reactivity to a Stroop task that contains emotionally salient stimuli (ego-threat) in non-clinical females who self-reported bulimic symptoms, but who have never met the criteria for an eating disorder, with a control population. Given that these women were likely to score highly on restrained eating scales, a comparison was also be made with (high) restrained eaters, who *did not* display bulimic tendencies.

**4.4.6 Stress, Hormones, Food Intake and Food Choice.** Biochemical measures can be employed to explore mechanisms that may underlie effects of stress on the development of pathology, as well as in studies of energy expenditure and metabolism, that are related to food preferences and intake. Hormones released in the stress response may favour increased food intake, and perhaps intake of specific nutrients such as fat, which can lead to energy imbalance and weight gain. For example, a study by Epel, Lapidus, McEwen & Brownell (2001) investigated physiological and psychological predictors of stress-induced eating in 59 healthy pre-menopausal women. Given the relations between cortisol and both psychological stress and mechanisms affecting hunger, it was hypothesized that individuals who secreted more cortisol in response to stress would consume more calories. It was also predicted that high cortisol reactors would demonstrate a preference for sweet or high fat food. Three challenging tasks were performed over a 45-minute period. Tasks were designed to be stressful by giving unrealistic time constraints to meet the expected goals. These were visuo-spatial puzzles, serial subtraction of a prime number from a high number, and delivery of a videotaped speech, with a supposed research committee providing evaluation from behind a one-way mirror.

Results showed that high cortisol reactors consumed more calories on the stress day compared to low reactors, but ate similar amounts on the control day. In terms of taste preferences, high reactors ate significantly more sweet food across days. In addition, an increase in negative mood in response to the stressors was related to greater food consumption. The authors suggest that biochemical response to stress may influence subsequent eating behaviour and that such responses could, over time, impact both weight and health (Epel et al., 2001).

There is also evidence that normal physiological variations in cortisol in humans can have a significant direct influence on macronutrient metabolism (Simmons, Miles, Gerich, & Haymond, 1984; Divertie, Jensen, & Miles, 1991; Dinneen, Alzaid, Miles, & Rizza, 1995). In this respect, cortisol seems to increase lipolysis[5], and proteolysis[6], as well as increasing gluconeogenesis[7], thereby raising the contribution of protein and fat to energy substrate supply, while protecting glycogen stores. It has been suggested that the ability of cortisol to increase plasma free fatty acid levels may underlie the emerging link between cortisol and abdominal obesity, together with its associated metabolic syndrome (Björntorp, 1991).

In support of this contention, there is much evidence from animal studies that HPA axis function can profoundly influence expression of appetite and regulation of body weight (York, 1992), whereas HPA axis activity itself can be modified by changes in feeding patterns (Honma, Honma, & Hiroshige, 1984). It is somewhat surprising, therefore, that relatively little attention has been given to studying the relationship between food intake and cortisol in human beings (Castonguay, 1991; Mahoudeau & Reznik, 1993; Gibson, Checkley, Papadopoulos et al., 1999). Food- and macronutrient-dependent effects on cortisol release might also help explain reported effects of meal composition on subsequent mood (Smith, Leekam, Ralph, & McNeill, 1988). The current research therefore investigates the relationship between food and macronutrient intake and cortisol release following stress exposure in an attempt to provide useful insight into links between the HPA axis, appetite, food choice (sweet, salty and bland), and psychological health.

---

[5] Proteolysis refers to the breaking down of proteins by enzymes called proteases.
[6] Gluconeogenesis is the process of making glucose (sugar) from its own breakdown products or from the breakdown products of lipids (fats) or proteins. Gluconeogenesis occurs mainly in cells of the liver or kidney.
[7] NOTE: This refers to the emotional Stroop task containing disorder salient information (e.g., food and body shape). The Stroop task employed within the present research contains information unrelated to eating (ego-threat).

In addition to the main hormones involved in the stress response, there are numerous other substances released during stress that have the potential to influence food intake mechanisms, if of sufficient magnitude. In terms of eating behaviour two important hormones are the opioids and serotonin.

**4.4.7 Opioids.** Research evidence has indicated a role for opiates in gastrointestinal motility, food intake and food choice, both in animals and humans (Drewnowski, 1992). Opioid receptor antagonists have been found to *reduce* food intake in humans (Drewnowski, 1992). Yeomans, Wright, McLeod & Critchley (1990) found that an orally administered opioid antagonist (nalfemene) selectively *reduced* intake of the most palatable foods. Yeomans & Gray (1997) found that the initial increase in appetite stimulated in hungry subjects by a palatable food was prevented by the opioid antagonist - naltrexone.

**4.4.8 Serotonin.** The neurotransmitter, amine serotonin (5-hydroxytryptamine: 5-HT) has been implicated in both the control of appetite and in food choice (eg. Blundell, 1984; 1991). A considerable literature exists to suggest that increased release of 5-HT is associated with *reduced* appetite or increased satiety during *acute* stress. As with research into the effects of endogenous opioids, much of the evidence is derived from studies using exogenous agents, such as the indirect 5-HT agonist/releaser - fenfluramine. Acute stress in animals has been associated with increases in 5-HT release (Fulford & Marsden, 1998). Increased 5-HT activity in acute stress activates the hypothalamic pituitary adrenal (HPA) axis, thus increasing secretion of cortisol (Dinan, 1994; Van Praag, 1996).

**4.4.9 Individual Differences, Cortisol, and Food Intake.** A high secretion of cortisol in response to laboratory tasks is indicative of deregulation of the HPA axis (Pasquali, Cantobelli, Casimirri et al., 1993). The extent to which an individual can cope with a stressful event varies, and these individual differences are a product of many factors, including genetics, developmental influences, experience, training, social support and current mental and physical health (DeLongis & Preece, 2000; McEwan, 1997; Sapolski, 1994). Table 2 shows some of the effects of cortisol.

**Table 2. The Effects of Cortisol**

| System affected | Effect |
|---|---|
| Digestive function | Increases gastric secretion |
| Immune response | Decreases immunoglobulin synthesis, lymphocytes, macrophages (immunosuppresant); Inhibits the inflammatory response |
| Nutrient Metabolism: Carbohydrate | Increases cellular uptake/use of glucose; Decreases brain uptake/use of glucose increase in gluconeogenesis; promotes increase in blood glucose in concert with other compounds |
| Nutrient Metabolism: Lipid | Promotes lipolysis; Increases mobilization of free fatty acids |
| Nutrient Metabolism: Protein | Promotes catabolism of protein in muscle, adipose tissue, skin, bone |
| Urinary Function | Promotes urinary excretion |

Research shows that two people exposed to the same laboratory stress task can display very different physiological (catecholamine, cardiovascular and gastrointestinal) reactivity profiles. This is known as individual difference response specificity, and may be related to subsequent eating behaviour (eg. Blair, Wing & Wald, 1991). For example, findings from a study by Blair et al. (1991) suggest that obese individuals have a more rapid gastric emptying than age and sex matched lean individuals following exposure to an active coping task (a reaction-time task). At this juncture, it is pertinent to point out that the 'active coping tasks' typically employed often involve an evaluation/performance related component, and as such could be regarded as potentially ego-threatening. It is possible to speculate, therefore, that individual differences in gastrointestinal response to different types of stress by restrained and unrestrained individuals may be related to the differential eating patterns displayed by the two groups following stress.

Few studies have documented physiological markers of stress, in conjunction with subsequent food consumption, in restrained and unrestrained eaters. An exception is the work of Rutledge & Linden (1998) who employed three active coping tasks; a mental arithmetic task, a Stroop task (incongruent colour), and a word scramble task. In their study, multiple regression analyses showed that the most effective predictors of post- stress eating were restraint and degree of physiological arousal. High restraint scores were associated with increased eating, whereas greater physiological reactivity was associated with reduced food consumption.

The negative association that Rutledge and Linden found between physiological changes and food consumption *is* in line with prior research and theory which suggests that physiological mechanisms mediate the effects of stress on eating. In a normal population, this would be expected, since studies show that increased autonomic reactivity leads to the release of appetite inhibiting catecholamines and to a variety of gastric changes believed similarly to suppress eating (Blair et. al., 1991). However, Rutledge and Linden`s study also showed that, for restrained eaters, this relationship may not be as stable. When correlations between physiology and food consumption were undertaken separately for restrained and unrestrained eaters, the relationship for restrained eaters was non-significant. This suggests the possibility that restrained eaters may be less sensitive to physiological signs of stress than unrestrained eaters, or even that they have acquired a sort of conditioned appetite response, for which (certain types of) stress has become an eliciting stimulus.

In an attempt to clarify these relations, a study was undertaken by the present author (Lattimore & Caswell, 2004). The study involved a direct comparison of an active coping task (a reaction-time task involving an aversive auditory stimulus and a monetary reward, dependent on performance), and a passive coping task (the cold pressor task, wherein participants are required to submerge their hands in [20 seconds] and out [20 seconds] of ice water. The two stress manipulations were compared to a no-stress (relaxation) task, wherein participants were simply required to read magazines. Results revealed that the reaction-time task used in this study had the effect of making restrained eaters consume more food than unrestrained eaters, and more food than following the cold pressor task. The relaxation task effects were what one might expect in that restrained eaters maintained restraint yet unrestrained eaters took the opportunity to eat some free food.

The data on physiological reactivity was, by itself, inconclusive, as both stress tasks did not produce credible increases in autonomic nervous system (ANS) activity when one examined baseline versus task averages. However, when data were broken down, by examining change scores for heart rate reactivity (task minus baseline values), and subsequently identifying responders and non-responders, overall differences in amount of food consumed by the two groups were observed following exposure to the active coping task. These small differences were further moderated when restraint status was considered. Later analyses suggested that restrained eaters who exhibit a physiological stress response (increased heart rate reactivity) consume significantly more food than unrestrained eaters who show similar stress responses ($p<.001$). These results suggest that restrained responders (to the active coping task) seem capable of overriding a physiological stress response that should (and normally does) suppress appetite/ingestive behaviour. Research is now needed to produce clearer data on the link between ANS activity and gastric activity following exposure to stress by restrained and unrestrained individuals.

## 4.5 Measurement of the "Stress" Response

Grunberg & Singer (1995) advocate using several levels of analysis in the study of stress: self-reports, behavioural, physiological, and biochemical. There can be changes in some but not all of these levels in response to stressors. Once activated, the various physiological stress systems do not necessarily move in parallel. It is therefore important to use multilevel assessment simultaneously. Physiological and biochemical measures serve as objective indices of the stress response. They also serve to bolster information obtained from self-report measures of anxiety, that are most commonly employed within the dietary restraint literature, and that are often criticized when used in isolation (e.g., Rutledge & Linden, 1998).

In the current research, self-report measures provide information about attributions, anxiety, self-esteem and dieting and bulimic behaviours. Behavioural measures of food intake and performance on emotive reaction time tasks provide another level of analysis. Physiological (heart rate and blood pressure) and biochemical (salivary cortisol) measures provide: a) an index of the process (is stress occurring, and if so, how much?), and b) a profile of individual differences and task specific responses to stress that may help to explicate the mechanisms underlying the translation of the individual's psychological experience to physical and mental health problems, via maladaptive behaviours (e.g., overeating).

**4.5.1 Laboratory assessment.** Reactivity to a stressor is commonly assessed in the laboratory. The underlying assumption is that there are stable dispositions to react similarly to different stressors. Reactors will be reactive whether tested today or next month, irrespective of whether the stressor is a physical endurance task, or a demanding cognitive task, and irrespective of whether assessment takes place in the laboratory setting or in the natural environment (Cohen & Hamrick, 2003).

Physiological responses to stressors may vary according to the type of stressor (e.g., social conflicts versus achievement tasks). There is considerable evidence for stability of response to the same task over time, and more limited evidence on stability of response across different tasks (see Cohen & Hamrick, 2003). It has been suggested that averaging reactivity to a single stressor across multiple assessments provides more information about the stability of responses over time (Cohen & Hamrick, 2003). Therefore, this latter method is employed within the present research.

**4.5.2 Measurement of Cortisol.** Any biological sample (blood, urine, tissue, cerebrospinal fluid) can be assayed for cortisol (Grunberg & Singer, 1995). However, blood sampling to extract cortisol can be problematic. There is now ample evidence for significant endocrine responses to catheterization with large individual differences (e.g., Watkins, Sullivan & Laughlin, 1962). Thus, an endocrine response 30 minutes into the protocol (during the stress phase) may actually represent catheterization stress during the baseline period (Kirschbaum, 1999). Urinary values provide integrated measurements for extended periods of time (usually an hour or more), which is an advantage in the study of long-term (chronic) psychosocial stress (Baum et al., 1987). However, this method is not suited to the laboratory protocol, where frequent and repeated measurements are required. Collection of saliva is non-invasive and can be performed repeatedly in parallel with self-reports of perceived stress. The concentration of free active cortisol in serum is closely mirrored by its concentration in saliva (Kirschbaum & Hellhammer, 1994), verifying the usefulness of measurements of salivary cortisol.

Beyond the usual diurnal pattern, various stimuli can influence cortisol response. These include non-psychological variables such as nicotine (cigarette smoking), caffeine (coffee, tea) medication (betablockers, contraceptive pill, estrogen hormone therapy), body weight (e.g., malnutrition). Food intake is commonly employed as a physiological challenge to the HPA axis (Rosmond & Bjorntorp (1998). Characteristics of the stressor (stimulus parameters) influence cortisol reactivity, as well as the characteristics of the participant (individual differences).

**4.5.3 Classification of Stressful Stimuli.** Stressors can be divided into four main categories: 1) physical stressors have been sub-divided into the traumatic (e.g., surgery) and the homeostatic (e.g., exercise), 2) psychological stressors that reflect a learned response to previously experienced adverse conditions. Psychological stressors profoundly affect emotional processes and may result in behavioural changes such as anxiety, fear, or frustration; 3) social stressors reflecting disturbed interactions among individuals, for example unemployment and marital discord; and 4) stressors that challenge cardiovascular and metabolic homeostasis, such as exercise, food intake, hypoglycemia and hemorrhage (Pacak et al., 1998; McCarty, 1989).

In terms of duration, stressors may be divided into two main categories: acute (single, intermittent, and time-limited exposure versus continuous exposure) or chronic (intermittent and prolonged versus continuous exposure) stressors. Stressors also differ greatly in terms of their intensity.

Within the dietary restraint literature, laboratory stressors have been labelled as physical or ego-threatening. Stress and cardiovascular researchers have categorized stressors as active versus passive coping tasks. Active tasks demand an active behavioural response from the participant, who is able to influence the outcome of the task with that response. Active tasks are associated with increases in systolic blood pressure, heart rate, cardiac output, and stroke volume; shortened pre-ejection periods and decreases in total peripheral resistance (Obrist, 1979; Sherwood, Dolan & Light, 1990; Buhler, Bolli, Huthu & Kiowski, 1983). These responses can be modulated by a number of factors, including the individual's control (actual or perceived) over the task, novelty, incentives, amount of effort required and social context (Schneiderman & McCabe, 1989). Passive tasks typically involve passive sensory intake or vigilance and do not provide the participant with an opportunity to influence the outcome of an event. Passive coping tasks frequently employed in the stress and cardiovascular research literatures include the cold pressor task (e.g, Miller, 1994; Lattimore & Caswell, 2004) and non-contingent feedback tasks (e.g., Sherwood, Dolan & Light, 1990). Passive tasks are associated with an increase in total peripheral resistance, presumed to be mediated by alpha-adrenergic activity with heightened haemodynamic, but minimal cardiac response (Sherwood, Dolan & Light, 1990). Classification of stimuli can be more complex. For instance, the cold pressor task requires the individual to submerge their hand in ice-water for a specified period of time. In some instances, the participant may employ active coping strategies to combat the pain experienced, for example mental imagery or distraction techniques.

Stimulus parameters such as intensity, chronicity, duration of exposure, anticipation and type of stressor, the individual's perceived or actual lack of control over the task, and reliability of baseline measures have been shown to play a major role in determining the HPA response.

**4.5.4 Intensity and chronicity**. Evidence from both animal and life events studies suggests that sustained psychobiological reactions to provoking stimuli will be more likely where demand upon responses is intense or chronic (Paterson & Neufield, 1987). The determining factor is whether or not adaptation takes place (Sklar, Bruto & Anisman, 1981). SAM responses of Three Mile Island residents did not habituate, and even after nine years, blood pressure, urinary noradrenaline and symptom reporting were still elevated (Baum, Gatchel, & Schaeffer, 1983; Schaeffer & Baum, 1984; Baum, 1990). Chronicity effects upon immune competence have been shown in examination candidates, following bereavement, and in response to chronic noise (Kiecolt-Glaser & Glaser, 1987; Stein, Keller & Schleifer, 1985; Monjan & Collector, 1977).

**4.5.5 Ego involvement**. Kirschbaum & Hellhammer (1989) suggest that the most important determinants of a cortisol response are emotional ego involvement and the suspenseful anticipation of a noxious event.

**4.5.6 Anticipation.** Bassett, Marshall, & Spillane (1987) found that cortisol increased in anticipation of public speaking and was sustained for two hours.

**4.5.7 Duration.** Because activation of the HPA system can take a long time (in comparison to the SNS), brief stressors can result in short-term increases in adrenaline (epinephrine) and noradrenaline without concomitant increases in cortisol. Thus, not all stress-induction procedures elicit measurable increases in cortisol levels.

**4.5.8 Control.** Muller, Budde & Netter (1990) found that cortisol responses to a concentration task were larger if the task was uncontrollable.

### 4.5.9 Baseline Measurement.

Al'Absi & Lovallo (1992) found that a novel experimental setting enhanced cortisol levels, and adaptation ameliorated the effect. Thus, habituation to the laboratory environment is essential. In addition, in order to reduce the influence of circadian rhythms and individual differences in baseline cortisol levels, individual responses to stress in relation to corresponding baseline levels, obtained during relaxation is recommended.

## 4.6 Cortisol: Individual Differences in Responding.

Recent evidence has shown that cortisol response is not unidirectional. Generally speaking the more intense and salient the stimulus the larger the response. For example, a parachute jump elicits a far more severe response than mental arithmetic or speech task performance (Deinzer, Kirschbaum, Gresele, & Hellhammer, 1997; Kirschbaum, Wust, & Hellhammer, 1992). However, cortisol *decreases* in some individuals during stress exposure (Hein, Ehlert, & Hellhammer, 2000). For example, hypocortisolism, a characteristic of Cushing's syndrome, describes a profile where there is a reduced mean output, hyporeactivity, enhanced negative feedback, or reduced receptor sensitivity (Heim et al., 2000). This non-linear stress-response relationship produces methodological problems, such as analysis of individual differences in cortisol reactivity (see Roy, 2004), and inconsistent relationships with other reactivity and affect measures (e.g, Deinzer et al., 1997; Roy, 2004). Thus, in terms of individual differences in cortisol reactivity there appears to be variation in the size, direction and timing of cortisol reactivity (Roy, 2004).

## 4.7 The 'Emotional' Stroop Task: Methodological and Conceptual Issues

Within the present research, psychophysiological reactivity was assessed particularly in relation to ego-threat stress. The emotional Stroop task was employed both as a laboratory stress manipulation and to assess information processing in different target populations. Although the association between information processing biases and disordered eating has been clearly demonstrated in both clinical and non-clinical populations by a variety of different tasks (e.g., Stroop task, dot-probe task, dichotic listening task) for both memory (later free-recall of stimuli) and attention for eating disorder relevant stimuli (e.g., food-, shape-, weight-related and self-directed ego-threat words), a problem with the majority of this research is that *causality* cannot be established from these studies.

Recent research in the field of anxiety has addressed the issue of causality by experimentally manipulating attentional bias to emotional stimuli using the modified dot probe task (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). These results have supported the notion that attentional biases play a causal role in anxiety (in the form of emotional reactions to a stress task), and the authors of this study have developed a novel paradigm whereby attentional biases towards anxiety relevant stimuli are enhanced or lessened. Thus, cognitive biases are more likely to lead to clinical advances if they can be used in experimental paradigms that indicate the direction of causality.

There are also a number of other methodological and conceptual issues that the researcher should take into account when employing the emotional Stroop method as a measure of information processing (e.g., Rieger et al., 1998) or as a laboratory stress manipulation.

**4.7.1 The Problem of Automaticity.** It is argued that participants are not required to consciously process the affective material. Therefore any attentional bias must be inferred from reduced colour-naming latencies. Researchers have attempted to overcome this problem by employing tasks that require active identification of information (e.g., Waller et al., 1995; Waller & Meyer, 1997; Meyer et al., 2005). More specifically, some have questioned the extent to which the Stroop methodology actually demands *automatic* responses (Rieger et al., 1998). Because of this, some have questioned whether interference effects derived from this task should be interpreted as evidence of a mood-congruent attentional bias towards, or as evidence of cognitive avoidance away from threat stimuli (De Ruiter & Brosschot, 1994). Tasks such as the emotional Stroop are not, in their normal form, well suited to discriminating different attentional mechanisms (Mathews & Well, 2000). Much of the debate about the nature of attentional bias has focused around the concept of *automaticity.* A process satisfies a strong definition of automaticity if it meets three logically distinct criteria: a) initiation and termination are involuntary, b) few or no attentional resources are required for processing, and c) processing is inaccessible to conscious awareness (Schneider, Dumais, & Shiffrin, 1984). Conversely, controlled processing is said to be voluntary, resource- or capacity-limited, and partially accessible to consciousness (Schneider et al., 1984). However, the concept of a rigid dichotomy between the two processing types has been criticized, and it has been suggested that automaticity might best be conceptualized as a *continuum* (Cohen, Servan-Schreiber & McClelland, 1992). Indeed, in order to measure attentional responses at a preconscious level, cognitive researchers commonly employ the emotional Stroop task in conjunction with masked visual presentation of stimuli (i.e., the subliminal Stroop task). The subliminal Stroop task involves presenting the stimuli for a short period of time (e.g., 20 milliseconds) and then replacing the stimuli with a visual mask, which prevents conscious recognition of the stimuli. Measurement of attentional biases at a *conscious* level is thought to occur with the presentation of stimuli *without* a mask to allow conscious recognition of the stimulus content. Therefore, it is unclear whether results obtained from the unmasked Stroop task demonstrate automatic or strategic processing.

Clarification of this issue was sought within the present research through the inclusion of an incidental free recall task within the laboratory protocol, whereby approximately 30 minutes after completing of the Stroop task, participants were asked to recall as many words as they could remember from the task. It was hoped that the measure might highlight a) the extent to which Stroop words are processed at a *pre*conscious level (i.e., whether the *slowing* response commonly observed is a demonstration of an attentional bias towards, or a cognitive avoidance away from threat that is unrelated to eating), and b) whether there exists a memory bias for self-directed ego-threat stimuli in females with bulimic and restrained eating attitudes and behaviours.

Within the current research, the 'emotional' Stroop task was also modified so as to demand the more *strategic* processing of information through the inclusion of pre-test instructions for later free recall (i.e., cued recall of Stroop words). In this instance, participants were issued with conflicting demands: a) to respond to the colour of the word as quickly and as accurately as possible, and b) to memorize the words contained within the task for subsequent recall. To date, no studies have assessed food intake in response to tasks that include ego-threat stimuli, but that demand primarily *strategic* processing in order to assess the relationship between emotional arousal and bingeing in different target populations.

**4.7.2 Raw Latency versus Interference Scores.** Because the most unbiased estimate of cognitive interference entails the comparison of an individual's reaction time to target words relative to baseline scores, interference scores are commonly employed rather than raw latency scores.

However, interference scores generate stronger group comparisons than do latency scores (Dobson & Dozois, 2004). Thus, within the current research both raw latency and interference scores are reported.

**4.7.3 Choice of Stimuli.** Stimuli for the current research are taken from Waller et al. (1996). Of the 5 categories of threat words originally employed in Waller et al.'s (1996) study, the two considered most theoretically relevant are employed, namely ego-threat from self and ego-threat from others, together with their matched neutral words.

**4.7.4 Stimuli Presentation and Response Measurement.** The majority of studies assessing attentional bias in disordered eating populations have consisted of a series of words. These are generally a mixture of eating, weight, and shape words, that are presented either together under the general category of 'eating disorder relevant stimuli' (Cooper, Anastasiades, & Fairburn, 1992), or separately by word type (Cooper & Todd, 1997). Presentation of written stimuli has been carried out on cards and computer screens, in both blocks of words and single-word presentations. An alternative method employed by Walker, Ben-Tovin, Paddick, & McNamara (1995) was pictorial presentation of figures ranging from thin to fat. Associated with the card presentation is the problem of order effects. It was only possible to counterbalance the order of presentation with each pair of threat and neutral word lists within each threat category, rather than across categories, using the colour-naming card method (Waller et al. 1994). Lack of counterbalancing of the order of the presentation may lead to problems in the interpretation of findings (Lee & Sharfan, 2004). One way to overcome this problem is to employ a computer driven Stroop task, capable of random colour and word stimulus presentation across threat categories. The current research adopted this latter method, with single word presentation, within three separate trials, so that any habituation of responding could be assessed over time.

*Habitutation of Responding*

No studies to date have assessed habituation of responding to ego-threat stimuli. In this respect, the tasks employed within the current research involved the delivery of stimulus over several trials (blocks or matrices), with a 'rest' gap between each trial. It may be that trials undertaken early in the task cause a priming of 'threat' causing a carryover effect and post-attentional rumination from one trial to the next. Warren (1972) noted that it takes longer to colour name when a preceding prime is from the same semantic category as opposed to a different category. Broadbent & Broadbent (1988) have suggested that in non-clinical participants the effects of the contents of 'threat' words build during the experimental session. This is thought to be most likely due to increasing post-attentive awareness of the presence of the threatening words. Green et al., (1994) have reported habituation effects to the semantic content of body shape words in women with AN. In addition, in lexical decision tasks, priming effects have been found to occur for up to 10 minutes after the original priming stimulus (Duchek & Neely, 1989).

It is important to assess whether the tasks [that include very specific stimuli – ego threatening] presented increase, decrease or maintain their potency over time, so that in future tasks can be developed for use in studies employing restrained and bulimic symptomatic target populations that possess maximum potency [to disinhibit dietary restraint].

**4.7.5 Mode of Response.** Reaction times have been measured via stopwatches (e.g., Ben-Tovin et al., 1989), keyboard-activated equipment (Davidson & Wright, 2002), and voice activation equipment (e.g., Jones-Chesters et al. 1998). Both the use of cards for presentation of stimuli and the measurement of responses via stopwatch are crude and problematic (Jones-Chesters et al., 1998). Measurement of latencies of the individual stimuli (one word at a time) allows greater temporal precision and mapping of habituation effects. Studies that use button press response modes have been shown to lead to smaller amounts of interference (MacLeod, 1991) and button press response mode has proved more reliable than voice-activated response mode (Davidson & Wright, 2002). Therefore, button press responding was required of participants during the present research.

**4.7.6 Population: Problems with Clinical Populations.** Studies employing the emotional Stroop procedure have been conducted across three decades, and have varied in terms of the diagnostic criteria employed due to multiple revisions of the *Diagnostic Manual of Mental Disorders (APA, 2000*), possibly resulting in differential classification of participants (Rofey, Corcoran & Tran, 2004). In addition, the first diagnostic criteria employed often fails to account figures of co-morbidity – for example, substance or alcohol abuse. Studies tend to ignore the fact that there is a high co-occurrence between eating disorders and alcohol problems that may reflect what Helzer & Pryzbeck (1988) labelled Berkson's bias – "an increased tendency for persons with multiple diagnoses to seek and receive treatment and thus fall into study populations drawn from treatment sources" (p219). Wilson (1993) argues that only a minority of individuals with an eating disorder enter treatment, and it is not unlikely that those with additional disorders, such as depression or a substance problem are more likely to seek treatment and therefore be represented in clinical populations. Therefore, the present research employed females with no prior or current diagnosis of an eating disorder.

**4.7.7 Classification of Participants.** One common flaw within attentional research is that studies do not always match groups for age (Ben-Tovin & Walker, 1991). This may be a particular problem, as age has been shown to affect the Stroop interference in sub-clinical samples (Seddon & Waller, 2000).

### 4.8 Chapter Summary

Underpinning much stress research is the attempt to explain the relationship between the psychological state and mental and physical health status of the individual. Early models of stress focused on basic stimulus - (physiological) response, whereas later models place emphasis on the *meaning* of an event for the individual. Individual responses to the same stressor can vary greatly, and different types of acute stress manipulation can provoke different patterns of physiological and neuroendocrine reactivity. The intensity and duration of a physiological stress response is controlled largely by higher brain systems. Many different variables, such as the parameters of the stressor, the perception and appraisal of the threatening stimulus by the individual, the emotional response to the stimulus, prior experience, attribution processes and coping strategies all act to moderate the response.

This individual variation in responding can render the individual vulnerable to psychopathology and physical illness. Dietary restraint research has identified individual differences in the behavioural response to ego-threat stress – restrained eaters break their diets and overeat. Although many cognitive explanations have been forwarded to explain 'stress-eating' there is evidence from cardiovascular and stress research that individual differences in physiological characteristics and also the individual's physiological and biological stress response can influence their food choice and food consumption. For example, one of the major hormones released during a stress response of sufficient magnitude is cortisol. Cortisol release has been implicated in the development of abdominal obesity and in Cushing's syndrome, where an accumulation of abdominal adipose tissue is common. In the laboratory high cortisol responders have been found to consume significantly more calories than low responders, and to favour sweet food items.

It has been suggested that the effort involved in restraining one's food intake may itself be stressful, leading to increases in cortisol output and to the development of abdominal obesity via a disruption of the functioning of the HPA axis. However, evidence in this respect is inconsistent. The current research therefore investigated the relationship between dietary restraint (in females both with and without bulimic symptoms), food (and macronutrient) intake and cortisol release following stress exposure (particularly in relation to ego-threat stress) in an attempt to provide useful insight into links between the HPA axis, appetite, food choice (sweet, salty and bland) and psychological health.

# Chapter 5. Aims and Hypotheses

The present research employed non-clinical females, made up of two target populations [restrained eaters, with and without bulimic symptoms] and a control population [unrestrained eaters]. In consideration of methodological issues (see Section 6.13), data were subjected to both categorical and continuous analyses. In consideration of prior research findings (e.g., Blair et al., 1991; Renaud & Blondin, 1997; Silva & Leite, 2000; Tulen et al., 1989; Ruddell et al., 1988), it was anticipated that the tasks employed within the present research would provoke a significant *elevation* in [self-reported anxiety, physiological and biological[8]] responding, and a significant *lowering* of self-reported self-esteem, for all participants, when compared to baseline measurements.

**Aim 1: Stress-Induced Eating**

The first main aim was to test two competing theoretical explanations of bingeing – the limited capacity versus the 'escape' theory (see Sections 2.9 and 3.5). The following predictions were made:

**Study 1**

**H1.** Condition 1 [unmasked Stroop task containing ego-threat word stimuli: ***high emotional/low cognitive loading***] would provoke greater responding [S-R mood and food intake] than Condition 2 [unmasked Stroop task containing incongruent colour words: ***low emotional/low cognitive loading***] in target populations when compared to a control population.

**Study 2**

**H2.** Condition 2 [unmasked Stroop task containing ego-threat word stimuli, accompanied by pre-test instructions for later word recall: ***high emotional/high cognitive loading***] would provoke greater responding [S-R mood, physiological and biological reactivity, and food intake] than Condition 1 [unmasked Stroop task containing ego-threat word stimuli: ***high emotional/low cognitive loading***] in target populations when compared to a control population.

**Study 3**

**H3.** Condition 2 [serial addition math task [MAT], accompanied by an audio [distraction] tape [containing ego-threat word stimuli], plus pre-test instructions for later word recall: ***high***

[8] physiological and biological measures were employed in study 2 and 3 only.

***emotional/high cognitive loading***] would provoke greater responding [S-R mood, physiological and biological reactivity, and food intake] than both Condition 1 [MAT: ***low emotional/low cognitive loading***] and Condition 3 [MAT, accompanied by an audio [distraction] tape [containing neutral word-threat stimuli], plus pre-test instructions for later word recall: ***low emotional/high cognitive loading***] in target populations when compared to a control population. Condition 3 would provoke greater responding than Condition 1.

In consideration of the continuum model of BN (Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987) it was also anticipated that the results derived from each of the three studies would exist as a function of symptom severity. In addition, in consideration of the new generation schema-based emotional model of BN (Waller, submitted for publication – see Mountford et al., 2004), it was anticipated that overeating would occur in response to tasks that contained either an *explicit* [study 1: condition 1, study 2: condition 1 and 2, and study 3: condition 2] or *implicit* [all tasks] threat to the ego, and in response to tasks where ego-threatening information was required to be strategically processed (study 2: condition 2 and study 3: condition 2). Further, overeating in response to stress would add support for Herman & Polivy's (1980) restraint theory (see Section 2.4).

**Aim 2: Arousal responses to [post-stress] food intake**

The second aim of the present research was to assess arousal responses [self-reported anxiety and self-esteem, and physiological and biological] to food intake. Given that prior research results regarding the effect of post-stress food ingestion are either conflicting or unavailable, no specific predictions were made in this respect.

**Aim 3: Information processing and memory bias**

The third main aim of the current research was to ascertain the existence of information processing and memory biases for schema-relevant cues *unrelated* to eating (self-directed ego-threat) in non-clinical females who self-reported bulimic symptoms, and in restrained eaters, who self-reported no such symptoms. In consideration of the 'escape' theory of bingeing (Heatherton & Baumeister, 1991), the new generation schema-based emotional model of BN (Waller, submitted for publication – see Mountford et al., 2004), and the continuum model of BN (Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987) (see Chapter 3) the following predictions were made:

**Information processing bias**

**H4.** Target populations would demonstrate a significant *slowing* in the time taken to colour-name self-directed ego-threat stimuli when the task employed involved [primarily] the *automatic* processing of information [Study 1, condition 1; Study 2, condition 1], when compared to a control population, and when compared to the time taken to colour name matched neutral word stimuli.

**Memory bias**

**H5.** Target populations would demonstrate a greater recall of self-directed ego threat words when compared to a control population, and when compared to the number of matched neutral word stimuli correctly recalled.

It was also anticipated that the predicted [information processing and memory bias] results would exist as a function of symptom severity.

**Aim 4: Habituation effects/Temporal responding: The problem of 'automaticity' of the Stroop task.**

The fourth aim of the present research was to assess whether temporal (see Section 4.7.1) and habituation (see Section 4.7.4) effects occur in terms of the information processing of ego-threat stimuli, when information is processed over several trials, and to address the problem of the extent to which the unmasked emotional Stroop task demand the automatic processing of information (see Section 4.7.1). Given that prior research results relating to these issues are either conflicting or unavailable, no specific predictions were made in this respect.

# Chapter 6. General Methodology

## 6.1 Chapter Overview

This Chapter outlines some of the common methodology that is employed throughout the thesis. Details of participant selection, laboratory protocols and tasks employed are provided, together with information relating to data reduction and analysis.

There were three experiments:

*Experiment 1* compared the effects of an ego and conventional [colour] Stroop task in a between subjects design. Self-reported anxiety, self-esteem, response times to and delayed and incidental free recall of ego threat and neutral stimuli were recorded, along with ice cream and water consumption (see Figure 4 for laboratory protocol). Subsequent experiments adopted a psychophysiological approach to the measurement of the stress response. Heart rate was measured continuously, and measures of blood pressure and salivary cortisol were obtained at various time points throughout the laboratory protocol.

*Experiment 2* employed the ego Stroop task (used in Experiment 1) in two conditions; with and without pre-test instructions for later immediate free word recall (ego recall vs ego Stroop). A between subjects design was employed. Measures of self-reported anxiety, self-esteem, and response times to and recall of threat and neutral stimuli were recorded, together with intake of ice cream and water (see Figure 5 for laboratory protocol).

*Experiment 3* employed a repeated measures design with three conditions, a) mental arithmetic task with no audio distraction tape (MAT: no tape), b) mental arithmetic task with audio distraction tape incorporating ego-threat words (MAT: ego tape), and c) mental arithmetic task with audio distraction tape incorporating neutral-word stimuli (MAT: neutral tape) (see Figure 6 for laboratory protocol). Measures of self-reported anxiety, self-esteem and [cued and immediate] free recall of threat and neutral stimuli were recorded, together with intake of water and snack foods categorized as sweet, salty and bland.

Figure 4. Experimental Protocol for Study `1`

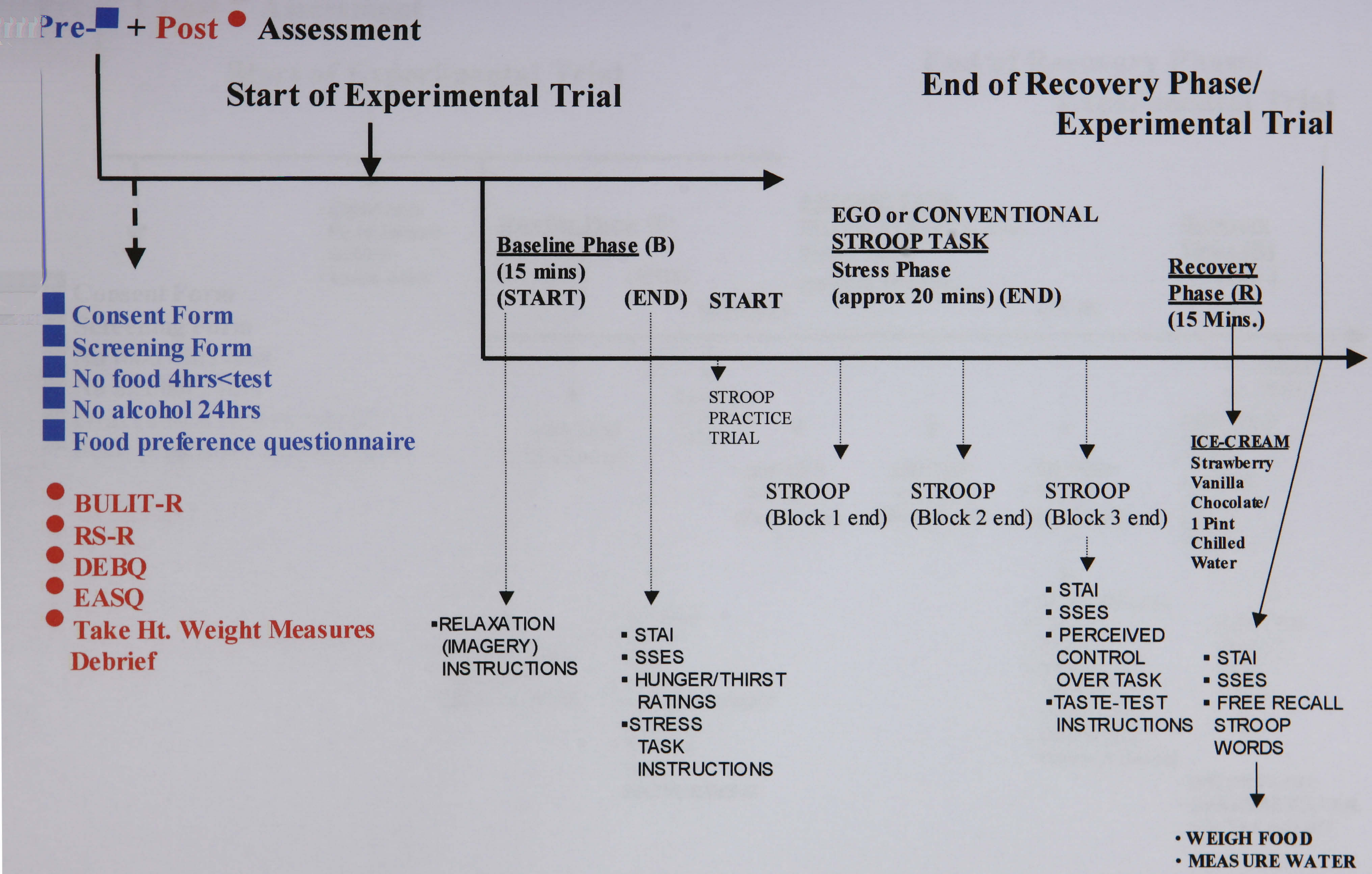


Figure 5. Experimental Protocol for PhD Study 2

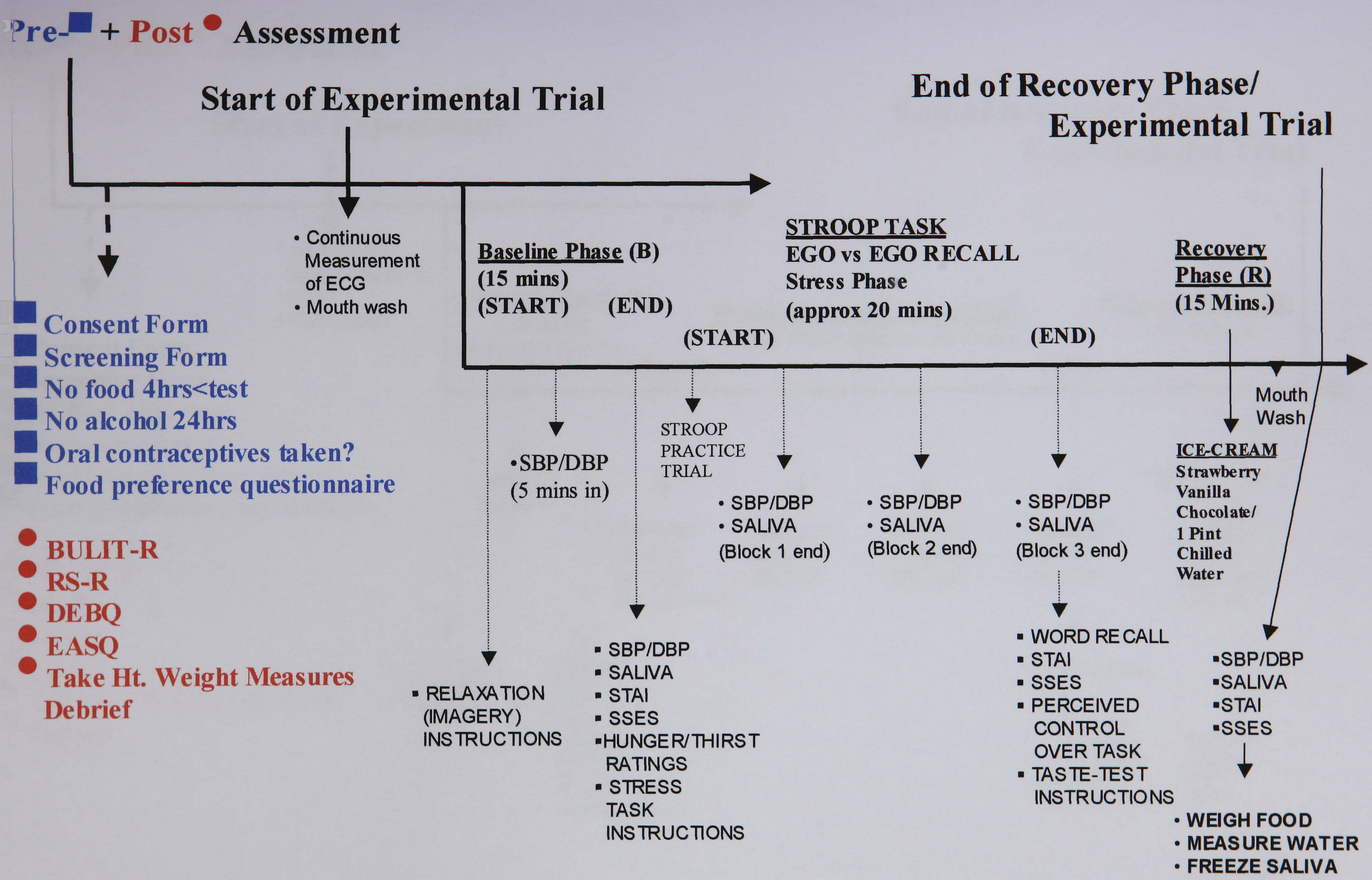
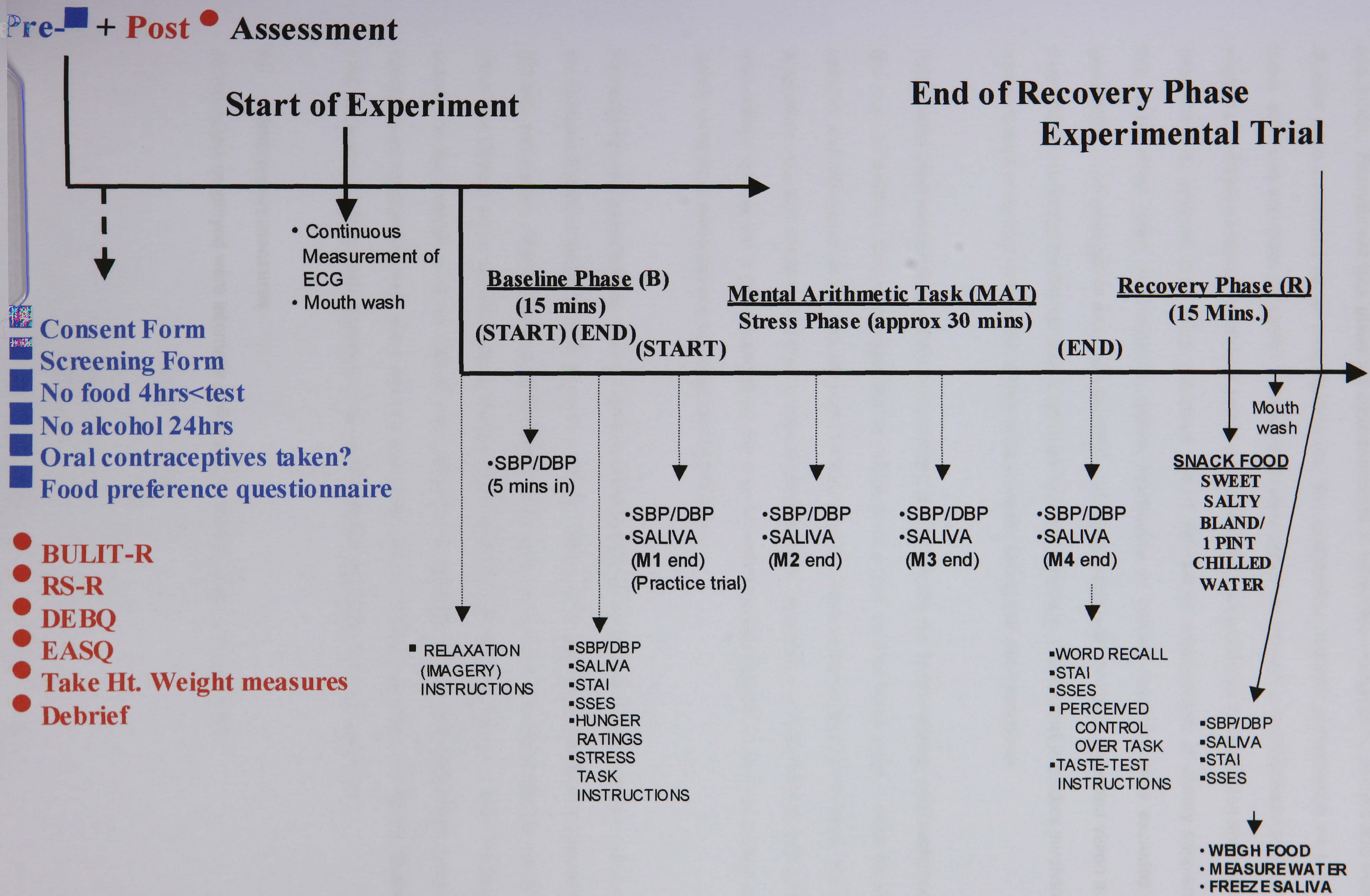


Figure 6. Experimental Protocol for Study 3



## 6.2 Selection of Participants

Participants were normal weight, non-clinical females recruited from the University (staff and student) population. Recruitment took place via advertisements in University newspapers, posters and mailings. Studies were advertised as an investigation into 'the relationship between performance on laboratory tasks, emotions and taste perception'. Participants were screened through a questionnaire to determine eligibility. Individuals reporting medical problems (especially heart problems, hypertension and epilepsy), food allergies, dyslexia, pregnancy, excessive use of substances, medications, or dietary supplements that could affect heart rate, appetite, gastric functioning or cortisol reactivity were excluded from participation. All participants were non-smokers. All participants had normal or corrected vision and, in experiments involving the Stroop task, English as their first language. Participants in studies involving the measurement of cortisol were asked if they were currently taking oral contraceptives.

Participants were requested to refrain from drinking alcohol on the day before testing, and throughout the test day. In addition, they were requested to refrain from eating for four hours prior to each laboratory session, and adherence to this request was checked prior to commencement of each session. For study 3, students received credit toward their course for participation. In addition, a financial incentive of £5.00 was offered for the top 3 performances on the mental arithmetic test (based on the percentage of the matrix completed and accuracy achieved during the task).

Participants were classified as having high/low restraint/bulimic symptoms using a median split on both the Revised Restraint Scale (RS_R: Herman & Polivy, 1980), the Dutch Eating Behaviour Questionnaire (DEBQ: van Strien, Frijters, Bergers, & Defares, 1986) (see Section 2.8.1 for rationale for use of both RS-R and DEBQ) and a cut-off of 80 on the Bulimia Test (BULIT-R: Smith & Thelan, 1984). Participants scoring on the median or at the cut-off were classified as possessing low restraint/bulimic symptoms. Sample size calculations were estimated using a general power analysis program (G*Power) (Erdfelder, Faul, & Buchner, 1996). (*see Appendix 1 for confidentiality, screening and consent form*)

## 6.3 Self-report measures

All measures employed were internally consistent (Cronbach's alpha = 0.85-0.95).

**6.3.1 Revised Restraint Scale** *(RS_R:* Herman & Polivy, 1980) is a measure of restrained eating status. This scale includes 10 questions rated along 4-5-point Likert scales covering current dieting habits, weight fluctuation history, and excessive concern about eating. Items are summed to give a total ranging from 0-35. A higher score indicates a higher level of dietary restraint. The validity of this scale has been tested (Heatherton, Herman, Polivy, King & McGree, 1988) *(see Appendix 2 for questionnaire).*

**6.3.2. The Bulimia Test** *(BULIT-R)* (Smith & Thelan, 1984): A 36-item multiple-choice questionnaire designed to investigate bulimic (including binge-eating) behaviour. Participants are provided with a choice of five answers ranging from "strongly agree" to "strongly disagree" and are required to indicate where they consider themselves to be in relation to various binge-eating behaviours. Some of the items on the scale are reverse scored. A higher score represents a higher level of bulimic symptoms *(see Appendix 3 for questionnaire).*

**6.3.3.** The restraint sub-scale of the **Dutch Eating Behaviour Questionnaire** (DEBQ; van Strien, Frijters, Bergers, & Defares, 1986) is a measure of restrained eating status. This is a 33-item instrument designed to assess three aspects of eating behaviour: restrained eating; emotional eating; and external eating. Only the restraint sub-scale, which consists of 10 items concerning deliberate, planned weight control efforts, was used in this research. Participants rate each item with respect to how often they engage in each particular restrained eating behaviour, ranging from "never" to "very often." The mean on these 10 items is calculated resulting in an average score ranging from 0-5. A higher score represents a higher level of restrained eating. The validity of this scale has been tested (Wardle, 1986;1987). *(see Appendix 4 for example questionnaire).*

**6.3.4** The state anxiety sub-scale (Form Y-1) of the **State-Trait Anxiety Inventory** (STAI: Spielberger & Vagg, 1984) was used to measure state anxiety. This self-report measure consists of 20-items that assess how one feels at this particular moment in time. Respondents indicate the presence of anxiety on a four-point scale ranging from 1 (not at all) to 4 (very). Some of the 20 items on the scale are reverse scored. Higher scores on this questionnaire reflect a higher level of anxiety. (*see Appendix 5 for questionnaire).*

**6.3.5 The State Self-Esteem Scale** (SSES: Heatherton and Polivy, 1991) was designed to assess short-lived changes in self-esteem. This scale consists of 20 items modified from the Janis-Field Feelings of Inadequacy Scale (1959). Some items on the scale are reverse scored. A *lower* score on this scale indicates *lower* self-perceptions of self-esteem (*see Appendix 6 for questionnaire*).

**6.3.6 The Eating Attributional Style Questionnaire-Revised** (EASQ_R). This questionnaire was based on the Attributional Style Questionnaire (e.g., Peterson, 1991). The questionnaire comprises six scenarios depicting persons eating low- or high-calorie food items.

Three of the scenarios in the EASQ depict the questionnaire respondent as displaying *moderation* in eating, and they are: a) you receive a box of your favourite chocolates at Christmas. You eat two and share the rest with friends and family; b) you are at a friend's birthday party where there is a table full of your favourite foods, including chocolate cheesecake. You eat a salad and for dessert a slice of melon and a few strawberries; c) you and your friends go to the cinema. Your friends decide to buy their favourite ice cream, popcorn sweets and cola. You have a cup of coffee only. Three of the scenarios depict the questionnaire respondent as *indulging* in fattening food, as follows: a) you are at home, alone, watching a movie on TV. You eat a big bag of crisps with a dip and drink a couple of cans of cola; b) It's Easter and you go shopping for chocolate eggs for an Easter egg hunt. You decide to buy your favourites because if there were any left over you would hate to see them go to waste. You arrive home and eat all the chocolate eggs you bought before anyone else arrives; c) you go to a relative's house for a big Christmas dinner with all the trimmings. You have two helpings of everything and a slice of chocolate cake with ice cream for dessert.

In order to answer this scale, the respondent was required to imagine that she was the protagonist in each scenario in the EASQ and then to rate on a seven-point Likert scale:

a) the extent to which the eating behaviour described was due to something about you or something about other people or circumstances (***locus of control***)(1 = totally due to other people or circumstances; 7 = totally due to me);

b) the degree to which the person felt they had control over what caused the eating behaviour in the scenario (***control A***)(1 = no control; 7 = complete control);

c) the extent to which that cause would be present in the future (***stability***) (1 = will never again be present; 7 = will always be present);

d) the degree to which the individual felt they had control over eating the food depicted in the scenario (***control B***) (1 = no control; 7 = complete control);

e) the extent to which that cause influences only that given eating behaviour or influences other life situations (***globality***)( 1 = a cause only of this particular event; 7 = a cause of many other similar events);

f) the degree to which the questionnaire respondent could change what caused the eating behaviour described in the scenario (***change***) (1 = not at all change; 7 = completely change); and

g) the extent to which the situation would be important if it happened to her (***importance***). This latter question served as a validity check on the food consumption incidents. (*see Appendix 7 for example questionnaire).*

**6.3.7 Food preference ratings** were obtained (1= really dislike, 5 = really like) for peanuts, apples, plain crackers, sponge cake, pizza, ice cream, crisps, chocolate, and oranges) (*see Appendix 8 for questionnaire).*

**6.3.8 Hunger and thirst ratings** were obtained (1= not (hungry/thirsty, 10 = very (hungry/thirsty). These were later employed as a manipulation check to ensure no group differences were in existence in terms of pre-test self-reported perceptions of hunger and thirst.

**6.3.9 Perceived control over task.** Participants were asked to indicate on a seven-point scale ranging from 1, "none at all" to 7, "complete" how much control they felt they had over the experimental task undertaken.

**6.3.10 Dieting status.** Participants were asked to indicate whether they were currently dieting to lose or maintain weight.

## 6.4 Anthropomorphic measurements

**6.4.1 Weight measures** were taken using Weylux Electronic Scales®. The weighing instrument was calibrated prior to each day's measurement sessions. Participants were requested to remove shoes, heavy outer garments such as jackets and cardigans, heavy jewellery, loose change and keys. Measurement was obtained with the participant standing with feet together in the centre of the scale, with arms hanging loosely at their sides and head facing forward.

**6.4.2 Height measures** were obtained using a stadiometer (a device with a sliding head plate, a base plate and back plate with measuring scale). With shoes removed, the participant was requested to stand on the centre of the base plate, feet together and heels against the rod. The participant's back was positioned as straight as possible against the rod (but not leaning on it), their arms hanging loosely by their sides. With the participant facing forwards, and the head at right angles to the chest, she was instructed to breathe in deeply and to stretch to her fullest height. The head plate was positioned onto the participant`s head, and a measurement taken. From the measurements of weight and height, Quetelet`s Body Mass Index (BMI) was calculated as a ratio of weight (kg) to height (m) squared.

## 6.5 Cardiovascular Measures

**6.5.1 Electrocardiogram: ECG`s** (QRS complex) were continuously recorded (sampling rate, 200 samples/second) by means of a standard three-lead ECG procedure (Guyton & Hall, 1996) and disposable Ag/AgCl electrodes connected to the BIOPAC MP100 multichannel physiological data acquisition system (BIOPAC Systems Inc.). Data were stored for off-line analysis with Acqknowledge software (BIOPAC Systems Inc.). Markers to indicate the beginning and end of each experimental phase, and sub-sections of the task phase were inserted manually, for all experiments.

**6.5.2 Systolic (SBP)** and **Diastolic (DBP)** were recorded using a standard occluding cuff attached to the participant's upper, non-dominant arm. Inflation of the occluding cuff was performed manually using a Vital Signs Monitor (Critikon Dinamap®) at certain time-points throughout three laboratory phases (baseline, task and recovery) (see Figures 5 and 6).

### 6.6 Neuroendocrine measure

#### 6.6.1 Salivary Cortisol.

Saliva was collected at specific intervals during the experimental protocol (see Figures '5' and '6') for the assessment of cortisol, using the salivette (Sarstedt™). The salivette is a centrifuge vessel containing a suspended insert in which there is a cotton wool swab, this is sealed with a stopper. Participants were instructed to place the cotton dental roll in one side of the mouth (between the gum and inner side of their cheek) and gently chew on the swab for two minutes. The swab was then replaced into the salivette and was stored in a freezer at approximately $-20^{O}$C. In order to extract the saliva from the cotton wool swab, the salivettes were centrifuged at 5000 rpm for 10 minutes. The inner chamber of the salivette, and cotton roll, were removed and the saliva was stored in a freezer at approximately $-20^{O}$C.

#### 6.7.1 Laboratory Tasks

Experiment 1 employed both the conventional and ego Stroop. Experiment 2 employed the ego Stroop in two conditions: with and without free word recall. Experiment 3 employed the Mental Arithmetic Task with audio distraction tape.

#### 6.7.2 Stroop

**6.7.2 The conventional Stroop** task requires participants to respond to incongruent colour-names (red, yellow, green, blue). Control stimuli for this task are strings of four Xs (XXXX) printed in either one of the four Stroop stimuli colours.

**6.7.3 The ego Stroop** task comprises two categories of threat word; *self directed ego threat* – failure, stupid, ugly, inadequate, bad, inferior, worthless, defeated, and *ego threats from others* – ridiculed, sniggered, derided, mocked, jeered, criticised, humiliated, insulted. Associated with each threat word is a neutral (control) word, matched in terms of frequency of use within the English language, initial letter, word length, and (as far as possible) number of syllables; *self directed ego threat control words* – flowers, skilled, urban, innumerable, bit, immortal, wavering, deciding. *Ego-threat from others control words* – reappeared, snookered, destined, modelled, jogged, commended, heralded, immersed. (words were taken from Waller et al., 1996). The ego Stroop task was originally programmed by Simon Chu[9], and modified for use in the studies within this thesis by the thesis Author in terms of number of threat categories included, font size, and inter-stimulus interval.

#### 6.7.3.1 Presentation of Stroop stimuli.

For both tasks, threat and neutral words were displayed centrally in lower case on a Dell Pentium computer, with 14" high-resolution flat screen colour monitor (using the ERTS (Experimental Run-Time System software, with MS-DOS) in an Arial size 18 font, with a 32-ms inter-stimulus-interval (Sharma & McKenna, 2001). Stimuli were colour-named one at a time. Each of the 32 ego Stroop stimuli was presented three times (96 presentations in total). Each of the 8 conventional Stroop stimuli was presented twelve times (96 presentations in total) per block, with three blocks, separated by a thirty-second rest period. The order of presentation was randomised, with the restriction that no identical stimuli should follow each other. Response times were recorded in milliseconds.

#### 6.7.3.2 Practice stimuli.

Experimental trials were preceded by a practice trial consisting of strings of A`s (AAAA) and O`s (OOOO), printed in either one of the four Stroop colours. Correct/incorrect feedback was provided for the first twenty of forty stimuli presentations within the practice trial. Response times were recorded in milliseconds.

---

[9] Dr. Simon Chu is currently a lecturer at UCLAN.

### 6.7.4 Mental Arithmetic Task (MAT)

This task was adapted from a method originally described by Ruddel, Langewitz, Schachinger, Schmieder, & Schulte (1988). The task involved one practice trial and three experimental trials. For each trial a matrix of numbers (1 to 51) was displayed to participants on a computer screen. Each matrix was divided into three boxes, green (5 rows), blue (5 rows), red (5 rows). Each row contained 11 or 12 numbers. The matrix remained on the screen for 5 minutes. Participants were required to add up as many of the numbers as possible during that time. At the end of the 5-minute period, participants were asked to provide the following information: a) their total, b) the row they reached, c) the last number they added to the total. A financial incentive was offered for completion of the task, based on the percentage of the matrix completed and the accuracy achieved during the task. Following completion of a practice matrix, participants were presented with three further (experimental) matrices. All participants completed the mental arithmetic challenge on their first visit to the laboratory, without an accompanying audio-distraction tape (Condition 1). The order of Condition 2 (with audio-distraction tape containing ego-threatening words) and Condition 3 (with audio-distraction tape containing neutral words) was randomised amongst participants to eliminate order effects. Words used in each distraction tape were taken from Waller, et al. (1996). Words were recorded one at a time at a pace of 1 every two seconds, and were superimposed over white noise. Audio-distraction tapes were played at 70dB, and were designed to increase the difficulty of the task. Instructions for the task were presented to participants on the computer screen immediately prior to the task using a Dell Pentium computer with PowerPoint display and automatic timing (*see Appendix 10 for task instructions*).

## 6.8 Food items

Macronutrients are defined broadly as those food components which are present in quantities of one gram or more in the daily diet, and which generally provide energy. They therefore include protein, fat and carbohydrates.

***Ice cream*** macronutrient information for strawberry, vanilla and chocolate ice cream (Morrisons Soft Scoop ®) (used in Experiment 1 and 2) can be viewed in Table 3. Ice cream was stored in a chest freezer at a constant temperature of $-2^{o}$F.

**Table 3. Macronutrient content of ice cream – Experiment 1 and 2**

| Brand | Item | Nutritional Information | Per 100g |
|---|---|---|---|
| Morrisons® | Strawberry Soft Scoop | Energy | 169 kcal |
| | | Protein | 2.8g |
| | | Carbohydrate | 23.0g |
| | | Fat | 7.3g |
| Morrisons® | Vanilla Soft Scoop | Energy | 202 kcal |
| | | Protein | 3.8g |
| | | Carbohydrate | 24.9g |
| | | Fat | 9.7g |
| Morrisons® | Chocolate Soft Scoop | Energy | 174 kcal |
| | | Protein | 3.6g |
| | | Carbohydrate | 24.0g |
| | | Fat | 7.1g |

***Snack food*** macronutrient information for snack foods categorised as sweet (miniature chocolate bars), salty (ready salted crisps and peanuts) and bland (plain crackers) (used in experiment 3) can be viewed in Table 4.

***Water.*** Although unable to provide energy, water is also considered a macronutrient. For all experiments, participants were provided with 20 fl. oz (UK) (568 millilitres or 1 pint) of chilled water, along with food items served

**Table 4. Macronutrient content of food items - Experiment 3**

| Brand | Item | Multipack weight | Individual item weight (minus wrapper) | Nutrition information | | | |
|---|---|---|---|---|---|---|---|
| Walkers | Crisps Ready salted | 12 x 25g | 25g | | **Per pack** | **Per 1g** | **Per 100g** |
| | | | | Energy | 550kj | 22.00kj | 2200kj |
| | | | | | 133 kcal | 5.30kcal | 530kcal |
| | | | | Protein | 1.6g | .065g | 6.5g |
| | | | | Carbohydrate | 12.3g | .492g | 49.0g |
| | | | | Fat | 8.5g | .34g | 34.0g |
| Cadbury | Twirl (choc bars) | 300g | 22g | | **Per finger** | **Per 1g** | **Per 100g** |
| | | | | Energy kj | 480 | 21.95kj | 2195 |
| | | | | Kcal | 115 | 5.25kcal | 525 |
| | | | | Protein g | 1.8 | .018g | 8.1 |
| | | | | Carbohydrate g | 12.3 | .559g | 55.9 |
| | | | | Fat g | 6.6 | .301g | 30.1 |
| Cadbury | Crunchie (choc bars) | 274g | 18g | | **Per bar** | **Per 1g** | **Per 100g** |
| | | | | Energy kj | 345 | 19.60kj | 1960 |
| | | | | Kcal | 80 | 4.65kcal | 465 |
| | | | | Protein g | 0.7 | .040g | 4.0 |
| | | | | Carbohydrate g | 12.6 | .720g | 72.0 |
| | | | | Fat g | 3.2 | .181g | 18.1 |
| Mars | (choc bars) | 439g | 21g | | **Per 100g** | **Per 1g** | **Per pack** |
| | | | | Energy | 1867kj | 18.67kj | 358kj |
| | | | | | 444 kcal | 4.44kcal | 85kcal |
| | | | | Protein | 3.7g | .037g | 0.7g |
| | | | | Carbohydrate | 69.6g | .696g | 13.4g |
| | | | | Fat | 16.8g | .168g | 3.2g |
| Masterfoods Holland | Twix (choc bars) | 406g | 29g | | **Per 100g** | **Per 1g** | **Per pack** |
| | | | | Energy | 2070kj | 20.70kj | 601kj |
| | | | | | 494 kcal | 4.94kcal | 143kcal |
| | | | | Protein | 4.6g | .046g | 1.3g |
| | | | | Carbohydrate | 64.8g | .648g | 18.8g |
| | | | | Fat | 24.1g | .241g | 7.0g |

**Table 4 cont.....**

| Brand | Item | Multipack weight | Individual item weight (minus wrapper) | Nutrition information | | | |
|---|---|---|---|---|---|---|---|
| Masterfoods Holland | Bounty (choc bars) | 427g | 29g | | **Per 100g** | **Per 1g** | **Per pack** |
| | | | | Energy | 1972kj | 19.72kj | 563kj |
| | | | | | 471 kcal | 4.71kcal | 134kcal |
| | | | | Protein | 3.7g | .037g | 1.1g |
| | | | | Carbohydrate | 56.4g | .564g | 16.1g |
| | | | | Fat | 25.6g | .256g | 7.3g |
| Masterfoods Holland | Snickers (choc bars) | 439g | 19g | | **Per 100g** | **Per 1g** | **Per pack** |
| | | | | Energy | 2075kj | 20.75kj | 414kj |
| | | | | | 496 kcal | 4.96kcal | 99kcal |
| | | | | Protein | 9.3g | .093g | 1.9g |
| | | | | Carbohydrate | 53.8g | .538g | 10.7g |
| | | | | Fat | 27.1g | .271g | 5.4g |
| Mars | Milky Way | 406g | 17g | | **Per 100g** | **Per 1g** | **Per pack** |
| | | | | Energy | 1880kj | 18.80kj | 316kj |
| | | | | | 447 kcal | 4.47kcal | 75kcal |
| | | | | Protein | 3.7g | .037g | 0.6g |
| | | | | Carbohydrate | 71.6g | .716g | 12.1g |
| | | | | Fat | 16.2g | .162g | 2.7g |
| Morrisons | Peanuts Salted | | 100g | | **Per 100g** | **Per 1g** | |
| | | | | Energy | 2559kj | 25.59kj | |
| | | | | | 618kcal | 6.18kcal | |
| | | | | Protein | 23.0g | .230g | |
| | | | | Carbohydrate | 12.4g | .124g | |
| | | | | Fat | 52.9g | .529g | |
| Jacobs | Cream crackers | 200g | 16g (=2 cracker pack) | | **Values per 8g cracker** | **Per 1g** | **Per 100g** |
| | | | | Energy | 148kj | 18.75kj | 1875kj |
| | | | | | 35kcal | 4.46kcal | 446kcal |
| | | | | Protein | 0.8g | .096g | 9.6g |
| | | | | Carbohydrate | 5.4g | .685g | 68.5g |
| | | | | Fat | 1.2g | .148g | 14.8g |

PAGE MISSING IN ORIGINAL

## 6.9 The Laboratory Procedure

Participants were tested individually in the Cardiovascular Psychophysiology Laboratory, located at the University of Central Lancashire. Approval was obtained from the local ethics committee. Prior to commencement of the laboratory session, participants were screened for eligibility to participate. A brief overview of the laboratory procedure was provided, as was an opportunity for the participant to ask questions. Informed written consent was obtained from all participants. Participants arrived at the laboratory having fasted for 4 hours, and having abstained from drinking alcohol on the day before each test day, and throughout each test day. Adherence to these requests was checked prior to commencement of the experimental session. Details of current dieting status (See Section 6.3.10) and food preferences (see Section 6.3.7) were obtained, and participants were asked to confirm that they were non-smokers, and whether or not they were currently taking oral contraceptives. In experiments where cardiovascular reactivity was measured (study 2 and 3), participants were attached to monitoring equipment via electrodes and a blood pressure cuff, and continuous recording of ECG began. Participants were requested to avoid movement as much as possible to avoid influencing physiological measurement. All recording equipment was located behind a partition. Where salivary cortisol was measured (study 2 and 3), participants were required to use a mouthwash prior to commencement of the experimental session, and again at the end of the recovery period (after food ingestion). Throughout the experimental session, the participant remained seated in a chair, located opposite to a computer.

The laboratory procedure consisted of three distinct phases: baseline, task and recovery. Self-reported measures of anxiety (STAI: see Section 6.3.4) and self-esteem (SSES: see Section 6.3.5) were taken at the end of each phase. For study 1 and 2, the task phase was made up of three separate Stroop blocks (B1, B2, and B3). For study 3, the task phase was made up of four separate maths matrices (M1, M2, M3, and M4). For study 2 and 3, measures of SBP, DBP and saliva were taken at the end of the baseline, task (study 2: end Stroop B2, B2, and B3; study 3: end M1, M2, M3, and M4), and recovery phase (see Figure 4, 5, and 6 for experimental protocol used in study 1, 2 and 3).

### 6.9.1 The Baseline Phase (duration 15 minutes).

Immediately prior to commencement of the 15-minute baseline period, lighting in the laboratory was dimmed, and participants were issued with the following relaxation (imagery) instructions:

> *"I would like you to use your imagination to help you relax. Begin by imagining being in a very pleasant and happy mood. Imagine that you are doing something you really like, such as lying on a warm, sandy beach, with the sound of the waves in the distance. Imagine what you can see and what you can feel. You can close your eyes if you wish. Breathe in deeply and then breathe out slowly, relaxing your muscles. You should feel peaceful and relaxed. Just let go, and enjoy the calm, relaxed feeling.*

Participants were left alone for the entire duration of the baseline period, interrupted only when a blood pressure reading was taken (from behind the partition), 5 minutes into the session. Ratings of hunger and thirst were obtained at the end of the baseline phase

### 6.9.2 The Task phase (duration approx. 20 minutes)

#### 6.9.2.1 Study 1

Participants completed either the conventional Stroop task or the ego-threat Stroop task (see Section 6.7.1). Participants were seated approximately 55 cm from the computer monitor, and were informed that all instructions for the task they were about to undertake would be presented on the computer screen. The experimenter then returned to a position behind the partition to monitor the participant's responses to the stimuli on another computer screen, connected to the participant's computer. This served as a check that the participant understood the task, and (for Experiment 2 and 3) to inform the experimenter when blood pressure readings and saliva samples should be obtained, and when markers should be inserted for ECG recordings, and also to indicate the beginning and end of Stroop blocks. The following instructions were displayed to participants for the Stroop tasks:

> *"You will see words written in different colours. Each word will appear in either RED, YELLOW, GREEN or BLUE. Press the button on the keyboard corresponding to the colour of the word which appears."*
>
> *"You will have 40 practice trials at this task. In these practice trials, rows of A's or O's will appear on the screen in different colours."*

Once the participant had completed the practice block, the following instructions were displayed:

> *"You will now have a series of trials with real words. Ignore the meanings of the words. Just respond to the colours in which they appear. The task will run in 3 parts with a 30-second break between each part. Respond as quickly and accurately as you can."*

During rest periods, participants were issued with the following instructions:

> *"You should rest your hands and eyes for a few seconds. The task will continue shortly."*

Then, at the end of the rest period, the following message was displayed:

> *"To continue with the task, please press any of the response keys."*

Participants were not provided with feedback regarding their performance on any Stroop task. Participants undertaking the ego Stroop task were asked to perform an *incidental* free recall task of words contained within the ego Stroop task they had previously undertaken at the end of the recovery phase.

#### 6.9.2.2 Study 2

Participants completed either the ego Stroop task (see Section 6.7.3), with or without pre-test instructions for later word recall. For both tasks, instructions were as per Experiment 1 with the exception that, immediately prior to undertaking the ego recall Stroop task, participants were informed that they should complete the task in the normal way, but that at the end of the task they would be provided with a sheet of paper, and that they should write down as many words as they could remember from the Stroop task. A time limit of three minutes was allowed for word recall. Participants undertaking the ego Stroop task were asked to complete an *incidental* free recall task following completion of the ego Stroop task.

#### 6.9.2.3 Study 3.

All participants undertook the Mental Arithmetic Test (MAT), with no distraction (audio) tape condition first (Condition 1: MAT: no tape). Thereafter, the order of condition 2: MAT with audio distraction tape containing ego-threat words (ego threat from self and ego threat from others) (MAT: ego tape), and condition 3: MAT with audio distraction tape containing matched neutral words (MAT: neutral tape) was randomised (see Section 6.7.5. for MAT conditions details). Initially, participants were informed that a monetary reward of £5.00 could be earned, if their performance ranked in the top three performances for each of three experimental conditions. The performance-related financial incentive and the expectation concerning other individuals' performance (see below) were strategies used to maximise effort and task involvement amongst the participants. Participants were informed that all instructions for the task were located on the computer monitor. The experimenter then returned to behind the partition to monitor progress on another computer screen, connected to the participant's computer. The following instructions were presented to the participant via PowerPoint display, with automatic timing:

**Slide `1`: The Serial Mental Arithmetic Challenge.**

*"Are you ready!"*

**Slide `2`: Instructions.**

*"During the challenge you will see 4 mental arithmetic matrices, projected on the screen. Each will be displayed for 5 minutes. Your challenge is to add up as many of the numbers in the matrix as you can in five minutes."*

**Slide `3`: Presentation of the Matrix Slides.**

*"Start at the beginning of line one and add all the numbers in the* **row.** *Carry your total from the end of each row to the next line, as you try to add up all the numbers on the slide. Keep working until you reach the end of the slide, or the presentation of the matrix ends and you are instructed to stop. The slide will then be displayed again, and you will be asked for, a) your total, b) the row you reached, c) the last number you added to your total."*

**Slide `4`: Your performance........**

*"How well you do on the challenge depends upon two factors: a) how far you got through the slide, b) how accurate was your total. You should try to work quickly but accurately. If you make a mistake or lose your place, you should start again."*

**Slide `4`: Each arithmetic problem matrix is colour banded**

"In the past we have found that:

- 85% of people taking the maths challenge easily add up all the numbers in the first 5 rows, completing the green zone.
- 25% of people add up all the numbers in the first 10 rows, completing both the green and blue zones.

- Only 2 people have ever added up all the numbers, completing green, blue and red zones correctly."

**Slide `5`** displayed a full size example of a matrix and asked participants whether they could see the numbers clearly. **Slide `6`** prompted participants to ask any questions they might have, and **Slide `7`** began the build-up to the first matrix, with the words "Are you ready for Matrix `1`."

Upon completion of Matrix 1, participants were asked for their total, the row they had reached, and the last number they had added. They were then informed that Matrix `1` was undertaken for practice purposes only, and that the procedure would be repeated, with the presentation of three more experimental matrices. Any questions the participant had at this stage were answered.

### 6.9.3 The Recovery phase: taste-test paradigm)(duration 15 minutes)

#### 6.9.3.1 Ice cream taste test (Study '1' and '2')

Participants were presented with three bowls, each filled with 100 grams (frozen = 98 grams melted) of either vanilla, chocolate or strawberry ice-cream. Presentation of ice-cream flavour was randomised. Participants were asked to taste and rate each ice cream, and were issued with the following instructions:

> *"Please circle one number to indicate your opinion to these questions. Take as many spoonfuls as you need to make your decision."*

On a 10-point scale (1=not at all to 10=very), participants were asked to decide a) how sweet the ice cream was, b) how salty the ice cream was, c) how they would rate the taste of the ice cream, and d) how much they liked the ice cream. When participants had completed the rating sheet for ice cream `A`, they were asked to proceed to the rating sheet for ice cream `B`, and then to the rating sheet for ice cream `C`. At the bottom of the rating sheet for ice cream `C` was the following message:

> *" Well done, you have completed the ratings. Feel free to eat as much of the remaining ice cream as you want, as anything left over will be disposed of.*

The ice cream taste-test was employed in Experiments 1 and 2.

#### 6.9.3.2 Snack food (Study '3')

Food items categorised as *sweet* (miniature chocolate bars), *salty* (ready salted crisps, peanuts), and *bland* (plain crackers) were made available in abundant quantities in three separate baskets, according to food category. Presentation of food categories was randomised.

Participants were issued with the following instructions:

> *"I would like you to try the foods contained within each category; first category `A`, then category `B`, then category `C`. Have as much of the food from each category as you need to get an accurate rating, then fill in the appropriate rating forms. When you are sure of your ratings for category `A`, move on to category `B`, then to category `C`. It is important that you do not change your ratings once you have finished with a category of food. You will have 10 minutes to complete this task, so take your time and enjoy. If you have any time left after rating each of the categories, please feel free to help yourself to food from any of the categories".*

Foods were served in their original wrappers, and participants were required to open them and to decide how sweet, salty, bland and good (tasting) was the food contained within each category, using a 10-point scale from 1 (not at all) to 10 (extremely). Using the same scale, participants were also asked to rate how eating the food in each category made them feel.

Although this procedure is prone to "cheating" (eg. participants hiding wrappers) careful monitoring ensured that the number of items set out at each testing was the same as with the number of wrappers disposed of in a waste basket. There was no evidence to indicate that any participant "cheated".

Participants were left alone in the laboratory to undertake the taste test, and were informed that the experimenter would return in 15 minutes time.

### 6.10 Free Recall Task

An A4 sheet of lined paper was placed before each participant, containing the following instructions: *"Now write down as many words as you can remember from the Stroop task you performed earlier. You have 3 minutes to perform this task".* (see Appendix '10').

### 6.11 Comparison of experimental designs and laboratory protocol

Within the laboratory, researchers investigating the stress-eating relationship have predominantly employed acute stressors coupled with a between subjects design (e.g. Abramson & Wunderlich, 1972; Baucom & Aiken, 1981; Bleu, 1996; Boon et al., 2002; Cavallo & Pinto, 2001; Chua et al., 2004; Cools et al., 1992; Eldredge, 1993; Frost et al., 1982; Giner-Sorolla, 2001; Grunberg & Straub, 1992; Haynes et al., 2003; Heatherton et al., 1998; Heatherton et al., 1991; Heatherton et al., 1993; Herman & Polivy, 1975; Herman et al., 1987; Lattimore & Maxwell, 2004; Macht et al., 2005; McFarlane et al., 1998; McKenna, 1972; Mitchell & Epstein, 1996; Mitchell & Perkins, 1998; Oliver et al., 2001; Oliver et al., 2000; Pine, 1985; Polivy & Herman, 1999; Polivy et al., 1994; Pollard et al., 1995; Reznick & Balch, 1977; Rotenberg & Flood, 1999; Rotenberg et al., 2005; Ruderman, 1983; Rutledge & Linden, 1998; Schachter et al., 1968; Schotte et al., 1990; Shapiro & Anderson, 2005; Slochower, 1976; Steere & Cooper, 1993; Strauss et al., 1994; Tanofsky-Kraff et al., 2000; Tice et al., 2001; Urbszat et al., 2002; Wallis & Hetherington, 2004; Ward & Mann, 2000), although some have employed repeated measures or within subjects designs (e.g. Epel et al., 2001; Lattimore & Caswell, 2004; Mayer & Pudel; 1972; 1977; Roemmich et al., 2002; Sheppard-Sawyer et al., 2000). In terms of the laboratory protocol employed, only pre-post test self-report measures are usually obtained, and there is commonly a failure to assess the participant's levels of arousal either during or after the taste-test session itself. Therefore, Experiment 1 and 2 of this thesis employ a between subjects design, whereas Experiment 3 employs a repeated measures design. The laboratory protocol for each of the three experiments is divided into three distinct phases: baseline, task (acute stress), & recovery. This protocol has several advantages over the majority of existing research as follows:

Firstly, the concept of "stress" is difficult to define operationally (Grunberg & Singer, 1995). The almost exclusive use of subjective or self-report definitions of acute stress is a major weakness in past studies of the stress-eating relationship. This is a primary reason for the inclusion of physiological and biological, as well as subjective markers of stress (see also Section 4.5). Psychophysiological and neuroendocrine assessment requires reliable resting baseline measurement, particularly when attempting to determine the HPA response (see also Section 4.5.9).

Secondly, some researchers have found counter-regulators in the no pre-load condition (e.g. Dritchel, Cooper, & Charnock, 1993; Wardle & Beales, 1988), and it has been suggested that participation in the taste-test session itself may act as a disinhibitor for some individuals, regardless of whether they consumed a pre-load (e.g. Dritchel et al., 1993) or perceived the laboratory task to be stressful. Thus, simultaneous multilevel assessment of arousal during the recovery period allows the investigator to assess reactivity to actual food ingestion. (see also Section 2.8.3).

## 6.12 Data Reduction and Analyses

### 6.12.1 Cardiovascular Measurement

### 6.12.2 The Electrocardiogram (ECG).

Prior to off-line averaging of the ECG signal, visual inspection of the waveform detected all obvious major movement artifacts. Heart rate response rate (R-R) was scored in both inter-beat intervals (IBI) and beats per minute (BPM) using an off-line rate-detector algorithm to detect the distance between the R-waves. In some instances, the T-wave was similar in amplitude to the R-wave, causing the R-wave rate detector algorithm to `double trigger`. This was remedied by applying an IIR (Infinite Impulse Response) Band-Pass filter to 1Hz low cut-off and 35Hz high cut-off. Frequency detection was achieved using AcqKnowledge® Software (BIOPAC Systems Inc.). Values obtained were imported into SPSS and were explored for outliers. Any outliers detected (using histogram inspection) were removed, and remaining values were averaged across the baseline and recovery phase of the experimental protocol, and across sub-sections (blocks/matrices) of the task phase for Experiment `2` and `3`.

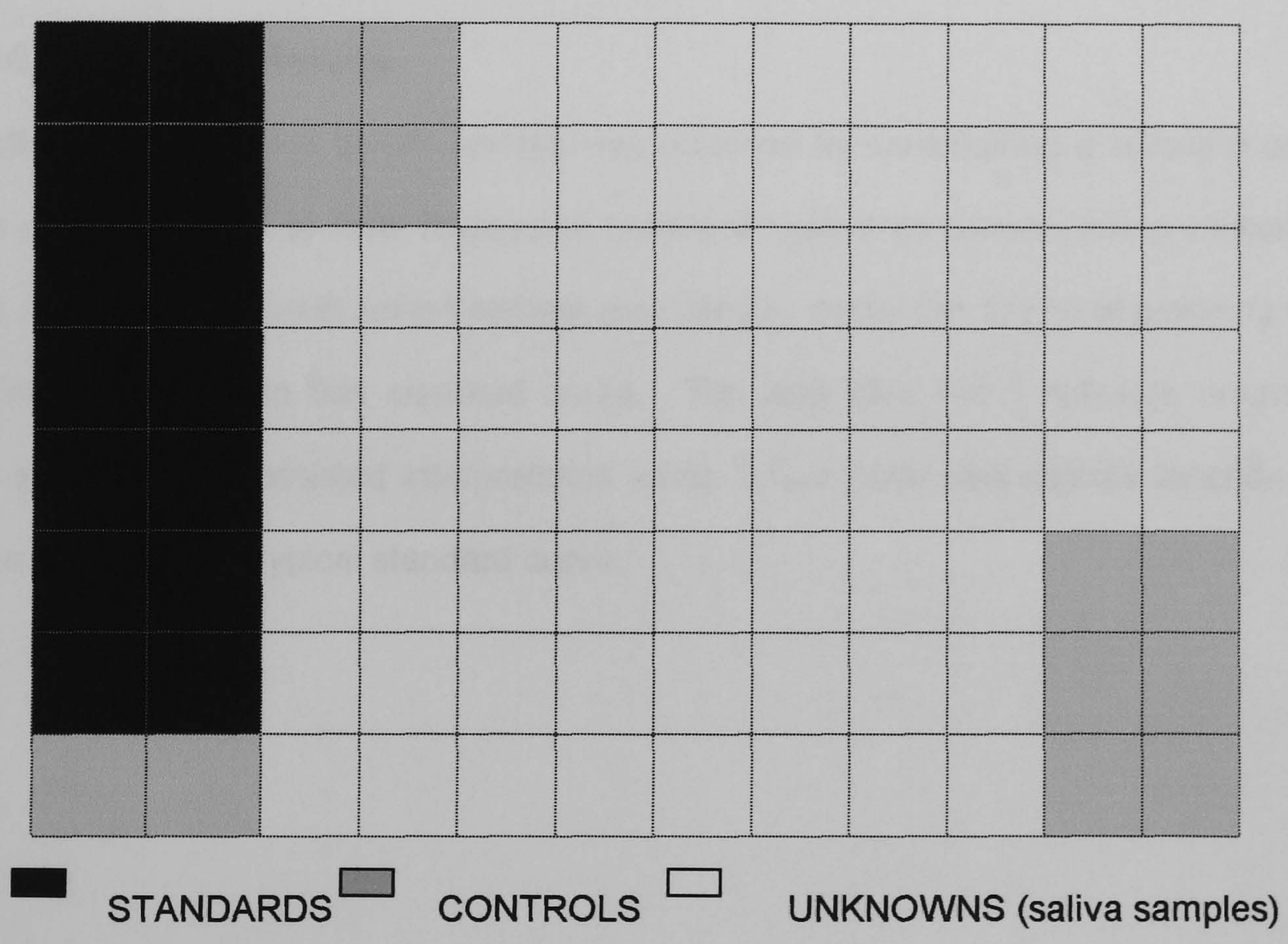
### 6.12.3 Blood Pressure (SBP & DBP).

Systolic and diastolic blood pressure readings were taken at various time intervals during each phase of the experimental protocol for Experiment `2` and `3`. Two measurements were taken for the baseline phase (5 mins. in and end). The two baseline measurements were subsequently averaged to produce one SBP and one DBP measurement. Four measurements were taken during the task phase (end block/matrix 1, end block/matrix 2, end block/matrix 3, end block/matrix 4). Only the latter three measurements were used for the purpose of analyses. A final measurement was obtained at the end of the recovery phase. (see Figure 5 and 6).

### 6.12.4 Biochemical Measure: Salivary Cortisol.

Samples were processed in the Neuroscience Laboratory located at the University of Central Lancashire, by the author. Samples were defrosted for 30 minutes at room temperature. The radioimmunoassay (RIA) kit (ELISA: Enzyme-Linked Immunosorbent Assay: DRG Instruments GmbH$^{TM}$) was stored at $5^{0}$C, but was removed from the refrigerator into room temperature for one hour prior to performing the RIA. The ELISA is based on the competition principle and the microtiter plate separation. An unknown amount of Cortisol present in the sample and a fixed amount of Cortisol conjugated with horseradish peroxidase compete for the binding sites of a polyclonal Cortisol –antiserum coated onto the wells of the microtiter plate (see Figure '7' below for microtiter plate layout). The contents of the kit were as follows: seven (0-6) Reference Standards; enzyme-conjugate (Cortisol conjugated to horseradish peroxidase); substrate solution; stop solution and wash solution. 30 ml of concentrated wash solution was added to deionized water to produce a final volume of 1200ml.

**Figure 7. Microtiter Plate Layout**



### 6.12.5 Cortisol Assay Procedure.

Cortisol Standards and Unknowns (saliva samples) were analyzed in duplicate. All standards and controls were vortexed for twenty seconds immediately prior to dispensing into the appropriate wells. 100 ul of Cortisol Standards and saliva sample (unknowns) were dispensed into appropriate wells (see Figure '7' above). Next, 200ul of Conjugate was added to each sample and standard and the microtiter plate was mixed thoroughly for 10 seconds using a Plate Reader (Spectra MAX Plus®) with Soft Max Pro software™. Following a 60-minute incubation period at room temperature, the contents of the wells were briskly shaken and rinsed 3 times with the diluted Wash Solution (400ul per well). Following each rinse, wells were struck sharply on absorbent paper to remove all residual droplets. 200ul of Substrate was then added to each well, and the microtiter plate was incubated for a further 30 minutes at room temperature. 100ul of Stop Solution was added to each well to stop the competition reaction. The concentration of Cortisol is inversely proportional to the optical density measured. Determination of absorbance of each well at 450 $\pm$ 10nm was carried out within 10 minutes using a Plate Reader (Spectra MAX Plus®) and Soft Max Pro™ software.

### 6.12.6 Calculation of Results.

The Cortisol value of each serum sample was obtained by constructing a standard curve, plotting the average absorbency (Y) of each Reference Standard against its corresponding concentration (X). The average absorbency of each serum sample was used to determine the corresponding Cortisol value by simple interpolation from this standard curve. The Soft Max Pro™ software program provided the reading and computer assisted interpretation using a four parameter logistic function. Table 5 below shows an example of a typical standard curve.

**Table 5. Example of a Typical Standard Curve**

| Standards | Concentrations (ng/ml) | Optical Units |
|---|---|---|
| 0 | 0 | 1.88 |
| 1 | 2 | 1.75 |
| 2 | 5 | 1.58 |
| 3 | 10 | 1.39 |
| 4 | 20 | 1.09 |
| 5 | 40 | 0.75 |
| 6 | 80 | 0.47 |

### 6.12.7 Quality Control

Controls, diluted 1:10 with Zero-Standard (ELISA: DRG Instruments GmbH™), were run with each calibration curve. Table 6 shows Mean values and standard deviations based on 45 processed ELISA RIAs, used to calculate inter-assay reliability. Intra- and inter-assay variability was 5% and 8% respectively (95% and 92% reliability respectively).

**Table 6. Means (SD) Control Values (nmol/l)**

| | Means (SD) | Means (SD) |
|---|---|---|
| **Pair 1** | **Co01** | **Co04** |
| | 1.41 (.60) | 1.47 (.60) |
| **Pair 2** | **Co02** | **Co05** |
| | .65 (.42) | .69 (.43) |
| **Pair 3** | **Co03** | **Co06** |
| | .50 (.29) | .53 (.32) |

Values of external controls that exceed +/-2SDs of reference distributions were considered atypical and withdrawn from subsequent analysis. Where repeated testing took place (Experiment 3) sessions were scheduled one week apart and samples were drawn at the same time of day for each experimental condition to avoid a crest of natural cycle (Grunberg & Singer, 1990). Statistical analysis was undertaken to confirm that time of sampling was not significantly different between groups or conditions. For unit conversion, ug/dl = nmol/liter x .03625.

### 6.12.8 Stroop Task Stimuli

ASCII results files were separated into two parts for the purpose of analysis – reaction time data and accuracy data.

### 6.12.9 Reaction-time data

Following removal of incorrect responses and practice stimuli, reaction time results were sorted into 4 categories (ego-threat from self, ego-threat from self control stimuli, ego-threat from others, ego-threat from others control stimuli) and sorted in ascending order. Data were trimmed high and low to 2 SDs above and below the mean, so as to exclude, respectively a) unattended trials and blinks and b) stimulus anticipations. Thereafter, the median measure of central tendency was employed with parametric analyses.

### 6.12.10 Accuracy data

Is defined as the percentage of errors made by each participant in each of the 4 Stroop categories. The following formula was used:

(Number of errors made*100)\Number of possible correct answers

### 6.12.11 Memory data: free recall of Stroop stimuli

A generated word was scored as correctly recalled if it represented either the singular or plural version of one of the Stroop words. Words spelled incorrectly were *not* scored as incorrect. Number of words correctly recalled for each of the four Stroop categories was totalled. Any repeated words were counted only once.

### 6.12.12 Food

### 6.12.13 Ice cream

Total ice cream consumed was calculated as pre-ingestion weight (melted: vanilla (98g) chocolate (98g) and strawberry (98g) minus post ingestion weight (melted).

### 6.12.14 Snack food

The net amount of snack food consumed was calculated by summing weights for consumed items and then subtracting from pre-consumption weights (which were calculated in advance by the experimenter for each item, excluding wrappers). Macronutrient ingestion was calculated using pre- minus post-ingestion values, along with package information for each item (see Table 3 and 4).

### 6.12.15 MAT Performance

Performance on the MAT was assessed for each participant for matrix 2, 3 and 4, as matrix 1 was employed for practice purposes only. A *correct* total (as at the last number added) within each of the zones (green, blue or red) received an allocation of points as follows:

*Green zone*: 2 points.

*Blue zone*: 3 points.

*Red zone*: 5 points.

Thus, a participant who achieved a correct total in the green zone for each of the three experimental matrices scored 6 points (i.e. 2 points * 3 matrices = 6 points). A maximum score of 15 could therefore be achieved by completing the green and blue zone, and finishing in the red zone, with a correct total, for each of the three matrices. An incorrect total for any of the three matrices was awarded a score of zero. Thus a participant who achieved a correct total in the green zone for matrix 2 and 3, but who finished in the green zone with an incorrect total would earn 4 points (i.e. 2 points + 2 points + 0 points = 4 points). For the purposes of analysis, a mean score for each participant was calculated. (see Appendix '9' for details of the MAT task).

### 6.13 Data Analyses: The problem with 'variable splitting'

A review of social science journals reveals that the most commonly used statistical technique employed is the analysis of variance (ANOVA). Generally, experimental research is planned in terms of factorial contrasts. Factorial designs are widely believed to be superior to multiple regression, and their use is often enforced by journal editors. The majority of researchers who have investigated the stress-eating relationship have employed this technique, along with its many variations. Typically the procedure of "variable splitting" has been used prior to analyses. This can take many forms, the most common being dichotomization through a median (or mean) split, where the investigator creates "high" and "low" groups prior to data analysis based on whether participants' score above or below the median (or mean) on some continuous measure, such as the RS-R or DEBQ (e.g. Boon et al., 2002; Chua et al., 2004; Cools et al., 1992; Frost et al., 1982; Haynes et al., 2003; Lattimore & Caswell, 2004; Lattimore & Maxwell, 2004; Oliver et al., 2000; Pollard et al., 1995; Roemmich et al., 2002; Rutledge & Linden, 1998; Schotte et al., 1990; Shapiro & Anderson, 2005; Sheppard-Sawyer et al., 2000; Steere & Cooper, 1993; van Strien et al., 1986; Wardle et al., 2000; Ward & Mann, 2000; Wallis & Hetherington, 2004), or through the use of a cut-off value (Heatherton et al., 1998; Heatherton et al., 1991; Heatherton et al., 1993; Herman & Polivy, 1975; Herman et al., 1987; Mitchell & Epstein, 1996; Mitchell & Perkins, 1998; Polivy et al., 1994; Tanofsky-Kraff et al., 2000). Other researchers have used only the tails for group classification purposes, for example, top third versus the bottom third. Use of the median (or mean) is considered more beneficial than the use of tails, in that the latter involves throwing out the middle of the distribution and would therefore reduce N, possibly causing a reduction in power too.

Other forms of "splitting" include trichotomization (the creation of three groups), bivariate group construction, where the investigator creates a special category of participants that exceed some criterion on more than one variable (e.g., classifying individuals into a group based on whether the person is above the median on two (or more) different scales or sub-scales) (e.g. Edwards & Nagelberg, 1986; Haynes et al., 2003; Kirschenbaum & Tomarken, 1982; Lattimore & Maxwell, 2004; van Strien et al., 1997; Yeomans, et al., 2004), in an attempt to create more "homogenous" comparison groups with regard to restraint status. Others have employed arbitrary categorization, where the groups are defined based on whether a participant scores higher or lower than some arbitrary value other than the median or mean, or have employed some variation of this. For example Britschel, Cooper & Charnock (1992) classified females who scored below the mean of 2.75 on the DEBQ restraint subscale as 'unrestrained eaters' and females who scored 1 standard deviation above the mean as 'restrained' eaters, in order to ensure a group of "genuinely high restrainers". Individuals who did not meet the prescribed criteria were excluded from participation in the study. Similarly, some researchers have omitted data derived from participants who score exactly on the median from statistical analyses (Boon et al., 2002), also in an attempt to create more "homogenous" comparison groups, and so accentuate any differences there may be in relation to dependent measures employed.

Some have suggested that the splitting continuous independent variables into categorical ones prior to statistical testing should be avoided for several reasons. It is argued that, compared to alternative methods, variable splitting lowers reliability of measurement, tends to yield smaller effect sizes, produces statistical tests that are generally either lower in power or more likely to yield spurious effects, and can contribute to the proliferation of conflicting findings in the literature (see Baayen, 2004; Cohen, 1983; Hayes, 2004; Maxwell & Delaney, 1993; Waller & Meehl, 1998). These arguments will now be considered in more detail.

***Lower reliability of measurement***

Reliability measures how much random error there is in a set of measurements. According to classical test theory, each observed score contains a "true" component and a random error component. Reliability is defined as the proportion of variability in observed scores that can be explained by true variation in what is being measured. The more random error in a set of measurements there is, the larger the observed variance relative to the true variance, and therefore the lower the reliability. If a measure is reliable, we can trust that an observed score is fairly close to the "true" score of what is being measured. The problem with variable splitting is that it lowers the reliability of the measurement by treating individuals who likely have different true scores as if they had the same true score in all analyses involving that variable. Variable splitting also results in treating people with similar true scores as if they are very different in the analyses.

For example, consider four observed scores on the RS-R: 2, 8, 10, and 17. The median of these numbers is 9. Based on a median split, the participants with scores of 2 and 8 are lumped together into a single "low" restraint or unrestrained group, and the participants with scores of 10 and 17 into the "high" restraint group. This procedure ignores the fact that 2 and 8 are not the same, nor are 10 and 17. The observed differences between the scores assigned to the same group may reflect meaningful differences between the true scores, statistically and practically, yet dichotomisation via a median split throws this information away and therefore could affect any analysis of the relationship between the measured characteristic and the outcome of interest. At the same time, participants with scores of 8 and 10 (in this example) are more similar than any participants assigned into the same group, and yet a median treats them as if they are maximally different. Thus, dichotomization creates larger differences on the independent variable than are justified given the likely similarity in true scores between cases with very similar observed scores that just happen to straddle the point at which the variable is split.

This can affect reliability. For example, if we consider the ideal (albeit extreme) case where the observed scores are exactly equal to the true scores, in classical test theory reliability is the square of the correlation between true and observed scores. Therefore, if the observed scores are equal to the true scores, the correlation is 1 and therefore reliability is also 1. However, splitting at the median treats the participants in their respective groups as if they had the same observed score. After coding these new dichotomous observed scores with any two arbitrary numbers (e.g., restrained = 1; unrestrained = 2), the correlation between the observed scores (the new group codes) and the true scores has decreased from 1 to 0.79. Therefore, reliability has fallen to 0.62 (0.79*0.79). Thus, following dichotomization, the observed scores contain more error, potentially resulting in negative consequences on analyses.

***Misclassification of participants into groups***

As intimated previously, the observed scores are unlikely to be equal to the true scores – they will contain some error. This random measurement error means that some participants that really are above (or below) the median on the true score may be misclassified as below (or above) the true median, with the frequency of misclassification depending on how reliably the construct is measured, or the reliability of the measurement instrument(s) employed for classification purposes. Thus, using a measurement instrument (or procedure) with a reliability to generate groups of .80, rather than 1 (perfect reliability), 15% of participants are likely to be misclassified using a median split, 26% using a trichotomization procedure, or 27% if a second measurement scale is also employed with a reliability of .80 to generate groups (i.e., above/below the median on one scale and above/below the median on the other scale).

### *Smaller Effect Size Estimates*

After variable splitting, researchers are mostly interested in whether the two (or more) groups differ significantly from each other on average. This difference between group means provides an estimate of effect size, and researchers usually seek to reject the null hypothesis that the effect size is zero, either with a null hypothesis test or the construction of a confidence interval. However, an effect size estimation based on a comparison of groups created via some variable splitting method will tend to underestimate the strength of the relationship between the original variable and the outcome of interest (Cohen, 1983). Cohen (1983) calculated that the Pearson product-moment correlation between a variable and its dichotomized version (divided at the mean) was .798, which suggests that the cost of dichotomization is approximately a 20% reduction in correlation coefficient. In other words, an artificially dichotomized variable accounts for only 63.7% as much variance as does the original continuous variable

### *The Consequence: Reduced Statistical Power*

The consequence of reduced effect size estimates, lower reliability, and misclassification that can potentially result from variable splitting is that statistical analyses undertaken to test hypotheses may be conducted with lower power. Power is defined as the probability of correctly rejecting a false null hypothesis and therefore finding an effect for the experimental hypothesis, or the odds that an effect will be observed (statistically speaking) when it occurs. Power equals one minus the probability of a Type II error (or mathematically, power = 1 – Beta). There are formulae that enable us to calculate how large a sample size needs to be with a particular set of data and a particular test to ensure a minimum level of statistical power. For the purpose of the research contained within this thesis, power calculations were undertaken using a general power analysis program (G*Power: Erdfelder, Faul, & Buchner, 1996).

Cohen (1983) provides numerical examples of the effect of dichotomization of a continuous variable on statistical power. For example, if the true correlation between two variables '*X*' and '*Y*' in a bivariate normal population is 0.30, the power to reject the null hypothesis that $p = 0$ is 0.79 in a sample of 80 participants. If one of these continuous variables is dichotomized prior to conducting the same hypothesis test, the power is reduced to 0.57. Cohen (1983) notes that one can consider the loss in power as equivalent to throwing out 30 cases in the data set (i.e., without dichotomization, power is equal to 0.57 for a sample size of 50 participants). Thus, dichotomization affects power in the same way as would decreasing the sample size or throwing out data. Therefore, variable splitting increases the probability of Type II errors (i.e., not finding a significant result when the effect is present).

Some would argue that of the many effects of dichotomization, power reduction seems the most innocuous and could be presented as a benefit, because it renders the analysis "conservative". In other words, Type II errors (i.e., not finding a significant result when the effect is present) are less costly than Type I errors (i.e., finding a significant result when the effect is not present)(Irwin & McClelland, 2003) and should therefore be attractive to scientists who wish to avoid misleading anyone with inaccurately significant results (Irwin & McClelland, 2003).

***Artifactual failures to replicate findings across populations and researchers***

Inspection of the stress-eating literature reveals inconsistent findings and replication failures. There are many different reasons why an investigator may fail to replicate previous research findings, such as different populations, stimuli, sample sizes, or even the passage of time, or changes in cultural beliefs and expectations. However, it is also true that two investigators, who employ variable splitting prior to analyses, may obtain and report very different results as a consequence of the location of the split chosen in order to classify their participants, even though the same basic relationship between the variables exists in the data (Hunter & Schmidt, 1990; Viele, 1988). In addition, wide variation in the laboratory consumption of high restraint individuals has previously been reported (e.g., Polivy & Herman, 1985; Wardle & Beales, 1988, Dritschel et al., 1992). It is possible that counter-regulation or overeating in response to stress only occurs in a minority of restrained eaters, and that this may not be detected in laboratory studies because of the characteristic examination of the data in terms of group means.

In summary, a review of the stress-eating literature reveals that it is convention for researchers to categorize prior to analyses, most commonly utilizing the median split in order to classify individuals as restrained or unrestrained eaters. However, there is evidence to suggest that creating groups through the dichotomization or trichotomization of one or more continuous measures prior to analysis can potentially lower reliability, enhance the likelihood of misclassification, reduce effect size estimates and statistical power of tests employed to test hypotheses, and can make comparison of findings across studies difficult. Therefore, in consideration of both convention and the aforementioned arguments for the avoidance of variable splitting, data within this thesis are analysed using both dichotomous and continuous methods of analyses.

To allow full investigation of the data and answer research questions several methods of analyses were employed, these included t-tests, Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA), Correlations and Multiple Regression (all data were analyzed using SPSS (Statistical Package for the Social Sciences: Version 11). Prior to undertaking the initial analysis the raw data were examined to ensure that the test assumptions were met, generally this was found to be the case. Where test assumptions were not met, this is indicated.

Repeated analysis on measures taken from one cohort of participants increases the risk of family wise error with possible type I errors. It is usual therefore to set more stringent levels for accepting significance. For both planned comparisons and post-hoc testing with Tukey HSD (equal variances assumed), or Dunnett's C (equal variances not assumed), alpha is adjusted for multiple comparisons to .005. Where group variances are unequal and Sphericity is violated, the Levene's and Greenhouse-Geisser tests are adopted.

## Chapter 7. Information processing and stress responses: Comparison of an ego-threat and colour Stroop task in females with restrained and bulimic eating attitudes.

### 7.1 Study Overview

There were several aims to this study:

The first aim was to compare the effects of two stress tasks, the ego-threat Stroop task and the conventional Stroop task, on mood (anxiety and self-esteem) and food intake (ice cream) in two target populations, females who display bulimic symptoms (who are also restrained eaters), and restrained eaters who do not display bulimic symptoms. The two tasks are comparable in terms of: a) cognitive loading (degree of difficulty to perform the task), and b) they both demand an *active* behavioural response. The tasks differ in terms of emotional loading in that the ego-threat Stroop task includes stimuli that have been found to be particularly salient to females who possess both restrained and bulimic eating attitudes and behaviours (ego-threat stimuli). The conventional Stroop task incorporates neutral stimuli (incongruent colour words).

The second aim was to assess the effects of the post-stress ingestion of a highly palatable food (ice cream) on mood (anxiety and self-esteem) in females with both bulimic and restrained eating attitudes.

The third aim was to assess whether information processing and memory biases exist for self-directed ego threat stimuli (but not for ego-threat from others) in females with both bulimic and restrained eating attitudes.

The fourth aim was to assess the extent to which the unmasked Stroop task demands the automatic processing of information. This was achieved through the addition to the protocol of a delayed (30 minutes) and incidental free recall task, of words contained within the ego Stroop task.

### 7.2 Method [see Figure 4]

### 7.2.1 Participants

Eighty-four females were initially recruited. Seven participants did not meet the requirements of the screening process and therefore did not take part in the study. Individual differences were assessed using the classification shown in Table 7. Data obtained from individuals who did not conform to the criteria were omitted from statistical analyses of group means comparisons (N=9). These nine individuals were found to be high in restraint, but low in bulimic symptoms (HR/LB). Although the original intention was to include a group of HR/LB females for comparison, nine was considered an insufficient number (see also Section 6.11 for a discussion of the creation of more 'homogenous' comparison groups with regard to restraint status). However, these data were included for the purposes of correlation and multiple regression analyses.

**Table 7. Participant classification information and ethnicity details**

| Instrument | | | Classification | Currently dieting to lose/maintain weight | N |
|---|---|---|---|---|---|
| RS_R median split | DEBQ median split | BULIT_R | | | |
| >14 | >2.9 | >80 | High restraint/high bulimic (HR/HB) | 82.76% (n=24) | 29 |
| ≤14 | ≤2.9 | ≤80 | Low restraint/low bulimic (LR/LB) | 15.38% (n=5) | 39 |

| Ethnicity | HR/HB (N) | LR/LB (N) |
|---|---|---|
| English/British | 25 | 35 |
| English/Scottish | 1 | 2 |
| English/Irish | 1 | 0 |
| Asian/British | 1 | 1 |
| Chinese/British | 1 | 1 |

**7.2.2 Oral contraceptive use.** A Chi-square test revealed no significant group difference.

**7.2.3 Design, Materials and Procedure** (see Chapter 6 and Figure 4)

### 7.3 Results

### 7.3.1 Preliminary Analysis

Inspection of a series of independent samples *t*-tests (Table 8) revealed that groups were well matched in terms of age. Although groups differed significantly in terms of body mass index (BMI), both groups were still within the *normal* weight category[10]. Groups also differed significantly in terms of the three instruments employed for classification purposes (RS-R; DEBQ, and BULIT-R), with HR/HB females scoring significantly higher than LR/LB females on all three scales.

**Table 8. Participant Characteristics (age, BMI, restraint and bulimic status) (Means (SD) and significance value)**

| | | HR/HB (*n* = 29) | LR/LB (*n* = 39) | *p* |
|---|---|---|---|---|
| **Age (yr)** | **Mean** | **26.34** | **26.18** | **NS** |
| | *SD* | *9.04* | *8.65* | |
| **BMI** | **Mean** | **24.61** | **22.54** | **<.005** |
| | *SD* | *4.78* | *2.33* | |
| **RS_R** | **Mean** | **20.45** | **8.87** | **<.001** |
| | *SD* | *3.53* | *2.58* | |
| **DEBQ** | **Mean** | **3.39** | **1.06** | **<.001** |
| | *SD* | *.61* | *.53* | |
| **BULIT-R** | **Mean** | **91.62** | **52.18** | **<.001** |
| | *SD* | *13.13* | *11.96* | |

*p*-values are 2-tailed

**Perceived control over task.** A 2 (Task: ego/conventional Stroop) X 2 (Group: HR/HB vs LR/LB) univariate ANOVA revealed no significant main or interaction effects. Table 9 shows Mean (SD) ratings for perceived control made by the HR/HB and LR/LB group following exposure to the ego and conventional Stroop task.

[10] 15-19 = underweight; 20-25 = normal weight; 26-30 = overweight; 30+ = obese

**Table 9. Mean (SD) ratings for perceived control made by the HR/HB and LR/LB group following exposure to the ego and conventional Stroop task.**

| | | HR/HB | LR/LB | Row Means/SD |
|---|---|---|---|---|
| **Ego Stroop** | **Mean** | **3.33** | **3.35** | **3.34** |
| | *SD* | *1.84* | *1.95* | *1.88* |
| **Conventional Stroop** | **Mean** | **3.71** | **4.42** | **4.12** |
| | *SD* | *2.05* | *2.46* | *2.29* |
| **Column** | **Mean** | **3.52** | **3.87** | |
| | *SD* | *1.92* | *2.25* | |

### 7.3.2 Ratings of Mood

### 7.3.3 Anxiety: STAI

A 2 (Group: HR/HB vs LR/LB) x 2 (Condition: ego vs conventional Stroop) between groups ANOVA on baseline self-reported anxiety ratings revealed a significant main effect of condition, $F(1,64) = 6.27$, $p<0.05$, $Eta^2 = .089$, with higher ratings recorded following the baseline period associated with the ego (M = 33.40; SD = 9.51) than the conventional Stroop task (M = 28.03; SD =8.64). Therefore, baseline anxiety ratings were entered as co-variate in further analysis.

Table 10 displays means and standard deviations for self-reported anxiety for HR/HB and LR/LB females for each of the three experimental phases (baseline, task and recovery), for the two Stroop tasks (ego and conventional).

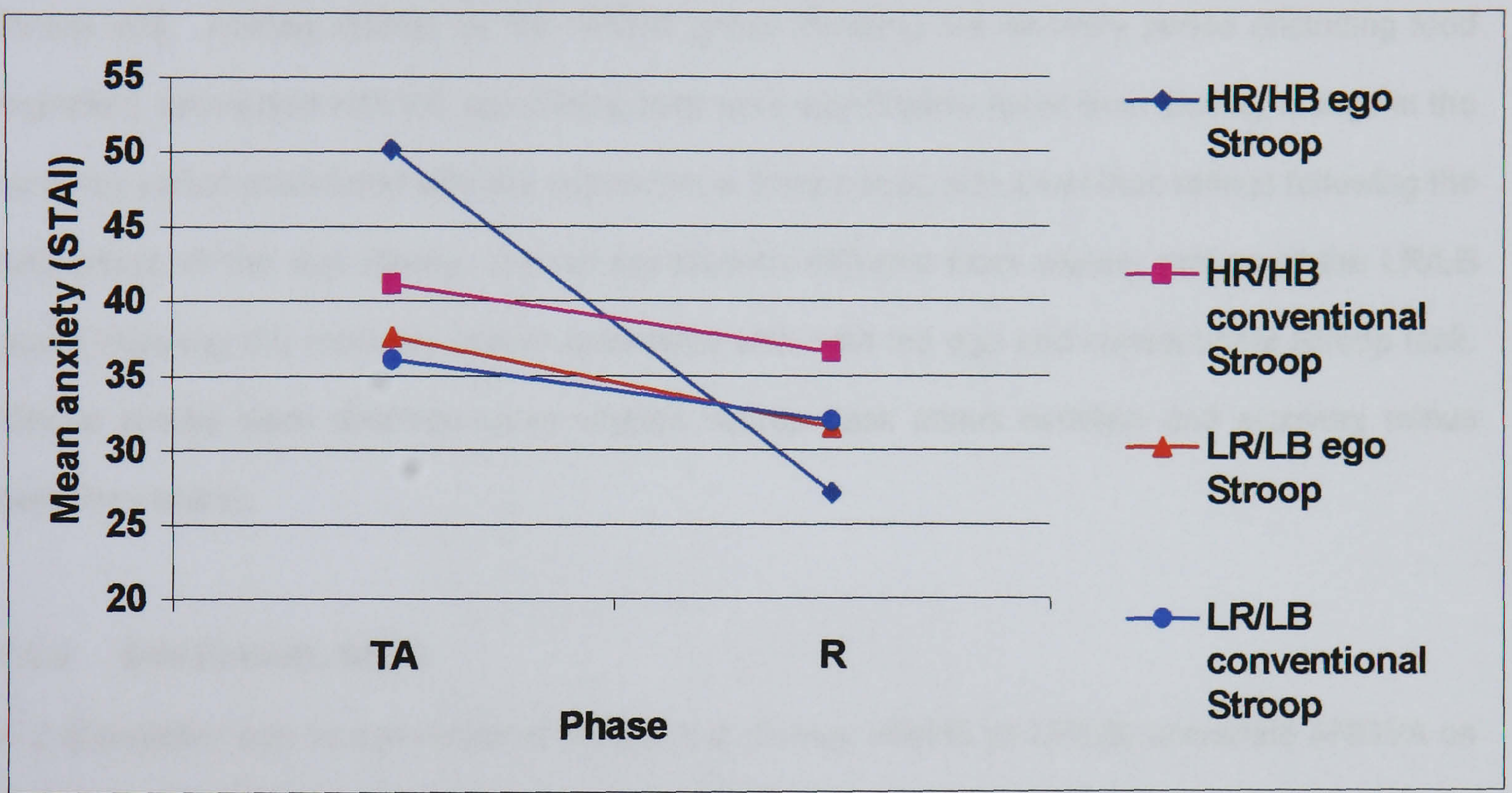
A 2 (Phase: TA/R) x 2 (Condition: ego/conventional Stroop) x 2 (Group: HR/HB vs LR/LB) mixed factorial ANCOVA, with phase as the within subjects factor and condition and group as the between subjects factors, revealed a significant effect of covariate, baseline STAI, $F(1,63) = 11.16$, $p<0.001$, $Eta^2 = .150$, and a significant main effect of group, $F(1,63) = 4.49$, $p<0.05$, $Eta^2 = .067$. There was also a significant two-way interaction between phase x group, $F(1,63) = 10.67$, $p<0.005$, $Eta^2 = .145$, and phase x condition, $F(1,63) = 12.26$, $p<0.001$, $Eta^2 = .163$. There was also a three-way interaction of phase x group x condition, $F(1,63) = 9.81$, $p<0.005$, $Eta^2 = .136$.

**Table 10.** **Means (SD) for self-reported anxiety ratings (STAI) for the HR/HB and LR/LB groups for the baseline (B), task (TA), and recovery (R) phase, for the ego and conventional Stroop conditions.**

| | | Baseline | | | Task | | | Recovery | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego Stroop | Conventional Stroop | Baseline phase Mean total | Ego Stroop | Conventional Stroop | Task phase Mean total | Ego Stroop | Conventional Stroop | Recovery phase Mean total |
| **HR/HB** | **Mean** | **35.67** | **28.43** | **32.05** | **50.20** | **41.21** | **45.71** | **27.13** | **36.64** | **31.89** |
| | *SD* | *10.16* | *9.17* | *9.67* | *6.95* | *9.56* | *8.26* | *7.06* | *10.45* | *8.76* |
| **LR/LB** | **Mean** | **31.70** | **27.74** | **29.72** | **37.65** | **36.11** | **36.88** | **31.55** | **32.00** | **31.78** |
| | *SD* | *8.86* | *8.48* | *8.67* | *9.90* | *10.31* | *10.11* | *9.16* | *9.15* | *9.16* |
| **Column** | **Mean** | **33.40** | **28.03** | | **43.03** | **38.27** | | **29.66** | **33.97** | |
| | *SD* | *9.51* | *8.64* | | *10.69* | *10.17* | | *8.51* | *9.84* | |

The main effect of phase failed to reach significance. Figure 8 shows the three-way interaction between group, phase and condition on the measure of self-reported anxiety (STAI).

**Figure 8. Three-way interaction between group, phase and condition on the measure of self-reported anxiety (STAI).**




Planned comparisons revealed that the HR/HB group in the ego Stroop condition (N = 15) self-reported significantly higher ratings of anxiety than the HR/HB group in the conventional Stroop task condition (N = 14), $t(27) = 2.91$, $p<0.005$, and than the LR/LB in the ego Stroop task (N = 20), $t(33) = 4.19$, $p<0.001$. However, there was no significant group difference in anxiety ratings between the HR/HB and LR/LB group (N = 19) following the conventional Stroop task, $t(31) = 1.45$, $p>0.05$.

With regard to post-recovery anxiety ratings following food consumption, the HR/HB group in the ego Stroop condition had significantly lower anxiety ratings than the HR/HB group in the conventional Stroop condition, $t(27) = 2.89$, $p<0.005$, and significantly lower ratings following the ego Stroop recovery than task phase, $t(28) = 6.47$, $p<0.001$. However, there was no significant difference in anxiety ratings between the HR/HB group in the ego Stroop condition and the LR/LB group in both the ego, and conventional Stroop condition.

In summary, controlling for baseline values, results revealed that self-reported anxiety ratings were significantly higher for the HR/HB group following exposure to the ego Stroop compared to the conventional Stroop task, and compared to the LR/LB group following exposure to the ego Stroop task. Anxiety ratings for the HR/HB group following the recovery period (including food ingestion) associated with the ego Stroop task were significantly lower than anxiety ratings in the recovery period associated with the conventional Stroop task, and lower than ratings following the task phase of the ego Stroop, but not significantly different from anxiety ratings of the LR/LB group following the recovery period associated with both the ego and conventional Stroop task. Similar results were obtained using change scores (task minus baseline and recovery minus baseline values).

### 7.3.4 Self-Esteem: SSES

A 2 (Condition: ego vs conventional Stroop) x 2 (Group: HR/HB vs LR/LB) univariate ANOVA on baseline self-esteem ratings revealed a significant main effect of group, $F(1,64) = 7.78$, $p<0.01$, $Eta^2 = .108$, with significantly *lower* ratings for the HR/HB (M=68.52; SD=15.45) than LR/LB (M=76.97;SD=9.21) group. Therefore baseline self-esteem ratings are entered into further analysis as covariate. Table 11 shows mean (SD) self-esteem ratings for the HR/HB and LR/LB groups, for the three phases (baseline, task and recovery) for the two experimental manipulations (ego and conventional Stroop). A *low* score indicates *lower* self-esteem.

A 2 (Phase: TA/R) x 2 (Condition: ego/conventional Stroop) x 2 (Group: HR/HB vs LR/LB) ANCOVA, with baseline values entered as covariate, revealed a significant effect of covariate, baseline ratings, $F(1,63) = 5.86$, $p<0.05$, $Eta^2 = .098$, a significant main effect of group, $F(1,63) = 31.06$, $p<0.001$, $Eta^2 = .330$, and a significant phase x group interaction effect, $F(1,63) = 5.32$,

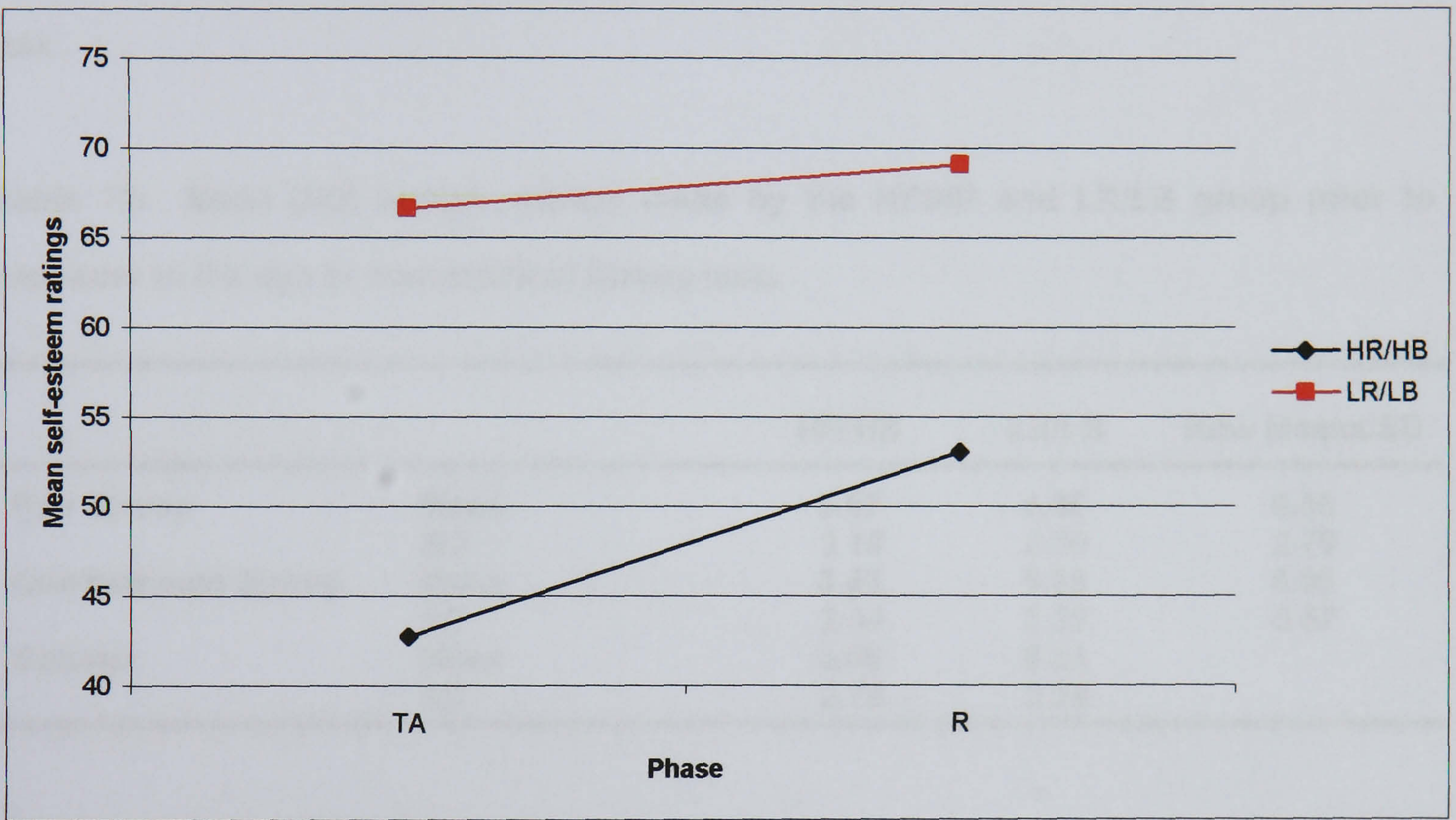
**Table 11.** Means (SD) self-esteem ratings (SSES) for the HR/HB and LR/LB groups for the baseline (B), task (TA), and recovery (R) phase, for the ego and conventional Stroop conditions.

| | | Baseline | | | Task | | | Recovery | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego Stroop | Conventional Stroop | Baseline phase Mean total | Ego Stroop | Conventional Stroop | Task phase Mean total | Ego Stroop | Conventional Stroop | Recovery phase Mean total |
| **HR/HB** | **Mean** | **67.20** | **69.93** | **68.52** | **49.80** | **50.07** | **49.93** | **54.33** | **52.50** | **53.45** |
| | *SD* | *14.69* | *16.67* | *15.45* | *16.05* | *16.71* | *16.08* | *19.15* | *18.08* | *18.33* |
| **LR/LB** | **Mean** | **75.45** | **78.58** | **76.97** | **66.30** | **66.00** | **66.15** | **69.60** | **68.00** | **68.82** |
| | *SD* | *9.16* | *9.22* | *9.21* | *10.81* | *17.22* | *14.10* | *14.44* | *20.88* | *17.65* |
| **Column** | **Mean** | **71.91** | **74.91** | | **59.23** | **59.24** | | **63.06** | **61.42** | |
| | *SD* | *12.37* | *13.40* | | *15.49* | *18.55* | | *18.06* | *20.94* | |

A *lower* score indicates *lower* self-esteem

$p<0.05$, $Eta^2 = .078$. Figure 9 shows two-way interaction between phase and group on the measure of self-esteem (SSES).

**Figure 9. Two-way interaction between phase (TA and R) and group (HR/HB vs LR/LB) on the measure of self-esteem (SSES).**




Planned comparisons revealed significantly lower ratings of self-esteem for the HR/HB group both post task, $t(61.11) = 8.53$, $p<0.001$, and post recovery, $t(66) = 3.50$, $p<0.001$ when compared to the LR/LB group. Ratings for the HR/HB group were also significantly lower post task than post recovery (following food ingestion), $t(28) = 3.55$, $p<0.001$.

In summary, results showed that HR/HB females had significantly lower perceptions of self-esteem than LR/LB females prior to experimentation. Controlling for baseline self-esteem values, results showed that self-esteem for the HR/HB group remained significantly lower than that of the LR/LB group following both task exposure and food ingestion. For HR/HB females, self-esteem ratings post task were significantly lower than post recovery. Similar results were obtained using change scores (task minus baseline and recovery minus baseline values).

### 7.3.5 Intake

Three 2 (Condition: ego vs conventional Stroop) X 2 (Group: HR/HB vs LR/LB) between subjects ANOVA testing for baseline differences in hunger ratings, thirst ratings and ratings of food liking for ice cream revealed no significant main or interaction effects. Table 12 shows Mean (SD) hunger ratings, Table 13 shows Mean (SD) thirst ratings, and Table 14 shows Mean (SD) ratings for ice cream liking made by the two groups prior to undertaking the ego or conventional Stroop task.

**Table 12. Mean (SD) hunger ratings made by the HR/HB and LR/LB group prior to exposure to the ego or conventional Stroop task.**

| | | HR/HB | LR/LB | Row Means/SD |
|---|---|---|---|---|
| **Ego Stroop** | **Mean** | **5.67** | **6.35** | **6.06** |
| | *SD* | *3.18* | *2.50* | *2.79* |
| **Conventional Stroop** | **Mean** | **5.43** | **6.53** | **6.06** |
| | *SD* | *2.34* | *2.32* | *5.57* |
| **Column** | **Mean** | **5.55** | **6.44** | |
| | *SD* | *2.76* | *2.38* | |

**Table 13. Mean (SD) thirst ratings made by the HR/HB and LR/LB group prior to exposure to the ego or conventional Stroop task.**

| | | HR/HB | LR/LB | Row Means/SD |
|---|---|---|---|---|
| **Ego Stroop** | **Mean** | **6.87** | **6.75** | **6.80** |
| | *SD* | *2.50* | *1.71* | *2.06* |
| **Conventional Stroop** | **Mean** | **7.07** | **6.53** | **6.76** |
| | *SD* | *1.77* | *1.65* | *1.70* |
| **Column** | **Mean** | **6.97** | **6.64** | |
| | *SD* | *2.15* | *1.66* | |

**Table 14. Mean (SD) ratings for ice cream 'liking' made by the HR/HB and LR/LB group prior to exposure to the ego or conventional Stroop task.**

| | | HR/HB | LR/LB | Row Means/SD |
|---|---|---|---|---|
| **Ego Stroop** | **Mean** | **4.47** | **4.50** | **4.49** |
| | *SD* | *1.06* | *1.47* | *1.29* |
| **Conventional Stroop** | **Mean** | **3.64** | **4.47** | **4.12** |
| | *SD* | *.93* | *1.26* | *1.19* |
| **Column** | **Mean** | **4.07** | **4.49** | |
| | *SD* | *1.07* | *1.36* | |

Next, Controlling for BMI, a series of 2 (Condition: ego vs conventional Stroop) X 2 (Group: HR/HB vs LR/LB) univariate ANCOVA were used to examine total quantity of ice cream consumed (pre- minus post-melted weight), ice cream by flavour (vanilla, chocolate, and strawberry) and water intake.

### 7.3.6 Intake: total ice cream : Vanilla, Chocolate and Strawberry

Table 15 shows Means (SD) total vanilla, chocolate and strawberry ice cream intake (grams) by the two groups following exposure to the two Stroop tasks.

Controlling for BMI, a 3 (Flavour: Vanilla, Chocolate, Strawberry) X 2 (Group: HR/HB vs LR/LB) X 2 (Task: ego vs conventional Stroop) mixed factorial ANCOVA with flavour as the within subjects factor and group and task as between subjects factors revealed a significant main effect of flavour, $F(2,128) = 29.776$, $p<0.001$, $Eta^2 = .318$. There were also significant group by task interaction effect, $F(1,64) = 14.254$, $p<0.001$, $Eta^2 = .182$, and a significant flavour by group by task interaction effect, $F(2,128) = 3.901$, $p<0.05$, $Eta^2 = .057$. Figure 10 shows the two-way interaction between group and condition. Figure 11 shows the three-way interaction between flavour, group and condition.

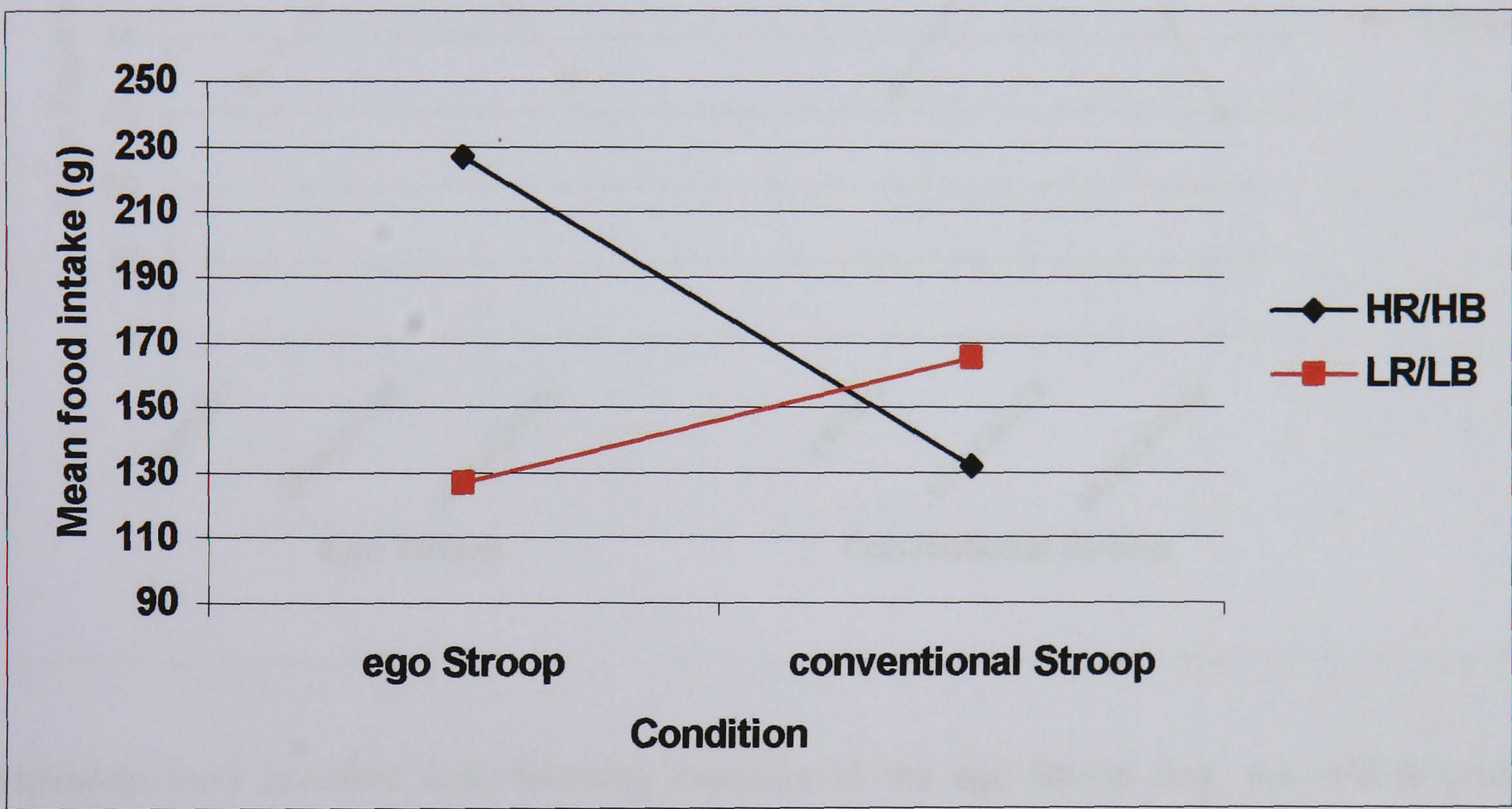
Participants consumed significantly more chocolate ice cream than both vanilla ice cream (Mean difference = 20.88; SD = 29.29), $t(67) = 5.88$, p<0.001, and strawberry ice cream (Mean

**Table 15. Means (SD) total ice cream intake (grams) by the HR/HB and LR/LB groups following exposure to the ego and conventional Stroop tasks.**

| | | HR/HB | | | LR/LB | | | Row Means/SD | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Vanilla | Chocolate | Strawberry | Vanilla | Chocolate | Strawberry | Vanilla | Chocolate | Strawberry |
| Ego Stroop | Mean | 78.80 | 85.20 | 62.87 | 33.80 | 58.80 | 34.50 | 53.09 | 70.11 | 46.66 |
| | *SD* | *23.91* | *17.31* | *32.60* | *30.53* | *29.85* | *26.45* | *35.59* | *28.23* | *32.11* |
| Conventional Stroop | Mean | 32.86 | 69.29 | 29.86 | 49.21 | 65.74 | 50.42 | 42.27 | 67.24 | 41.70 |
| | *SD* | *22.06* | *27.04* | *27.99* | *36.81* | *32.25* | *32.25* | *32.05* | *29.75* | *31.78* |
| Column | Mean | 56.62 | 77.52 | 46.93 | 41.31 | 62.18 | 42.26 | | | |
| | *SD* | *32.52* | *23.55* | *34.31* | *34.18* | *30.83* | *30.12* | | | |

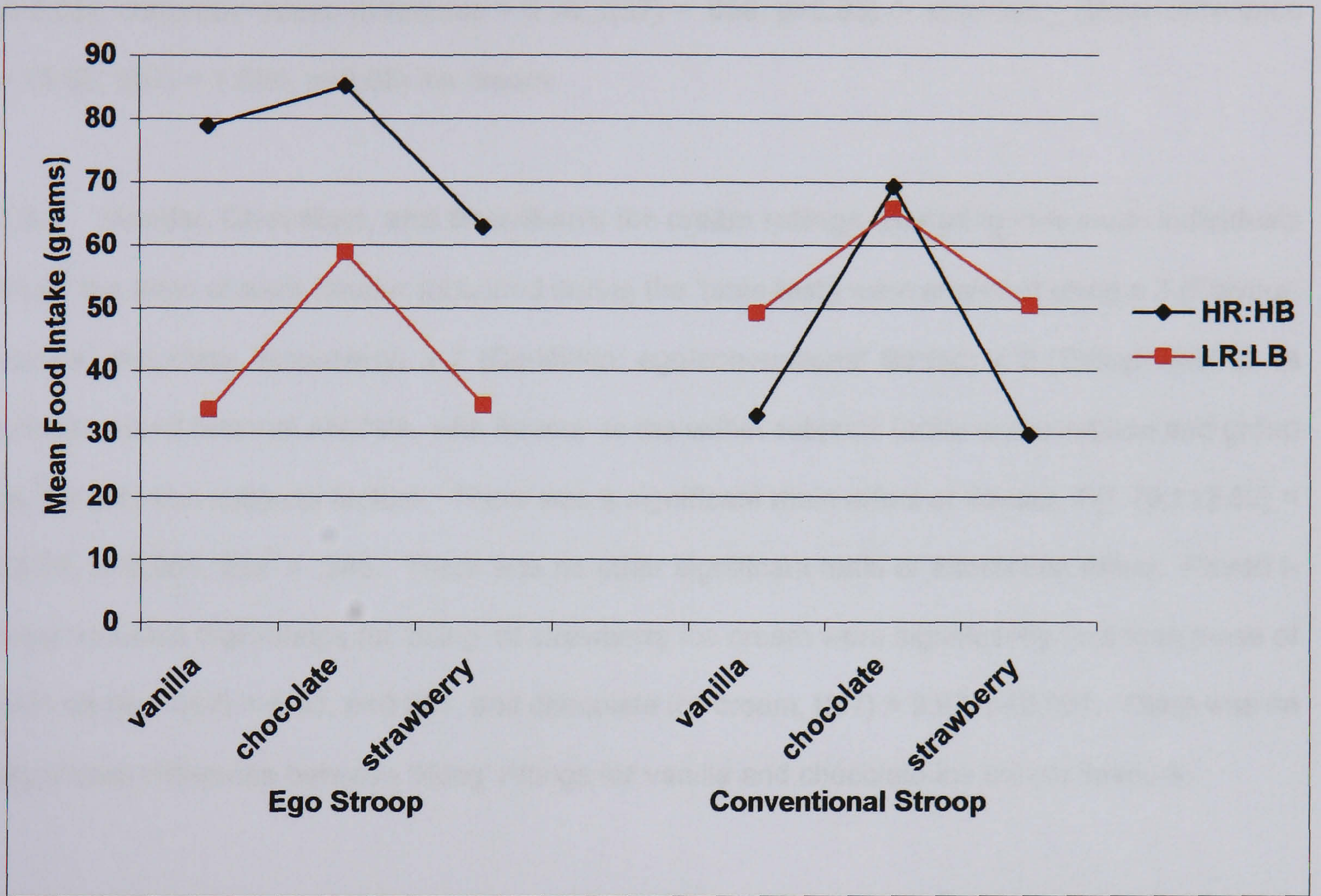
difference = 24.47; SD = 31.52), $t(67) = 6.40$, $p<0.001$. There was no significant difference in intake between vanilla and strawberry ice cream (Mean difference = 3.59; SD = 27.04), $t(67) = 1.09$, $p>0.05$.

**Figure 10. The two-way interaction between groups and conditions on the measure of total ice cream intake.**




Planned comparisons revealed that the HR/HB consumed significantly more ice cream following the ego Stroop task, compared to the conventional Stroop task, $t(27) = 4.38$, $p<0.001$, and compared to LR/LB females following the ego, $t(33) = 4.30$, $p<0.001$, and conventional Stroop task, $t(33) = 3.80$, $p<0.001$. For the LR/LB group, there was no significant difference in total ice cream consumption between the two experimental conditions. There was also no significant group difference in food consumption following exposure to the conventional Stroop task.

**Figure 11. The three-way interaction between flavour (vanilla, chocolate and strawberry), groups (HR/HB vs LR/LB) and conditions (Stroop: ego vs conventional).**




Follow-up tests revealed that, following exposure to the ego Stroop task, the HR/HB group consumed significantly more vanilla (Mean difference = 45.00; $t(33) = 4.720$, $p<0.001$), chocolate (Mean difference = 26.40; $t(31.31) = 3.287$, $p<0.005$), and strawberry (Mean difference = 28.37, $t(26.48) = 2.758$, $p<0.005$ ice cream than did the LR/LB group.

There was no significant group difference for intake of vanilla (Mean difference = 16.35; $t(31) = 1.475$, $p>0.05$), chocolate (Mean difference = 3.55; $t(31) = .334$, $p>0.05$) and strawberry (Mean difference = 20.56; $t(31) = 1.912$, $p>0.05$) ice cream following exposure to the conventional Stroop task.

The HR/HB group also consumed significantly more vanilla ice cream following exposure to the ego Stroop task then the conventional Stroop task (Mean difference = 45.94; $t(27) = 5.368$,

$p<0.001$), but not chocolate (Mean difference = 15.94; $t(27) = 1.901$, $p>0.05$), nor strawberry ice cream (Mean difference = 33.01; $t(27) = 2.916$, $p=0.007$). There were also no significant condition differences for the LR/LB group for vanilla (Mean difference = 15.41; $t(37) = 1.426$, $p>0.05$), chocolate (Mean difference = 6.94; $t(37) = .698$, $p>0.05$) or strawberry (Mean difference = 15.92; $t(37) = 1.690$, $p>0.05$) ice cream.

**7.3.7 Vanilla, Chocolate, and Strawberry ice cream ratings** assessing how much individuals 'liked' the taste of each flavour (obtained during the 'taste-test') were analyzed using a 3 (Flavour: vanilla, chocolate, strawberry) x 2 (Condition: ego/conventional Stroop) x 2 (Group: HR/HB vs LR/LB) mixed factorial ANOVA, with flavour as the within subjects factor and condition and group as the between subjects factors. There was a significant main effect of flavour, $F(1.76,112.52) = 33.69$, $p<0.001$, $Eta^2 = .345$. There was no other significant main or interaction effect. Paired t-tests revealed that ratings for 'liking' of strawberry ice cream were significantly less than those of both vanilla, $t(67) = 5.50$, $p<0.001$, and chocolate ice cream, $t(67) = 9.97$, $p<0.001$. There was no significant difference between 'liking' ratings for vanilla and chocolate ice cream flavours.

Table 16 shows Mean (SD) ice cream 'liking' ratings for the three ice cream flavours for the HR/HB and LR/LB groups in the ego and conventional Stroop task.

In summary, Participants consumed more chocolate than vanilla or strawberry ice cream, with no significant difference in intake between the latter two flavours. In terms of overall intake of ice cream, the HR/HB group in the ego Stroop condition consumed significantly more than the HR/HB group in the conventional Stroop condition, and significantly more than the LR/LB group following both experimental conditions. In respect of the ego Stroop task, the HR/HB females consumed significantly more vanilla, chocolate and strawberry ice cream compared to LR/LB females. For the conventional Stroop task, there was no significant group difference for intake of any of the three ice-cream flavours. According to analysis of ice cream 'liking' ratings, participants preferred the taste of vanilla and chocolate ice cream equally, and significantly more than the taste of strawberry ice cream.

**Table 16. Mean (SD) ice cream 'liking' ratings for the three ice cream flavours for the HR/HB and LR/LB groups in the ego and conventional Stroop task.**

| | | Vanilla | | | Chocolate | | | Strawberry | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego Stroop | Conventional Stroop | Vanilla ice cream row Mean (SD) | Ego Stroop | Conventional Stroop | Chocolate ice cream row Mean (SD) | Ego Stroop | Conventional Stroop | Strawberry ice cream row Mean (SD) |
| HR/HB | Mean | 5.73 | 5.79 | 5.76 | 7.07 | 7.21 | 7.14 | 4.40 | 3.86 | 4.14 |
| | *SD* | *3.03* | *2.29* | *2.65* | *2.37* | *1.72* | *2.05* | *1.06* | *1.10* | *1.09* |
| LR/LB | Mean | 6.55 | 6.63 | 6.59 | 6.70 | 6.53 | 6.62 | 4.45 | 4.53 | 4.49 |
| | *SD* | *2.48* | *2.36* | *2.39* | *1.69* | *1.65* | *1.65* | *1.47* | *1.61* | *1.52* |
| Column | Mean | 6.20 | 6.27 | | 6.86 | 6.82 | | 4.43 | 4.24 | |
| | *SD* | *2.72* | *2.34* | | *1.99* | *1.69* | | *1.29* | *1.44* | |

### 7.3.8 Water

Table 17 shows Mean (SD) water intake (millilitres) by the two groups following exposure to the two Stroop tasks.

**Table 17. Mean (SD) water intake (millilitres) by the HR/HB and LR/LB groups following exposure to the ego and conventional Stroop tasks.**

| | | HR/HB | LR/LB | Row Means/SD |
|---|---|---|---|---|
| **Ego Stroop** | Mean | **406.93** | **238.85** | **310.89** |
| | *SD* | *111.72* | *178.56* | *173.43* |
| **Conventional Stroop** | Mean | **310.36** | **194.68** | **243.76** |
| | *SD* | *143.38* | *166.00* | *164.99* |
| **Column** | Mean | **360.31** | **217.33** | |
| | *SD* | *134.90* | *171.74* | |

There was a significant main effect of group, $F(1,67) = 13.87$, $p<0.001$, $Eta^2 = .178$, with the HR/HB group consuming significantly more water than the LR/LB group. There was no other significant main or interaction effect.

### 7.3.9 Information processing of ego-threat

#### 7.3.9.1 Accuracy data

Table 18 shows Mean (SD) percentage of errors made by the two groups in the four Stroop categories (ego-self-threat, ego-self-control, ego-other-threat, ego-other control) within the three blocks making up the ego-Stroop task.

A 3 (Stroop block) X 4 (Stroop category: ego-self-threat, ego-self-control, ego-other-threat, ego-other-control) X 2 (Group: HR/HB vs LR/LB) mixed factorial ANOVA with Stroop block and Stroop category as within subjects factors and group as the between subjects factor revealed no significant main or interaction effects, indicating no significant group differences in errors made in response to threat and neutral words in the three Stroop blocks.

**Table 18.** Mean (SD) percentage of errors made in each of the four Stroop categories (ego-self threat, ego-self control, ego-other threat, ego-other control) by the HR/HB and LR/LB group in Stroop B1, B2 and B3.

| | | B1 | | | | B2 | | | | B3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego-self threat | Ego-self control | Ego-other threat | Ego-other control | Ego-self threat | Ego-self control | Ego-other threat | Ego-other control | Ego-self threat | Ego-self control | Ego-other threat | Ego-other control |
| HR/HB | Mean | 28.84 | 28.59 | 28.95 | 28.95 | 27.62 | 29.06 | 27.26 | 28.52 | 29.17 | 29.09 | 28.66 | 29.02 |
| | *SD* | *2.99* | *3.02* | *3.25* | *3.04* | *3.34* | *3.74* | *3.01* | *3.36* | *3.63* | *2.60* | *2.62* | *3.73* |
| LR/LB | Mean | 28.73 | 28.82 | 28.73 | 29.17 | 27.78 | 28.04 | 28.13 | 28.39 | 29.25 | 29.34 | 30.30 | 28.99 |
| | *SD* | *3.98* | *2.28* | *3.96* | *3.92* | *2.75* | *2.45* | *4.12* | *2.18* | *3.68* | *4.04* | *4.87* | *4.02* |

PAGE MISSING IN ORIGINAL

#### 7.3.9.2 Raw Scores: Median response times

Table 19 shows Mean (SD) raw (median) response times of the HR/HB and LR/LB groups to threat and neutral words contained within the three Stroop blocks.

Utilizing raw scores, a 3 (Stroop block) x 4 (Stroop category: ego-threat-self, ego-threat-other plus controls) X 2 (Group: HR/HB vs. LR/LB) mixed factorial ANOVA with Stroop block and Stroop category as the within subjects factors and group as the between subjects factor revealed a significant main effect of Stroop category, $F(1.24,40.77) = 5.35$, $p<0.05$, $Eta^{2} = .140$, and a significant Stroop category X group interaction effect, $F(1.24,40.77) = 8.20$, $p<0.005$, $Eta^{2} = .199$ (see Figure 12) . There were no other significant main or interaction effects.

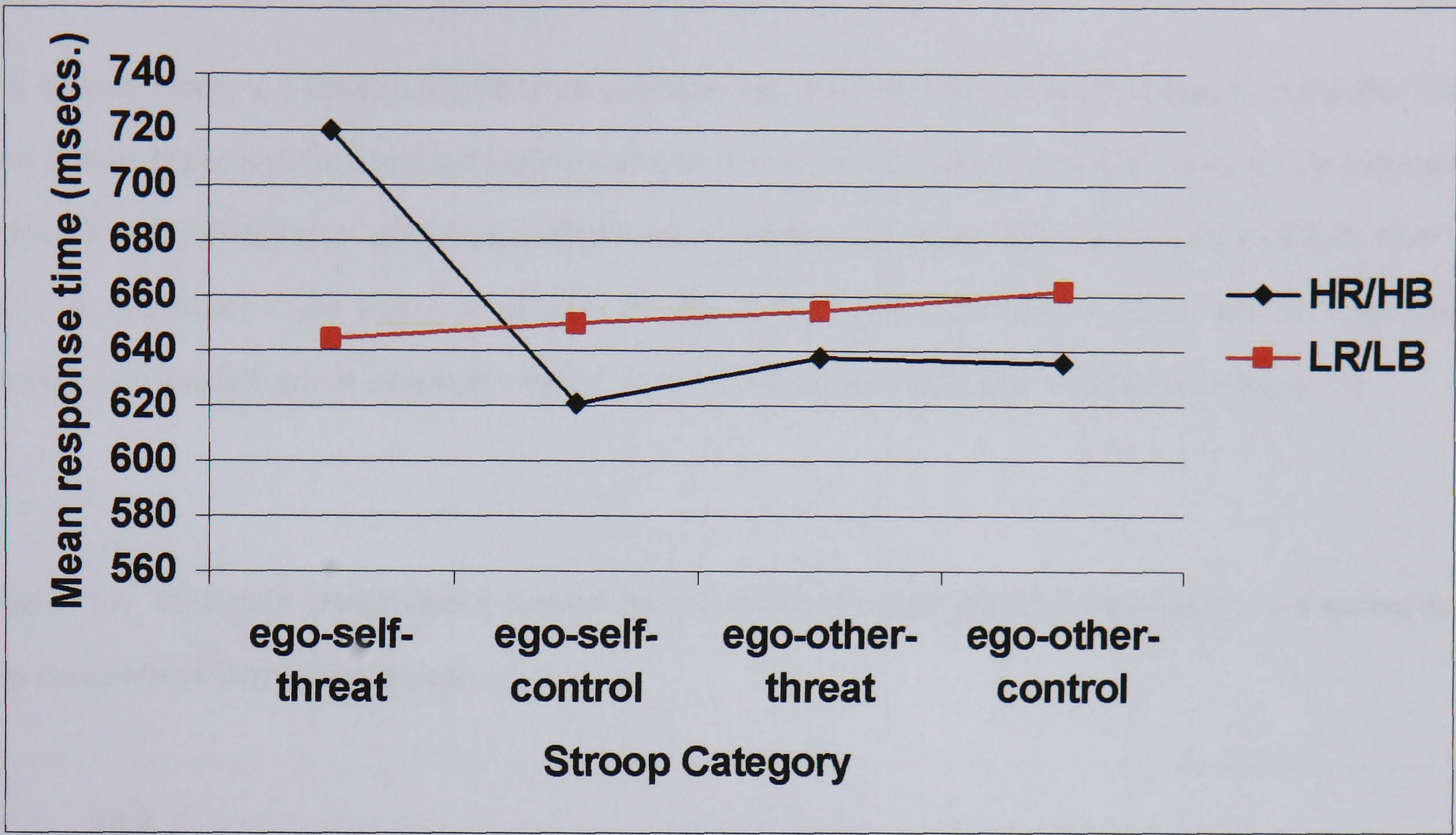
PAGE MISSING IN ORIGINAL

**Table 19.** Mean (SD) raw (median) response times made in each of the four Stroop categories (ego-self threat, ego-self control, ego-other threat, ego-other control) in Stroop B1, B2, and B3, by the HR/HB and LR/LB group.

| | | B1 | | | | B2 | | | | B3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego-self threat | Ego-self control | Ego-other threat | Ego-other control | Ego-self threat | Ego-self control | Ego-other threat | Ego-other control | Ego-self threat | Ego-self control | Ego-other threat | Ego-other control |
| HR/HB | Mean | 717.67 | 620.60 | 637.50 | 635.54 | 719.65 | 620.72 | 639.60 | 638.56 | 716.17 | 620.60 | 640.20 | 655.55 |
| | *SD* | *105.05* | *89.14* | *100.98* | *106.41* | *105.06* | *88.89* | *103.98* | *109.42* | *98.96* | *89.16* | *99.00* | *103.54* |
| LR/LB | Mean | 644.50 | 650.10 | 654.53 | 661.93 | 644.50 | 650.10 | 652.60 | 663.83 | 652.50 | 641.20 | 652.59 | 662.90 |
| | *SD* | *103.33* | *118.74* | *111.11* | *134.19* | *103.33* | *118.74* | *109.00* | *139.25* | *104.00* | *119.73* | *109.09* | *131.00* |

PAGE
MISSING
IN
ORIGINAL

**Figure 12. Two-way interaction between Stroop category and group on the measure of raw reaction-time responses to ego threat and neutral stimuli.**




Paired comparisons indicate that the HR/HB group were significantly *slower* to colour-name the ego-self-threat category than the ego-threat-control category, $t(15) = 3.58$, $p<0.005$. The comparisons for the ego-other-threat versus ego-other-control categories failed to reach significance, $t(15) = .22$, $p=0.828$. For the LR/LB group, no significant difference was found for either threat category: ego-self-threat vs. ego-self-control, $t(19) = .310$, $p=0.76$; ego-other-threat vs. ego-other-control, $t(19) = .96$, $p = 0.349$.

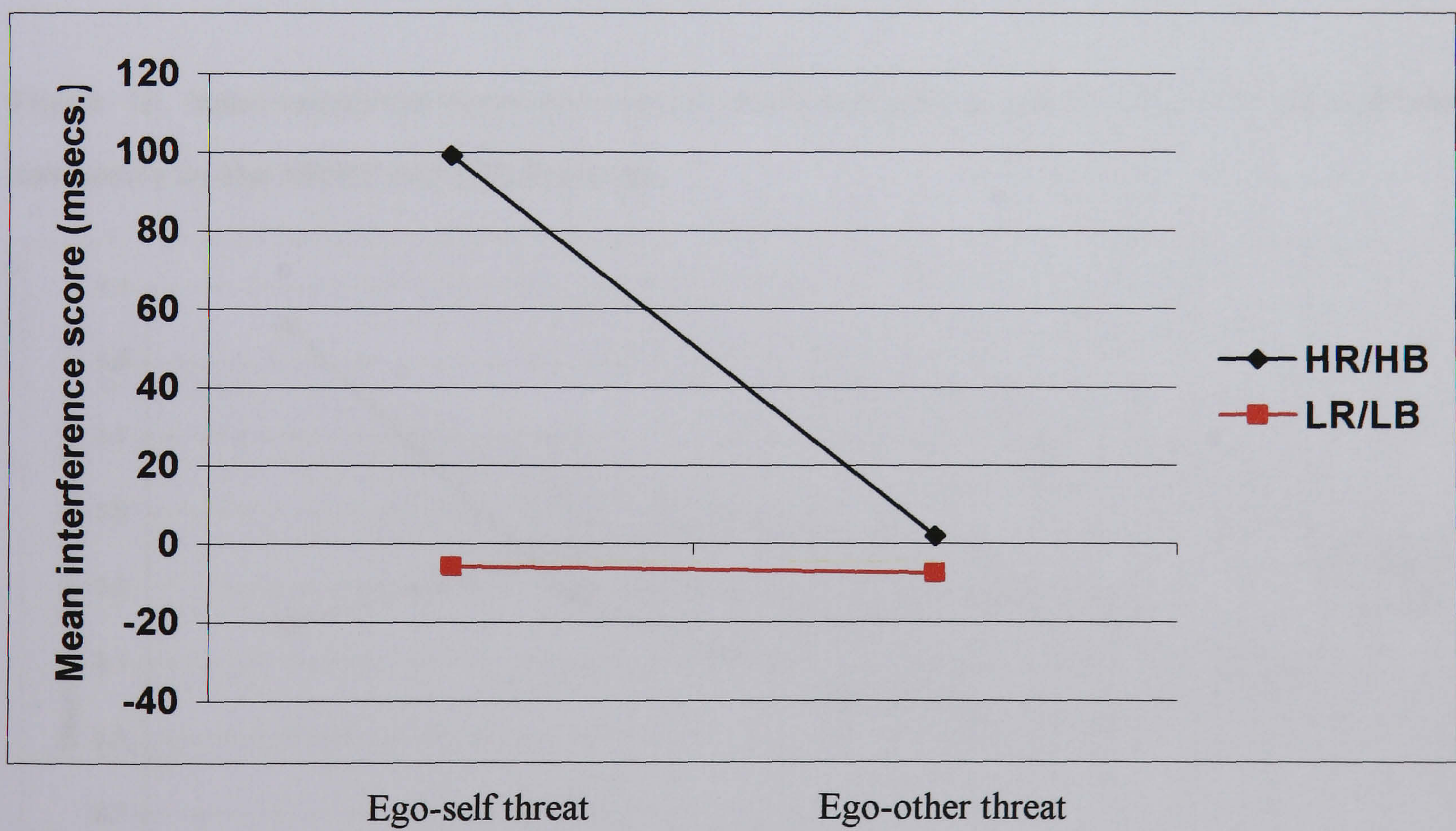
The HR/HB group were significantly *slower* to colour name the ego-self-threat category than the LR/LB group, $t(33) = 3.11$, $p<0.005$. There was no significant group difference for the ego-self-control, ego-other-threat, or ego-other-control category (all $p$'s>0.4).

#### 7.3.9.3 Interference scores.

Further analyses were undertaken using interference[11] scores. A higher interference score indicates a *slower* response.

A 3 (Stroop block) x 2 (Stroop Interference score) x 2 (Group: HR/HB vs LR/LB) mixed factorial ANOVA with Stroop block and Stroop interference score as the within subjects factors and group as the between subjects factor revealed a significant main effect of interference score, $F(1,33) = 10.53$, $p<0.005$, $Eta^2 = .239$, a significant main effect of group, $F(1,33) = 9.72$, $p<0.005$, $Eta^2 = .223$, and a significant interference score X group interaction effect, $F(1,33) = 9.53$, $p<0.005$, $Eta^2 = .226$ (see Figure 13)

**Figure 13. Two-way interaction between Stroop category (ego-self and ego-other) and group on the measure of interference score.**



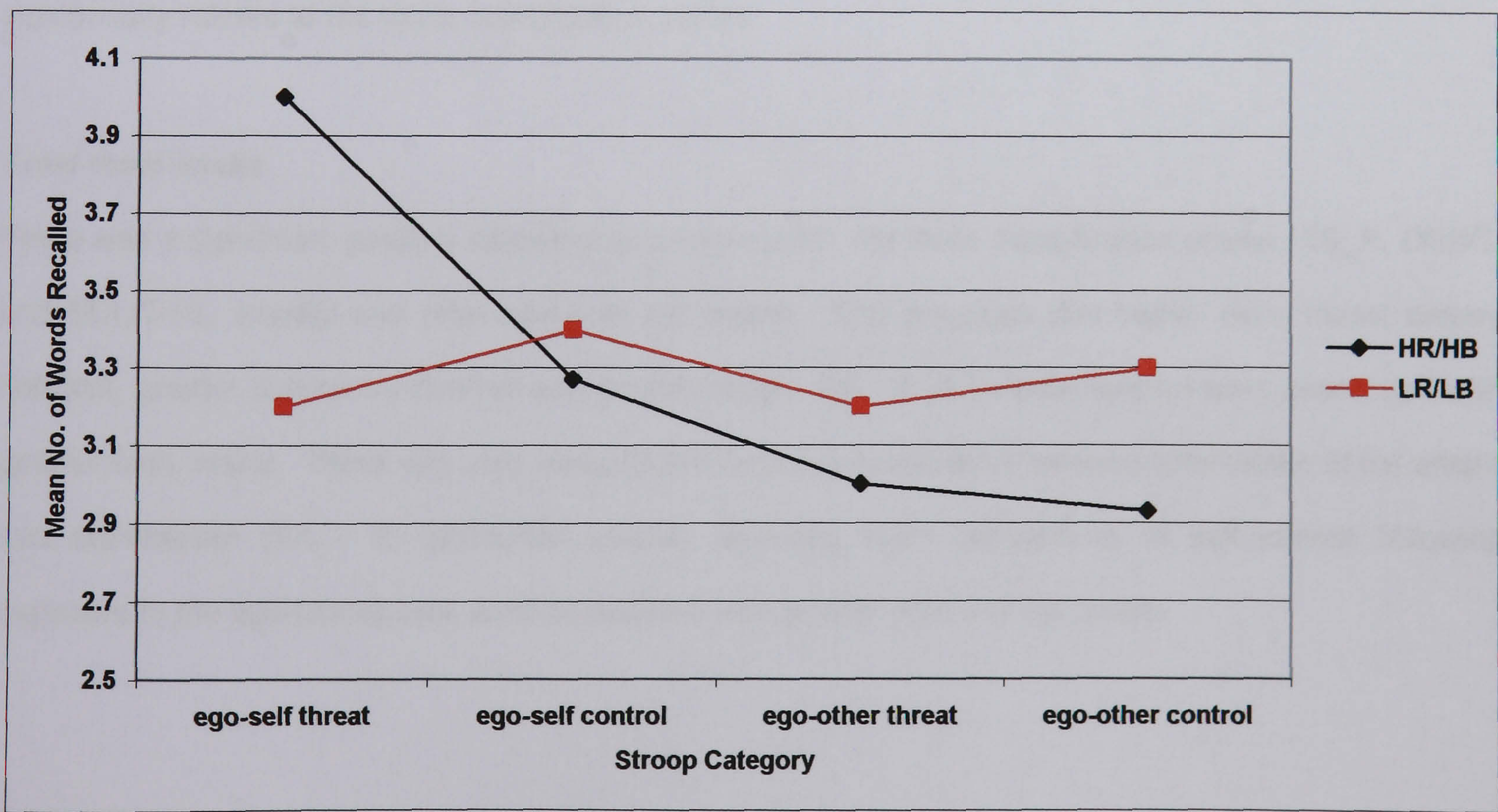

[11] Interference is the difference between the time taken to colour-name the threat and control stimuli.

Paired t-tests using interference scores averaged across the three Stroop blocks revealed that the HR/HB group had significantly *slower* interference scores for the ego-self category than the ego-other category, $t(15) = 3.66$, $p<0.005$. Independent-samples t-tests revealed that the HR/HB group had significantly *slower* interference scores than the LR/LB group for the ego-self threat category, $t(33) = 3.26$, $p<0.005$, but not for the ego-other threat category, $t(33) = .846$, $p=0.403$.

#### 7.3.9.4 Memory bias for ego threat words

A 4 (Stroop category: self-directed ego threat; self-directed ego threat control; ego-other threat; ego-other control) x 2 (Group: HR/HB vs LR/LB) mixed factorial ANOVA, with Stroop category as the within subjects factor and group as the between subjects factor, examining number of words correctly recalled from each of the four Stroop categories using an incidental recall test, with delayed recall (approximately 30 mins.) revealed a significant Stroop category x group interaction effect, $F(1.37, 45.14) = 3.54$, $p<0.05$, $Eta^2 = .103$. There were no significant main effects. Figure 14 shows Mean number of threat and control words correctly recalled in each of the Stroop categories by the HR/HB and LR/LB groups.

**Figure 14. Mean number of threat and control words correctly recalled in each of the four Stroop categories by the HR/HB and LR/LB groups.**



Planned comparisons revealed that, although the mean number of ego-self threat words correctly recalled by the HR/HB group was higher than the ego-self control words, ego-other threat words, and higher than the mean number of ego-self threat words correctly recalled by the LR/LB group, all of these comparisons failed to reach significance according to the adjusted alpha level of 0.005 (all $p$'s>0.03).

#### 7.3.9.5 Correlational analyses

Next, correlations were undertaken to examine a) the relationship between level of eating pathology and interference scores for self-directed ego threat stimuli, anxiety and self-esteem ratings, and b) the relationship between total food and water intake, measures of dietary restraint and bulimic symptoms, anxiety, self-esteem ratings and interference scores for the ego-self threat Stroop category (see Table 17).

In line with the prediction, a positive and significant association between interference scores for self-directed ego threat words (but not ego-threat from others) and level of eating pathology was observed. Values for the RS-R, the DEBQ and the BULIT-R were positively and significantly associated with time taken to colour name self-directed ego threat stimuli (r = .37, .47, and .39). Post task anxiety and self-esteem ratings were also positively (STAI: r = .57, .50, .48), negatively (SSES: r = -.36, -.31, -.32) and significantly related to the three classification scales.

***Total food intake***

There was a significant positive relationship between BMI, the three classification scales (RS_R, DEBQ, and BULIT-R), anxiety and total intake of ice cream. This suggests that higher body mass, dietary restraint, greater bulimic tendencies and anxiety levels (TA - B: difference values) were associated with greater food intake. There was also a significant negative association between total intake of ice cream and self-esteem (TA – B: difference values), whereby lower perceptions of self-esteem following exposure to the ego-Stroop task were associated with greater intake of ice cream.

***Total water intake***

There was a significant positive correlation between BMI, scores on the three classification scales (RS_R, DEBQ, and BULIT-R), and interference scores for self-directed ego threat and total water intake only. This suggests that higher body mass, restrained and bulimic tendencies and slower reaction-time scores for ego-self threat stimuli are associated with greater water intake.

**7.3.9.6 Multiple Regression Analyses**

Next, standard multiple regression analyses were performed to identify significant predictors of total food and water intake following the ego-Stroop task. The three classification scales (RS-R, DEBQ and BULIT-R) were highly inter-correlated ($p$<0.01). Therefore scores on these scales were standardized (converted to z scores) and averaged prior to entry into multiple regression analyses to provide a composite measure of dietary restraint/bulimic symptoms (Comp-RB). All variables entered into the analyses were z scores (Cohen, Cohen, West, & Aiken, 2003).

**Table 20.** **Correlations (Pearson's *r*) between total food and water intake, the RS-R, DEBQ, BULIT-R, anxiety (STAI: post task), self-esteem (SSES: baseline – task: difference scores) and interference scores for ego-self threat for the ego Stroop task (N = 35).**

| | BMI | RS-R | DEBQ | BULIT-R | STAI (post-task) | SSES (B-TA, difference scores) | Ego-self (interference scores) | Total food | Total water |
|---|---|---|---|---|---|---|---|---|---|
| **BMI** | | .47** | .40** | .49** | NS | NS | .29* | .46** | .34** |
| **RS-R** | | | .90** | .85** | .57** | -.36* | .37* | .74** | .55** |
| **DEBQ** | | | | .80** | .50** | -.31* | .47** | .75** | .52** |
| **BULIT-R** | | | | | .48** | -.32* | .39* | .60** | .50** |
| **STAI (post-task)** | | | | | | -.30* | NS | .33* | NS |
| **SSES (B-TA: difference scores)** | | | | | | | NS | -.34* | NS |
| **Ego-self (interference scores)** | | | | | | | | NS | .48** |

**$p<0.01$; *$p<0.05$ (2-tailed)

### 7.3.9.7 Multiple regression analyses

Table 21 shows standard multiple regression of Comp-RB, anxiety (STAI: TA – B: difference values), self-esteem (SSES: TA – B difference values), and on to total ice cream intake. Table 22 shows standard multiple regression of Comp-RB, anxiety (STAI: TA – B: difference values), self-esteem (SSES: TA – B: difference scores), and ego-self Stroop interference scores on to total water intake.

**Table 21. Standard multiple regression of restraint plus bulimic symptoms (Comp-RB), anxiety (STAI), self-esteem (SSES) regressed on total ice cream intake.**

| Variables | Beta | t | Sig t | $R^2$ | $AdjR^2$ |
|---|---|---|---|---|---|
| Comp-RB | .62 | 3.90 | <0.001 | | |
| Self-esteem (SSES) | -.14 | -.95 | .36 | | |
| Anxiety (STAI) | .03 | .19 | .86 | .45 | .39 |
| ANOVA: $F(3,31) = 8.27$, $p<0.001$ | | | | | |

**Table 22. Standard multiple regression of restraint plus bulimic symptoms (Comp-RB), anxiety (STAI), self-esteem (SSES), and ego-self Stroop interference scores regressed on total water intake.**

| Variables | Beta | t | Sig t | $R^2$ | $AdjR^2$ |
|---|---|---|---|---|---|
| Comp-RB | .40 | 2.19 | <0.05 | | |
| Ego-self Stroop interference scores | .33 | 2.09 | <0.05 | | |
| Self-esteem (SSES) | -.14 | -.90 | .38 | | |
| Anxiety (STAI) | .10 | .57 | .57 | .38 | .30 |
| ANOVA: $F(4,30) = 4.68$, $p<0.01$ | | | | | |

***Summary of Multiple Regression Results:***

*Total food intake*: controlling for BMI, results of the multiple regression analysis showed that only one of the predictor variables (Comp-RB) contributed significantly to the prediction of total food intake. Collectively, moderate prediction was available; 45% (39% adjusted) of the variability in total food intake was predicted by knowing the scores on the three predictor variables (Comp-RB, STAI (difference scores), and SSES (difference scores)). The overall ANOVA model was significant.

*Total water intake:* controlling for BMI, results of the multiple regression analysis showed that two of the predictor variables (Comp-RB and ego-self interference scores) contributed significantly to the prediction of total water intake. Collectively, 38% (30% adjusted) of the variability in total water intake was predicted by knowing scores on the four predictor variables (Comp-RB, STAI (difference scores), and SSES (difference scores) and ego-self Stroop interference scores). The overall ANOVA model was significant.

## 7.4 Discussion

This study compared the effects of two laboratory stress manipulations that varied in terms of emotional content. The effects of two Stroop tasks (one containing ego threat and neutral stimuli, the other containing incongruent colour words) on females high in dietary restraint and bulimic symptoms was assessed and compared to a control population in terms of self-reported anxiety, self-esteem, food and water intake This study also tested whether an attention and memory bias for ego threat stimuli existed for restrained eaters with bulimic symptoms, when compared to neutral stimuli and to a control population. In addition, the extent to which the Stroop task demands the *automatic* processing of information was also assessed.

Preliminary analysis showed no significant group difference in use of oral contraceptives, or ratings of perceived control over either stress task employed within this study. Research shows that a lack of perceived control over the stressor can lead to greater anxiety (e.g. Muller et al., 1990). Although ratings were similar for all participants, it should be noted that a mean total of 3.72 suggests feelings of only a *moderate* amount of control for all participants. Groups were similar in terms of age.

***Self-reported negative affect (STAI) following stress***

In line with predictions, self-reported anxiety ratings were significantly higher for the HR/HB group following exposure to the ego than the conventional Stroop task, and were significantly higher for the

HR/HB group than the LR/LB group following the ego Stroop task. However, it should also be noted that, after controlling for baseline anxiety levels, there was no significant group difference in post-stress anxiety ratings following the conventional Stroop task. This could indicate that the colour Stroop task failed to provoke a significant self-reported anxiety response. Inspection of the means suggests that the control population found both tasks to be similarly arousing (Ego, M=37.65; Colour, M=36.11), with each task provoking only a small *change* (increase) in self-reported anxiety ratings from baseline measures (Ego, Mean increase = 5.95; Colour, Mean increase = 8.37). For the target population, the mean STAI rating post stress was similar to that of the control population for the colour Stroop task (M=41.21). However, for this group the mean STAI rating following the ego-Stroop was 50.20, with a mean increase from baseline of 14.53. Taken together, these figures suggest that HR/HB females found only the ego-Stroop task to be particularly stressful, whereas the control population found neither task to be highly anxiety provoking.

These results therefore conflict with prior research, where results have shown a significant elevation in self-reported negative affect ratings following exposure to both an ego-threat and colour Stroop task (Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004). For example, in a study undertaken by Lattimore & Maxwell (2004), ANOVA results revealed a significant main effect of both time and group, whereby post-task anxiety ratings were significantly greater than baseline, and restrained eaters were generally more anxious than unrestrained eaters. The colour Stroop task employed within this study was comprised of three blocks of eight colour nouns from a house paint colour card (Block 1: RED, GREEN, BLUE, YELLOW, BURGUNDY, TURQUOISE, AQUAMARINE, MAGENTA; Block 2: RED, GREEN BLUE, YELLOW, PRIMROSE, VIOLET, SAGE, MAGNOLIA; Block 3: RED, GREEN, BLUE, YELLOW, SUNFLOWER, MOONLIGHT, BEIGE, CLARET). Within each block, the words RED, GREEN, BLUE, and YELLOW were printed in incongruent colours. The ego Stroop consisted of 3 categories of 'threat' (sociotropy, self-directed ego threat, and ego-threat from others).

Similarly, Wallis & Hetherington (2004) reported that retrospective ratings of perceived stressfulness were significantly higher following a computer driven incongruent colour Stroop task and an ego-threat Stroop task, when compared to a control condition (Stroop task containing neutral words). The colour

Stroop task was comprised of eight colour words (RED, GREEN BLUE, YELLOW, BROWN, PINK, BLACK, and ORANGE) presented in four colours (red, green, blue, and yellow) than for a control condition (a computer generated Stroop task containing neutral words). The ego Stroop task employed was constructed similarly to that employed by Lattimore & Maxwell (2004).

***Self-reported self esteem ratings (SSES) following stress***

With regard to self-reported ratings of self-esteem, the HR/HB group had significantly *lower* ratings than the LR/LB group prior to experimentation. Results of analyses controlling for baseline measures, and using change scores, showed that both tasks affected self-esteem ratings similarly, with self-esteem ratings for the HR/HB group remaining significantly lower than those of the LR/LB group following exposure to stress. Thus, the prediction relating to effects on self-esteem were partially supported.

***Total ice cream intake following stress***

Predictions were also supported with regard to total ice cream consumption. After controlling for BMI, the HR/HB group consumed significantly more ice cream when exposed to the ego Stroop than the conventional Stroop, and significantly more than the LR/LB group following the ego-threat Stroop task. The LR/LB group consumed similar amounts of ice cream whether exposed to the ego or conventional Stroop task. Although the HR/HB group consumed a *smaller* amount of ice cream following exposure to the conventional Stroop task than the control group, this comparison did not reach significance. However, the direction of the means suggests that restrained eaters with bulimic tendencies who undertook the colour Stroop task managed to maintain control over their eating behaviour. This pattern of results suggests that the ego Stroop *was* successful in inducing overeating in females with both high restraint and bulimic tendencies, whereas the conventional Stroop task was not. However, the observation that both groups consumed similar amounts of food following exposure to the colour Stroop task is contrary to prior research where researchers have demonstrated disinhibition of dietary restraint in response to incongruent colour nouns (e.g., Rutledge & Linden, 1998; Wallis & Hetherington, 2004). For example, Rutledge & Linden (1998) reported a significantly greater consumption of chocolate chip cookies and crackers in restrained eaters (classified using to both the RS: Herman & Polivy (1980), and the 20-item disinhibition subscale taken from Stunkard & Messick's (1985) TFEQ), as compared to a control population, following exposure to three active coping tasks (mental arithmetic, incongruent colour Stroop, and word scramble). Wallis & Hetherington (2004) reported that dietary restraint (as assessed by the restraint subscale of the DEBQ; van Strien et al., 1986) was associated with greater intake of chocolate following exposure to an incongruent colour Stroop task, compared to a control condition, consisting of neutral words.

However, *in line* with the present study, Lattimore & Maxwell (2004) reported no significant group difference in snack food intake following exposure to a computer driven Stroop task containing colour nouns, *some* of which were incongruent colour words. Participants in the present study differed from restrained eating populations in the aforementioned studies in that they possessed not only restrained eating attitudes, but also bulimic attitudes. None of these studies assessed levels of bulimic symptomatology in their restrained eating populations, making comparison with the present study difficult. However, the population employed in the present study was comparable to those employed by Levine & Marcus (1997) and Lattimore (2001).

Results of the present study are also contradictory to those of Levine & Marcus (1997) who reported that, counter to their hypothesis, non-clinical women with "significant bulimic symptoms" did not differentially increase their total intake of snack food items when exposed to an interpersonal stress task, that had the potential to be ego threatening, in that participants were required to prepare and deliver a three-minute speech about their negative qualities to a video camera that they believed to be filming them. However, in their study, there was a significant increase in carbohydrate intake following stress, but this effect was not mediated by bulimic status. Findings in relation to total food intake in the present study are, however, similar to those of Cattanach et al. (1988) reported a greater desire to binge eat following mood manipulation relating to interpersonal conflict and social interaction in non-clinical women with eating disorder symptomatology, compared to a control group. However, actual food intake was not measured in this study. The present results are also in line with those of Lattimore (2001) who found that dieters who self-reported binge-eating tendencies (BULIT-R; Smith & Thelan, 1984) were found to consume significantly more ice cream following exposure to an ego-threat Stroop task that was similar to the task employed within this research, when compared to a general stressor (a fearful film). These findings are also in line with prior studies that report that *subliminally* presented emotional cues unrelated to eating can induce greater levels of eating in non-clinical women with bulimic attitudes (Patton, 1992; Waller & Mijatovich, 1998; Meyer & Waller, 1999).

***Intake by flavour***

In respect of intake of each of the three flavours of ice cream provided, for the ego Stroop condition, the HR/HB group consumed significantly more vanilla, chocolate and strawberry ice cream compared to the LR/LB group. There was no significant group difference for any of the three flavours of ice cream following exposure to the conventional Stroop task.

One interpretation of the pattern of results is that the HR/HB group in the ego Stroop condition preferred the taste of each of the three flavours of ice cream served significantly more than did the control group, causing them to consume more of each of the different flavours of ice cream presented. To investigate this possibility ice cream 'liking' ratings for each of the three flavours, obtained during the bogus taste test, were analysed. Results of this analysis revealed that, although participants preferred the taste of the vanilla and chocolate ice cream served to them significantly more than the strawberry ice cream, there was no significant group or condition difference in ratings. Thus, it would appear that females who possess both restrained eating and bulimic tendencies consumed significantly more of an ice cream they did not rate particularly highly when stressed (following exposure to the ego-threat Stroop task).

***Self-reported anxiety ratings (STAI) following food ingestion***

In terms of ratings of self-reported negative affect following food consumption (during the recovery phase), anxiety ratings for the control population were similar to post-task ratings following both experimental conditions. Anxiety ratings for the target population were not significantly different to post-task ratings for the target population who undertook the colour Stroop task. However, for the HR/HB group who was exposed to the ego Stroop task, there was a significant *reduction* in anxiety ratings from task to recovery. Post-recovery ratings for this group were also lower than their baseline ratings (M=27.13 vs M=35.67). In addition, anxiety ratings for this group were also significantly lower following food ingestion than were ratings for the HR/HB females who undertook the conventional Stroop task, and the LR/LB females who undertook the ego Stroop task. Taken together, results suggest that the ego-threat Stroop task induced negative emotional affect in females with significant bulimic symptoms, triggering an 'escape' from self awareness response (Heatherton & Baumeister, 1991), resulting in the overeating of a highly palatable food, with food ingestion producing a reduction in anxiety levels.

***Self-reported self-esteem ratings (SSES) following food ingestion***

Results showed that, regardless of condition, there was no significant difference in self-reported self-esteem ratings between the task and recovery phases for the control population. However, also regardless of experimental condition, self-esteem ratings for females with significant bulimic symptoms were significantly elevated (indicating more positive feelings of self-esteem) following food ingestion than following exposure to the experimental manipulations.

In summary, the ego-threat Stroop task appears to have provoked a significant anxiety response, but only in females who are both high in terms of restrained eating and bulimic attitudes towards weight. This anxiety response was accompanied by a decrease in feelings of self-esteem and over-consumption of a highly palatable food. The ingestion of ice cream [a highly palatable food] resulted in a significant improvement in feelings of self-esteem and also served to reduce feelings of anxiety. Taken as a whole, the pattern of results obtained suggests an 'escape' from self-awareness was triggered by ego-threat stress, resulting in bingeing behaviour, that was mediated by [low] feelings of self-esteem (Heatherton & Baumeister, 1991). These results also add support to newer cognitive models of the eating disorders in that females with symptoms of BN overate in response to 'threat' that is unrelated to eating, and that overeating in this instance served as a coping mechanism to deal with negative feelings once activated (Waller – submitted for publication – in Mountford et al., 2004). It could be that the consumption of a highly palatable food served the function of relieving feelings of negative emotional affect (Bruch, 1973; Heatherton & Baumeister, 1991; Kaplan & Kaplan, 1957; Lacey, 1986; Leon & Roth, 1977; Root & Fallon, 1989), induced by threats to the individual's emotional stability or self-esteem (i.e., ego-threats) (Heatherton & Baumeister, 1991), possibly via the chemical properties of the food [through the release of beta-endorphin] (Dum et al., 1983; Davis et al., 1983), resulting in mood elevation (Benton & Donohoe, 1999).

***Information processing of ego threat***

Given that the ego-threat Stroop task was found to induce 'disinhibition' in restrained eaters with bulimic symptoms, the second aim of this study was to examine one possible mechanism whereby the ego Stroop task exerts its effect. Therefore the information processing of two different types of ego-threatening information contained within the ego Stroop task (self-directed ego threat and ego-threat from others) was examined. Based on the results of prior research (e.g., McManus et al., 1995, 1996, 1996a; Waller et al., 1996) (see also Sections 3.4.12 and 3.4.13), it was expected that females with bulimic [and restrained] eating attitudes would demonstrate an information processing bias for self-directed ego threat stimuli, but not for stimuli relating to ego-threat from others.

Research shows that interference scores generate stronger group comparisons than do raw latency scores (Dobson & Dozois, 2004). Thus, both raw latency and interference scores were analyzed. Preliminary analysis revealed no significant group differences in the percentage of errors made when responding to stimuli in the four Stroop categories (ego-self threat, ego-other threat and their respective control words), in each of the three blocks (trials) within the ego Stroop task.

As predicted, ANOVA analyses employing both raw latency and interference scores revealed that females with both bulimic and restrained eating attitudes were significantly *slower* to colour name the ego-self threat category than a) matched neutral words, b) stimuli relating to ego-threat from others, and c) the control population. For the ego-threat from others category, there was no significant group or category (threat versus neutral) difference in responding.

***Memory bias for ego threat stimuli***

The existence of a memory bias for ego threatening information was assessed using an incidental free recall task of words contained within the Stroop task, with a delayed recall (of approximately 30 minutes) and with recall taking place following food (ice cream) ingestion. The memory task was incorporated into the laboratory protocol with the intention that it might serve to highlight the extent to which information contained within an unmasked Stroop task is processed at a *pre*conscious level.

Results of the ANOVA model revealed that although a significant interaction effect between Stroop word category and the two groups was revealed ($p<0.05$), planned follow-up tests revealed that although the mean number of self-directed ego-threat words correctly recalled by the HR/HB group was higher than that of the control population, higher than the mean number of ego-self neutral words recalled, and higher than the mean number of ego-threat from others stimuli recalled, none of these comparisons attained significance at the adjusted alpha level.

Interpretation of these results is difficult. Inspection of the means might suggest a trend whereby non-clinical females who self-report bulimic symptoms may possess a memory bias specifically for ego threatening information that is self-directed. The failure to obtain significance according to the adjusted alpha level could be a problem of insufficient statistical power, arising from the classification of participants according to multiple scales (see Section 6.13), resulting in a Type II error. However, the largest mean difference was obtained in relation to the number of self-directed ego-threat words recalled by the two groups, and this mean difference was very small (.8), suggesting that the majority of participants in the two groups recalled a similar number of words, and that a non-significant statistical result may be true.

Given that all participants were able to recall *some* information contained within the Stroop task after a delay of approximately 30 minutes, this suggests that the words recalled were retrieved from *long-term* memory, and were therefore consciously or *strategically* processed within the Stroop task. This would suggest that the *slowing* response to self-directed ego threat words demonstrated by females with bulimic symptoms represents a *cognitive avoidance* away from threat, rather than an attentional bias towards such information. Further, if the non-significant group and threat category difference in word recall is genuine, this might suggest further evidence for the use of cognitive avoidance when HR/HB females are asked to recall threat information. However, it should also be noted that it is a well documented phenomenon that memory for emotionally toned material is in general better than memory for emotionally neutral material (e.g., Rapaport, 1942). Therefore, at least for the control population, recall of threat stimuli should have been greater than recall of neutral stimuli. This was not the case.

LR/LB females correctly recalled a similar number of words from each of the threat and neutral categories. More research is therefore needed in order to add clarity to these results.

***Relationship between mood and bingeing***

Correlation analyses were undertaken to examine the relationship between total food and water intake, measures of BMI, dietary restraint, bulimic symptoms, anxiety, self-esteem and information processing bias for ego threat stimuli.

***Total food intake***

It was also predicted that there would be a positive and significant association between and interference scores for self-directed ego threat words and a) level of eating pathology, and b) total amount of food consumed. Predictions were supported in respect of the anticipated association between the information processing performance for self-directed ego threat words and level of eating pathology. Each of the three classification scales (RS-R, DEBQ, and BULIT-R) was positively and significantly associated with self-directed ego threat interference scores, with the DEBQ showing the strongest association ($r$ = .47, 2-tailed). This result is in line with prior research suggesting an association between 'threat' processing and both bulimic (Waller et al., 1995) and restrictive (Quinton, 1999) attitudes.

However, although a positive association between self-directed ego-threat interference scores and food intake was revealed, this relationship was non-significant ($r$ = .23, $p$ = .062). This prediction was therefore not supported. However, a positive and significant relationship was also found between anxiety and total food intake, as well as a negative and significant relationship between self-esteem ratings and total food intake ($r$ = .33, -.34, $p<0.05$). Regression analysis revealed that the only significant independent predictor of total ice cream intake was the Comp-RB (A variable consisting of standardized scores of the three classification scales), with a Beta value of .62, and with the three variables (Comp-RB, anxiety, and self-esteem) together accounting for 45% (adjusted to 39%) of the variance in total ice cream consumed in response to ego-threat stress.

***Total water intake***

It is worth noting, however, that the relationship between interference scores for self-directed ego threat stimuli and water intake was highly significant ($r$ = .48, $p$<0.01). Each of the three classification scales (RS-R, DEBQ, and BULIT-R) was also positively and significantly related to total water intake ($r$ =.55, .52, .50, all $p$'s <0.01). Further, both the Comp-RB variable, and interference scores for self-directed ego-threat stimuli were found to be significant independent predictors of total water intake in a regression analyses. With STAI and SSES ratings [change scores] also entered, the overall regression Model was found to be significant (p<0.01), with all variables entered accounting for 38% (adjusted to 30%) of the variance in water intake following exposure to the ego-threat Stroop task.

To summarise, it was initially predicted that a task containing low cognitive load, but high emotional loading (i.e., the ego Stroop task) would induce greater food intake than would a task that was low in terms of both cognitive and emotional loading (i.e., the colour Stroop task) in females with bulimic symptoms, compared to controls. This prediction was supported. Consideration of the results when analyzed both categorically and dimensionally, suggest that self-directed ego-threatening information (but not ego-threat from others) triggered a highly aversive emotional state from which restrained eaters with bulimic attitudes were motivated to escape (Heatherton & Baumeister, 1991). This is evidenced by an increase in feelings of anxiety and a lowering of perceptions of self-esteem. In line with prior research (Lattimore, 2001; Lattimore & Maxwell, 2004; Patton, 1992; Waller & Mijatovich, 1998; Meyer & Waller, 1999; Wallis & Hetherington, 2004), it would appear that overeating can be triggered in response to threat unrelated to eating, and that overeating in this instance served as a coping mechanism to deal with negative feelings once activated (Waller – submitted for publication – in Mountford et al., 2004). Also in line with prior research, for females who demonstrate restrained eating *and* bulimic attitudes, a significantly slower colour-naming latency was obtained for self-directed ego threat words compared to matched neutral words (Waller et al., 1996). In addition, also in line with prior research, interference times for self-directed ego threat stimuli was positively and significantly related to level of eating psychopathology (McManus et al., 1995; Waller et al., 1996; Quinton, 1998). The results of this study therefore add support to the 'escape' model of bingeing (Heatherton & Baumeister, 1991) and also to more recently developed cognitive information-processing models of eating psychopathology (Cooper et al., 2004; Meyer & Waller, 1997; Waller – submitted for publication – in Mountford et al., 2004).

Given that both tasks were similar in terms of cognitive load, but that only the ego Stroop task provoked a high self-reported anxiety response, and only for the target population, this suggests that the anxiety may have been provoked specifically by the presence of the ego-threatening information contained within the task. In this respect, results add support to the 'escape' theory of bingeing (Heatherton & Baumeister, 1991), but not the limited capacity model (Boon et al., 2002; Ward & Mann, 2000) of disinhibition.

This study also assessed the effects of the post-stress consumption of a highly palatable food (ice cream) on mood (anxiety and self-esteem). Post-ingestion results suggest a reduction in feelings of anxiety and an increase in perceptions of self-esteem for the target population, in comparison to post-task results. These results also add support to Heatherton & Baumeister's (1991) functional model of bingeing. This model suggests that bingeing is a consequence of *internally* derived triggers (such as ego-threats) motivating the individual to 'escape' from negative self-awareness. Control participants in this study were only minimally affected by the two laboratory manipulations and by the consumption of the food item (ice cream), in terms of anxiety and self-esteem responses.

Results obtained from an incidental and delayed free recall of words contained within the Stroop task were inconclusive. Given that participants were able to recall some of the words contained within the Stroop task 30 minutes after undertaking the task, this would suggest that the words were retrieved from long-term memory, and that they were therefore processed at a conscious level. Although the pattern of results intimated the possibility of an explicit memory bias for self-directed ego threat words, when stimuli are presented visually, for females with both restrained and bulimic attitudes, follow-up comparisons failed to attain significance. More research is required in order to add clarity to this finding.

# Chapter 8. The psychophysiological effects of ego-threat stress in females with bulimic symptoms and restrained eaters

## 8.1 Study Overview

The first aim of the present study was to compare the effects of the ego-threat Stroop task (employed in study 1 of this thesis) in two conditions (high vs low cognitive load) on mood (anxiety and self-esteem), food intake (ice cream) and physiological and biological reactivity in two target populations, females who display bulimic symptoms (who were also restrained eaters), and restrained eaters who did not display bulimic symptoms.

The two experimental conditions were comparable in that they both contained a task with high emotional loading (i.e., ego-threat stimuli), and they both demanded an *active* behavioural response. However, participants who completed condition 2 were provided with pre-test instructions to perform an immediate free recall of words contained within the Stroop task (*cued and immediate free recall*), whereas participants who completed condition 1 were not issued with such pre-test instructions, but *were* given an immediate free recall task to complete (*incidental and immediate free recall*). Thus, cognitive load (degree of difficulty to perform the task) was increased in condition 2 over condition 1. In addition, in condition 2 participants were required to *strategically* process the words within the Stroop task, whereas in condition 1 they were not. In this study, physiological (HR, SBP and DBP) and biological (salivary cortisol) responding was assessed during a baseline period, during task performance, and during the recovery period (during food ingestion).

The second aim was to assess the cognitive (anxiety and self-esteem) and psychophysiological effects of the post-stress ingestion of a highly palatable food (ice cream) in females with both bulimic and restrained eating attitudes.

The third aim was to assess whether information processing and memory biases exist for self-directed ego threat stimuli (but not for ego-threat from others) in females with both bulimic and restrained eating attitudes.

The fourth aim was to assess habituation/temporal responding to ego-threat stress, assessed via delivery of the stimulus over several trials.

## 8.2 Method

### 8.2.1 Participants

Eighty-five prospective participants were initially recruited. Six participants did not meet the requirements of the screening process and therefore did not take part in the study. Individual differences were assessed using the classification shown in Table 23.

**Table 23. Participant classification information and ethnicity details**

| Instrument | | | Classification | Currently dieting to lose/maintain weight | N |
|---|---|---|---|---|---|
| RS_R median split | DEBQ median split | BULIT_R | | | |
| >15 | >2.8 | >80 | High restraint/high bulimic (HR/HB) | 83.33% (n=20) | 24 |
| >15 | >2.8 | ≤80 | High restraint/low bulimic (HR/LB) | 60.87% (n=14) | 23 |
| ≤15 | ≤2.8 | ≤80 | Low restraint/low bulimic (LR/LB) | 9.38% (n=3) | 32 |

| Ethnicity | HR/HB (N) | HR/LB (N) | LR/LB (N) |
|---|---|---|---|
| English/British | 20 | 20 | 28 |
| English/Scottish | 2 | 0 | 2 |
| English/Irish | 2 | 0 | 1 |
| Asian/British | 0 | 2 | 0 |
| Chinese/British | 0 | 1 | 1 |

### 8.2.2 Oral contraceptive use: A Chi-square test revealed no significant group differences.

### 8.2.3 Time of undertaking experimental session: A Chi-square test revealed no significant group differences in time of testing (9.30a.m., 11.30a.m., 1.30p.m., 3.30 p.m., or 5.30p.m.).

### 8.2.4 Design, Materials and Procedure (see Chapter 5 and Figure 5).

## 8.3 Results

Because of the construction of the experimental protocol, analyses relating to perceived control over the task, self-reported anxiety, self-esteem, food and water intake relate to ratings obtained after completion of both the Stroop task and the word recall task. Analyses of physiological reactivity (HR and BP) and biological reactivity (salivary cortisol) relate to values obtained during performance on the Stroop task only, and do not include performance during the word recall task.

### 8.3.1 Preliminary Analysis

Inspection of a series of one-way ANOVA (Table 24) revealed that groups were well matched in terms of age and BMI[12]. Groups differed significantly in terms of the three classification instruments (see Table 25 for Tukey's HSD post hoc tests). For the DEBQ and BULIT-R, the HR/HB group scored significantly higher than both the HR/LB and LR/LB group, and the HR/LB group scored significantly higher than the LR/LB group. For the RS-R, there was no significant difference in scores for restrained eaters, with and without bulimic symptoms. However, both of these groups scored significantly higher than did the control (LR/LB) group.

[12] BMI: 15-19 = underweight; 20-25 = normal weight; 26-30 = overweight; 30+ = obese

**Table 24. Characteristics of participants (age, BMI, restraint and bulimic status) (Means, standard deviations and significance value).**

| | | HR/HB (n=24) | HR/LB (n=23) | LR/LB (n=31) | p |
|---|---|---|---|---|---|
| Age (yr) | Mean | **26.17** | **31.35** | **29.00** | **NS** |
| | *SD* | *8.22* | *10.51* | *10.76* | |
| BMI | Mean | **24.19** | **24.76** | **24.10** | **NS** |
| | *SD* | *7.05* | *3.84* | *5.38* | |
| RS-R | Mean | **18.96** | **17.87** | **8.28** | **<0.001** |
| | *SD* | *3.42* | *5.08* | *3.54* | |
| DEBQ | Mean | **3.55** | **2.16** | **1.32** | **<0.001** |
| | *SD* | *.84* | *.88* | *.68* | |
| BULIT-R | Mean | **87.04** | **59.04** | **47.41** | **<0.001** |
| | *SD* | *14.22* | *14.05* | *6.67* | |

*p*-values are 2-tailed

**Table 25. Tukey HSD post hoc tests: Characteristics of participants.**

| Classification Scale | Groups | Mean difference | *p* |
|---|---|---|---|
| RS-R | HR/HB vs HR/LB | 1.09 | NS |
| | HR/HB vs LR/LB | 10.68 | <0.001 |
| | HR/LB vs LR/LB | 9.59 | <0.001 |
| DEBQ | HR/HB vs HR/LB | 1.39 | <0.001 |
| | HR/HB vs LR/LB | 2.23 | <0.001 |
| | HR/LB vs LR/LB | .83 | <0.001 |
| BULIT-R | HR/HB vs HR/LB | 28.00 | <0.001 |
| | HR/HB vs LR/LB | 39.64 | <0.001 |
| | HR/LB vs LR/LB | 11.64 | <0.001 |

**8.3.2 Perceived control over task.** A 2 (task: ego/ego recall Stroop) X 3 (group: HR/HB, HR/LB, LR/LB) univariate ANOVA revealed no significant main or interaction effect for amount of perceived control over the tasks (Stroop plus word recall) undertaken. Table 26 shows Mean (SD) ratings of perceived control for the three groups (HR/HB, HR/LB, LR/LB) for the two experimental conditions (ego/ego-recall Stroop).

**Table 26. Mean (SD) ratings of perceived control for the three groups (HR/HB, HR/LB, LR/LB) for the two experimental conditions (ego/ego-recall Stroop).**

| | | HR/HB | HR/LB | LR/LB | Row Means/SD |
|---|---|---|---|---|---|
| Ego Stroop | Mean | **4.93** | **5.42** | **5.33** | **5.21** |
| | *SD* | *3.10* | *3.32* | *3.15* | *3.11* |
| Ego recall Stroop | Mean | **2.78** | **4.18** | **5.12** | **4.27** |
| | *SD* | *1.79* | *2.82* | *2.83* | *2.71* |
| Column | Mean | **4.13** | **4.83** | **5.22** | |
| | *SD* | *2.85* | *3.08* | *2.94* | |

### 8.3.3 Ratings of Mood

#### 8.3.3.1 Anxiety: STAI

A 3 (Group: HR/HB, HR/LB, LR/LB) x 2 (Condition: ego/ego recall Stroop) univariate ANOVA on baseline anxiety ratings revealed no significant group or task differences.

Table 27 displays Means (SD) for self-reported anxiety ratings for HR/HB, HR/LB and LR/LB females for each of the three experimental phases (B, TA, and R), for the ego and ego-recall Stroop conditions.

A 3 (Phase: B/TA/R) x 2 (Condition: ego/ego recall Stroop) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA, with phase as the within subjects factor and condition and group as the between subjects factors, revealed a significant main effect of phase, $F(1.68,122.42) = 75.51$, $p<0.001$, $Eta^2 = .51$, and a significant main effect of condition, $F(1,73) = 4.86$, $p<0.05$, $Eta^2 = .06$ There were no other significant main or interaction effects.

Participants in the ego-recall Stroop condition self-reported significantly *higher* anxiety ratings than those in the ego Stroop condition (Mean difference = 2.94). Tukey HSD tests confirmed a significant rise in self-reported anxiety levels from baseline to task (Mean difference = 7.48, $p<0.001$). At the end of the recovery phase (following food ingestion) anxiety ratings were significantly lower than post-task measures (Mean difference = 5.99, $p<0.001$), but still significantly elevated compared to baseline (Mean difference = 2.48, $p<0.001$).

In summary, all participants, regardless of level of dietary restraint or bulimic symptoms, found undertaking the ego recall Stroop condition to be significantly more anxiety provoking than the ego Stroop condition. Both tasks were successful in provoking a significant rise in self-reported anxiety level from baseline. Anxiety ratings acquired at the end of the recovery period were still significantly elevated over baseline values, but were significantly lower than post-task ratings.

Table 27. Mean (SD) anxiety (STAI) ratings for the HR/HB, HR/LB and LR/LB groups in the ego and ego recall Stroop conditions measured immediately following baseline, task and recovery phases.

| | | Post Baseline | | Baseline Phase Mean Total | Post Task | | Task Phase Mean Total | Post Recovery | | Recovery Phase Mean Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego Stroop (N=42) | Ego Recall Stroop (N=37) | | Ego Stroop (N=42) | Ego Recall Stroop (N=37) | | Ego Stroop (N=42) | Ego Recall Stroop (N=37) | |
| **HR/HB** | **Mean** | **26.07** | **28.56** | **27.00** | **31.27** | **35.44** | **32.83** | **27.73** | **29.89** | **28.54** |
| | *SD* | *4.68* | *6.29* | *5.35* | *5.35* | *7.23* | *6.32* | *6.60* | *6.60* | *6.54* |
| **HR/LB** | **Mean** | **26.25** | **26.82** | **26.52** | **33.33** | **36.73** | **34.96** | **27.67** | **30.91** | **29.22** |
| | *SD* | *5.64* | *4.75* | *5.13* | *9.16* | *9.78* | *9.40* | *6.96* | *6.35* | *6.73* |
| **LR/LB** | **Mean** | **23.67** | **25.76** | **24.78** | **29.87** | **35.35** | **32.78** | **26.47** | **29.35** | **28.00** |
| | *SD* | *4.67* | *4.64* | *4.70* | *9.19* | *8.64* | *8.64* | *5.43* | *5.83* | *5.83* |
| **Column** | **Mean** | **25.26** | **26.76** | | **31.36** | **35.78** | | **27.26** | **29.95** | |
| | SD | *4.99* | *5.09* | | *7.20* | *8.72* | | *6.39* | *5.87* | |

#### 8.3.3.2 Self-Esteem: SSES

A 2 (Condition: ego vs ego recall Stroop) x 3 (Group: HR/HB, HR/LB, LR/LB) univariate ANOVA on baseline self-esteem ratings revealed a significant main effect of group, $F(2,73) = 3.65$, $p<0.05$, $Eta^2 = .091$, and condition, $F(1,73) = 8.71$, $p<0.005$, $Eta^2 = .107$, with the HR/HB group having significantly *lower* baseline self-esteem ratings than the LR/LB group (Mean difference = 6.01, $p<0.005$). There was no significant difference between the HR/HB and HR/LB, and the HR/LB and LR/LB group for baseline self-esteem ratings. Participants in the ego Stroop condition had significantly lower baseline ratings of self-esteem than participants in the ego recall Stroop condition. Therefore baseline self-esteem ratings are entered into further analyses as covariate.

Table 28 shows Mean (SD) self-esteem ratings for the HR/HB, HR/LB and LR/LB groups, for the three phases (baseline, task and recovery) for the two experimental manipulations (ego and ego recall Stroop). A *low* score indicates *lower* self-esteem.

A 2 (Phase: TA/R) x 2 (Condition: ego vs ego recall Stroop) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANCOVA with phase as the within subjects factor, condition and group as the between subjects factors, and baseline self-esteem ratings entered as covariate revealed a significant main effect of covariate, $F(1,72) = 125.86$, $p<0.001$, $Eta^2 = .636$, and group, $F(2,72) = 4.27$, $p<0.05$, $Eta^2 = .106$. There were no other significant main or interaction effects.

Tukey HSD test revealed that both the HR/HB and HR/LB groups had significantly *lower* self-esteem ratings than the LR/LB group (Mean difference = 3.99; 4.00, $p$'s<0.005). There was no significant difference in self-esteem ratings of the high restraint groups, with and without bulimic symptoms (Mean difference = .01, $p>0.05$).

Further analysis was undertaken using change scores from baseline values. A 2 (Phase: TA:/R change from baseline) x 2 (Condition: ego/ego recall Stroop) x 3 (Group: HR/HB, HR/LB, LR/LB) ANOVA revealed a significant main effect of phase, $F(1,73) = 12.19$, $p<0.001$ and a significant main effect of group, $F(1,73) = 4.93$, $p<0.005$. There were no other significant main or interaction effects.

**Table 28.** **Mean (SD) self-esteem (SSES) ratings for the HR/HB, HR/LB and LR/LB groups in the ego and ego recall Stroop conditions measured immediately following baseline, task and recovery phases.**

| | | Post Baseline | | Baseline Phase Mean Total | Post Task | | Task Phase Mean Total | Post Recovery | | Recovery Phase Mean Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego Stroop (N=42) | Ego Recall Stroop (N=37) | | Ego Stroop (N=42) | Ego Recall Stroop (N=37) | | Ego Stroop (N=42) | Ego Recall Stroop (N=37) | |
| **HR/HB** | **Mean** | **68.87** | **74.44** | **70.96** | **63.27** | **67.67** | **64.92** | **69.53** | **68.89** | **69.29** |
| | *SD* | *8.72* | *7.14* | *8.46* | *12.09* | *8.53* | *10.91* | *10.92* | *13.34* | *11.60* |
| **HR/LB** | **Mean** | **70.83** | **80.18** | **75.30** | **65.33** | **75.00** | **69.96** | **65.50** | **79.64** | **72.26** |
| | *SD* | *6.31* | *6.15* | *7.34* | *12.76* | *10.51* | *12.49* | *11.93* | *6.50* | *11.94* |
| **LR/LB** | **Mean** | **77.07** | **76.88** | **76.97** | **73.20** | **75.65** | **74.50** | **65.50** | **79.64** | **79.37** |
| | *SD* | *6.55* | *7.62* | *7.02* | *10.75* | *9.45* | *9.99* | *8.97* | *9.73* | *9.24* |
| **Column** | **Mean** | **72.36** | **77.27** | | **67.40** | **73.51** | | **72.02** | **76.76** | |
| | SD | *8.03* | *7.23* | | *12.36* | *9.90* | | *11.95* | *10.67* | |

Post-task change scores were significantly lower than post-recovery change scores (following food ingestion) (Mean difference = 3.71). Tukey post-hoc tests revealed that both the HR/HB and HR/LB groups had significantly *lower* self-esteem ratings than the LR/LB group (Mean difference = 3.82; 4.16, $p<0.005$).

In summary, results showed that restrained eaters, with bulimic symptoms had significantly *lower* ratings of self-esteem than the control group prior to experimentation, and participants undertaking the ego Stroop had significantly lower self-esteem ratings than participants undertaking the ego recall Stroop. Controlling for baseline values, results showed that group differences (change from baseline) in self-esteem ratings were in evidence following experimentation. Regardless of task undertaken, restrained eaters, with and without bulimic symptoms had significantly lower perceptions of self-esteem than controls. Results also showed a significantly greater change (lowering) of perceptions of self-esteem following exposure to stress, than following the recovery phase (including food ingestion) for all participants.

### 8.3.4 Food Intake: vanilla, chocolate and strawberry ice cream

Three 2 (Condition: ego vs ego recall Stroop) X 3 (Group: HR/HB, HR/LB, LR/LB) univariate ANOVA testing for baseline differences in hunger ratings, thirst ratings and ratings of food liking (ice cream) revealed no significant main or interaction effects.

Controlling for BMI, a 3 (Flavour: vanilla, chocolate, strawberry) X 2 (Condition: ego vs ego recall Stroop) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANCOVA, with flavour as the within subjects factor and condition and group as the between subjects factors, revealed a significant main effect of group, $F(2,73) = 56.665$, $p<0.001$, $Eta^2 = .608$. There were no other significant main or interaction effects. Irrespective of flavour or condition, ice cream intake by both the HR/HB and HR/LB groups was significantly greater than that of the LR/LB group. Although the HR/HB group consumed more ice cream than the HR/LB group, this comparison failed to reach the adjusted alpha level of 0.005.

Table 29 shows Means (SD) total ice cream (vanilla, chocolate and strawberry) intake (grams) by the three groups following exposure to the ego and ego recall Stroop tasks. Table 30 shows the results of simple group contrasts.

PAGE MISSING IN ORIGINAL

**Table 29.** Mean (SD) vanilla, chocolate and strawberry ice cream intake (g) for the HR/HB, HR/LB and LR/LB groups in the ego and ego recall Stroop conditions.

| | | Vanilla | | Vanilla ice cream Row Mean (SD) | Chocolate | | Chocolate ice cream Row Mean (SD) | Strawberry | | Strawberry ice cream Row Mean (SD) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego | Ego-recall | | Ego | Ego-recall | | Ego | Ego-recall | |
| HR/HB | Mean | 83.07 | 96.78 | 88.21 | 85.13 | 92.00 | 87.71 | 81.47 | 83.33 | 82.17 |
| | *SD* | *31.91* | *3.67* | *25.89* | *23.99* | *10.69* | *20.04* | *30.93* | *19.29* | *26.69* |
| HR/LB | Mean | 74.50 | 60.27 | 67.70 | 77.92 | 69.36 | 73.83 | 78.08 | 62.36 | 70.57 |
| | *SD* | *18.41* | *23.61* | *21.81* | *16.86* | *19.31* | *18.19* | *16.68* | *25.15* | *22.16* |
| LR/LB | Mean | 31.27 | 39.18 | 35.00 | 31.20 | 35.76 | 33.63 | 24.33 | 31.88 | 28.34 |
| | *SD* | *25.30* | *26.80* | *26.08* | *23.85* | *28.45* | *26.08* | *20.46* | *23.20* | *21.94* |
| Column | Mean | 61.76 | 59.46 | | 63.81 | 59.43 | | 60.10 | 53.46 | |
| | SD | *35.12* | *31.93* | | *32.88* | *32.38* | | *35.69* | *31.06* | |

**Table 30. Simple group contrasts on the measure of total intake of ice cream (g)**

| | Mean difference | P |
|---|---|---|
| HR/HB vs HR/LB | 15.33 | 0.027 (ns) |
| HR/HB vs LR/LB | 53.70 | <0.001 |
| HR/LB vs LR/LB | 38.37 | <0.001 |

### 8.3.5 Intake: water

Table 31 shows Mean (SD) water intake (millilitres) by the HR/HB, HR/LB and LR/LB groups following exposure to the ego and ego recall Stroop tasks.

**Table 31. Means (SD) water intake (millilitres) by the HR/HB, HR/LB and LR/LB groups following exposure to the ego and ego recall Stroop tasks.**

| | | HR/HB | HR/LB | LR/LB | Row Means/ SD |
|---|---|---|---|---|---|
| Ego Stroop | Mean | **392.67** | **142.33** | **146.80** | **233.33** |
| | *SD* | *101.21* | *150.94* | *144.13* | *176.51* |
| Ego recall Stroop | Mean | **418.44** | **150.18** | **116.06** | **199.76** |
| | *SD* | *139.97* | *135.24* | *80.07* | *168.22* |
| Column | Mean | **402.33** | **146.09** | **130.47** | |
| | *SD* | *114.95* | *140.43* | *113.72* | |

There was a significant main effect of group, $F(2,72) = 35.68$, $p<0.001$, $Eta^2 = .994$. There was no significant main effect of condition, or group by condition interaction effect. Results of simple contrasts analyses can be seen in Table 32.

**Table 32. Simple group contrasts on the measure of intake of water (millilitres)**

| | Mean difference | P |
|---|---|---|
| HR/HB vs HR/LB | 256.24 | <0.001 |
| HR/HB vs LR/LB | 271.86 | <0.001 |
| HR/LB vs LR/LB | 15.62 | NS |

### 8.3.6 Vanilla, Chocolate, and Strawberry ice cream 'liking' ratings

**8.3.6 Vanilla, Chocolate, and Strawberry ice cream 'liking' ratings** obtained during the 'taste-test' (recovery period) were analyzed using a 3 (Flavour: vanilla/chocolate/strawberry) x 2 (Condition: ego/ego recall Stroop) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with flavour as the within subjects factor and condition and group as the between subjects factors. There was a significant main effect of flavour, $F(2,146) = 15.98$, $p<0.001$, $Eta^2 = .180$. There were no other significant main or interaction effects. Table 33 shows simple contrasts for 'liking' ratings for the three ice cream flavours. The taste of the chocolate flavoured ice cream was rated significantly more highly than both the vanilla and strawberry flavoured ice cream. There was no significant difference in flavour ratings for the vanilla and strawberry flavoured ice cream.

**Table 33. Simple contrasts on the measure of intake of vanilla, chocolate and strawberry ice cream 'liking' ratings**

| | Mean difference | *P* |
|---|---|---|
| **Vanilla vs Chocolate** | -1.44 | <0.001 |
| **Strawberry vs Vanilla** | -.12 | NS |
| **Chocolate vs Strawberry** | 1.56 | <0.001 |

In summary, results of food intake show that, despite the fact that participants liked the taste of the chocolate ice cream served significantly more than that of the vanilla and strawberry ice cream served, regardless of flavour and task type high individuals high in dietary restraint, both with and without bulimic tendencies, consumed significantly more than did the control group. Although the highly restrained eaters with bulimic symptoms consumed more ice cream than the highly restrained individuals without bulimic symptoms, this comparison failed to reach significance at the adjusted alpha level. The HR/HB individuals also consumed significantly more chilled water than the HR/LB and the LR/LB individuals, with no significant difference between the latter two groups.

### 8.3.7 Cardiovascular reactivity

#### 8.3.7.1 Systolic Blood Pressure: SBP

A 3 (Group: HR/HB, HR/LB, LR/LB) x 2 (Condition: ego vs ego recall Stroop) univariate ANOVA examining baseline SBP values revealed no significant main or interaction effects.

Table 34 shows Mean (SD) Systolic Blood Pressure (SBP) values for the HR/HB, HR/LB and LR/LB groups during the three experimental phases (B, TA [Stroop B1, B2 and B3] R) of the ego and ego recall Stroop tasks.

**Table 34. Mean (SD) SBP values for the HR/HB, HR/LB and LR/LB groups in the ego and ego recall Stroop conditions measured immediately following baseline, task (Stroop BLOCK 1, 2 and 3) and recovery phases.**

| | | Post Baseline | | Baseline Phase Mean Total | Post Task | | | | | | Task Phase Mean Total | Post Recovery | | Recovery Phase Mean Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego Stroop (N=42) | Ego Recall Stroop (N=37) | | Ego Stroop (N=42) | | | Ego Recall Stroop (N=37) | | | | Ego Stroop (N=42) | Ego Recall Stroop (N=37) | |
| | | | | | B1 | B2 | B3 | B1 | B2 | B3 | | | | |
| **HR/HB** | **Mean** | **106.07** | **118.67** | **110.79** | **121.40** | **120.93** | **123.13** | **117.67** | **118.67** | **118.11** | **119.99** | **118.60** | **116.00** | **117.63** |
| | *SD* | *7.60* | *15.97* | *12.76* | *12.65* | *18.48* | *9.94* | *14.70* | *13.31* | *13.38* | *13.74* | *10.30* | *15.21* | *12.11* |
| **HR/LB** | **Mean** | **108.42** | **107.64** | **108.04** | **115.58** | **119.17** | **120.42** | **113.73** | **110.82** | **111.00** | **115.12** | **115.92** | **111.00** | **113.57** |
| | *SD* | *7.15* | *10.26* | *8.69* | *13.45* | *14.52* | *13.19* | *9.77* | *11.70* | *13.89* | *7.24* | *7.24* | *9.21* | *8.43* |
| **LR/LB** | **Mean** | **111.33** | **106.59** | **108.81** | **121.20** | **125.60** | **125.27** | **114.65** | **113.29** | **116.18** | **121.07** | **121.07** | **110.24** | **115.31** |
| | *SD* | *7.27* | *6.62* | *7.23* | *12.45* | *16.17* | *16.79* | *9.14* | *9.14* | *11.05* | *16.59* | *16.59* | *9.32* | *14.12* |
| **Column** | **Mean** | **108.62** | **109.84** | | **119.67** | **122.10** | **123.12** | **115.11** | **113.86** | **115.11** | | **118.71** | **111.86** | |
| | SD | *7.59* | *11.46* | | *12.77* | *16.43* | *13.44* | *10.67* | *11.11* | *12.48* | | *12.19* | *10.92* | |

A 5 (Phase: B/TA [Stroop B1, B2, B3] /R) x 3 (Group: HR/HB, HR/LB, LR/LB) by 2 (Condition: ego vs ego recall Stroop) mixed factorial ANOVA with phase as the within subjects factor and group and condition as the between subjects factors revealed a significant main effect of phase, $F(3.36,244.93) = 26.99$, $p<0.001$, $Eta^2 = .251$, and a significant phase x condition interaction effect, $F(3.36,244.93) = 9.09$, $p<0.001$, $Eta^2 = .095$ (see Figure 15). There were no other significant main or interaction effects. Figure 16 shows the two-way interaction between phase (B, TA (B1, B2, B3), R) and condition (ego vs ego recall Stroop) on the measure of SBP. Table 35 shows results of post-hoc analyses.

**Figure 15. Two-way interaction between phase (B, TA (B1, B2, B3), R) and condition (ego vs ego recall Stroop) on the measure of SBP (Mean $\pm$SE).**

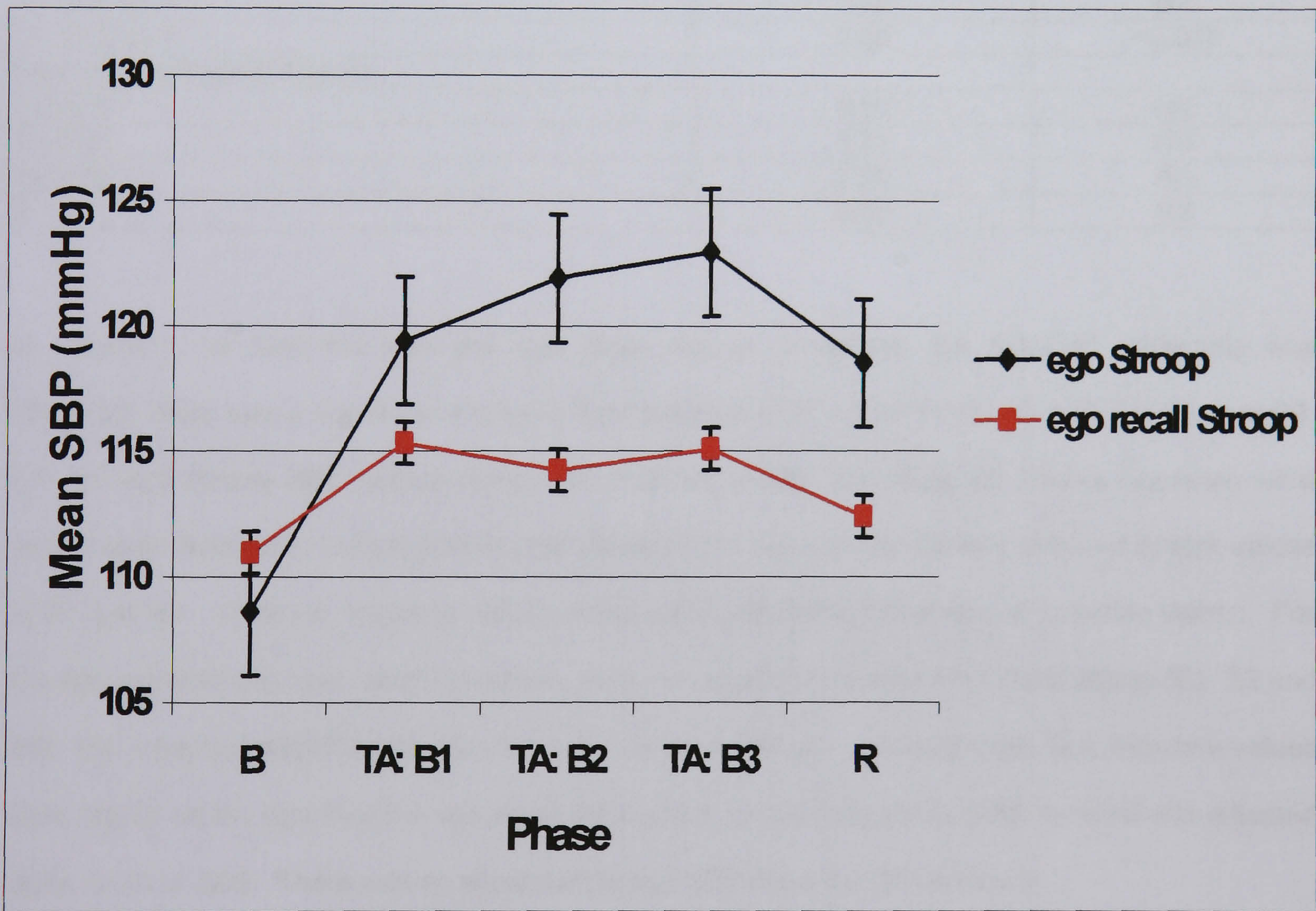


**Table 35. SBP: post-hoc analyses.**

| | Mean difference | *P* |
|---|---|---|
| **Ego Stroop** | | |
| B vs TA (B1) | -10.78 | <0.001 |
| B vs TA (B2) | -13.90 | <0.001 |
| B vs TA (B3) | -14.33 | <0.001 |
| B vs R | -9.92 | <0.001 |
| TA (B1) vs (B2) | -2.51 | NS |
| TA (B1) vs (B3) | -3.55 | NS |
| TA (B1) vs R | 1.37 | NS |
| TA (B2) vs (B3) | -1.04 | NS |
| TA (B2) vs R | 3.37 | NS |
| TA (B3) vs R | 4.41 | <0.001 |
| **Ego recall Stroop** | | |
| B vs TA (B1) | -4.39 | <0.001 |
| B vs TA (B2) | -3.30 | <0.005 |
| B vs TA (B3) | -4.13 | <0.001 |
| B vs R | -1.45 | NS |
| TA (B1) vs (B2) | 1.09 | NS |
| TA (B1) vs (B3) | .26 | NS |
| TA (B1) vs R | 2.94 | NS |
| TA (B2) vs (B3) | -.83 | NS |
| TA (B2) vs R | 1.85 | NS |
| TA (B3) vs R | 2.68 | <0.005 |
| **Ego vs Ego Recall Stroop** | | |
| TA (B1) | 4.56 | NS |
| TA (B2) | 8.23 | NS |
| TA (B3) | 8.01 | NS |
| R | 6.85 | NS |

In summary, for both the ego and ego recall Stroop conditions, the following patterning was observed; there was a significant increase from baseline SBP values to Stroop task B1, B2, and B3. For the ego Stroop SBP values during the recovery period (including ice cream ingestion) were significantly reduced in comparison to task values at B3, but non-significantly different to task values at B1 and B2. However, recovery values remained significantly elevated over baseline values. For the ego-recall Stroop task, recovery values were non-significantly different to task values (B1, B2 and B3), but remained significantly elevated over baseline values. Although task and recovery values were higher for the ego than the ego recall Stroop task, these differences failed to reach the adjusted alpha level of .005. There was no significant group difference in SBP reactivity.

#### 8.3.7.2 Diastolic Blood Pressure: DBP

A 3 (Group: HR/HB, HR/LB, LR/LB) x 2 (Condition: ego vs ego recall Stroop) univariate ANOVA examining baseline DBP values revealed no significant main or interaction effects.

Table 36 shows Mean (SD) Diastolic Blood Pressure (DBP) values for the HR/HB, HR/LB and LR/LB groups during the three experimental phases (B, TA [Stroop B1, B2 and B3] R) of the ego and ego recall Stroop tasks.

A 5 (Phase: B/TA [Stroop B1, B2, B3] /R) x 3 (Group: HR/HB, HR/LB, LR/LB) by 2 (Condition: ego/ego recall Stroop) mixed factorial ANOVA with phase as the within subjects factor and group and condition as the between subjects factors revealed a significant main effect of phase, $F(3.50,255.38) = 60.77$, $p<0.001$, $Eta^2 = .454$, and a significant phase x group interaction effect, $F(6.99,255.38) = 15.84$, $p<0.001$, Ets2 = .303 (see Figure 16). There was no other significant main or interaction effect. Figure 17 shows two-way interaction between phase (B, TA (B1, B2, B3), R) and group (HR/HB, HR/LB, LR/LB) on the measure of DBP (Mean $\pm$SE). Table 37 shows results of post-hoc analyses.

**Figure 16. Two-way interaction between phase (B, TA (B1, B2, B3), R) and group (HR/HB, HR/LB, LR/LB) on the measure of DBP (Mean $\pm$SE).**

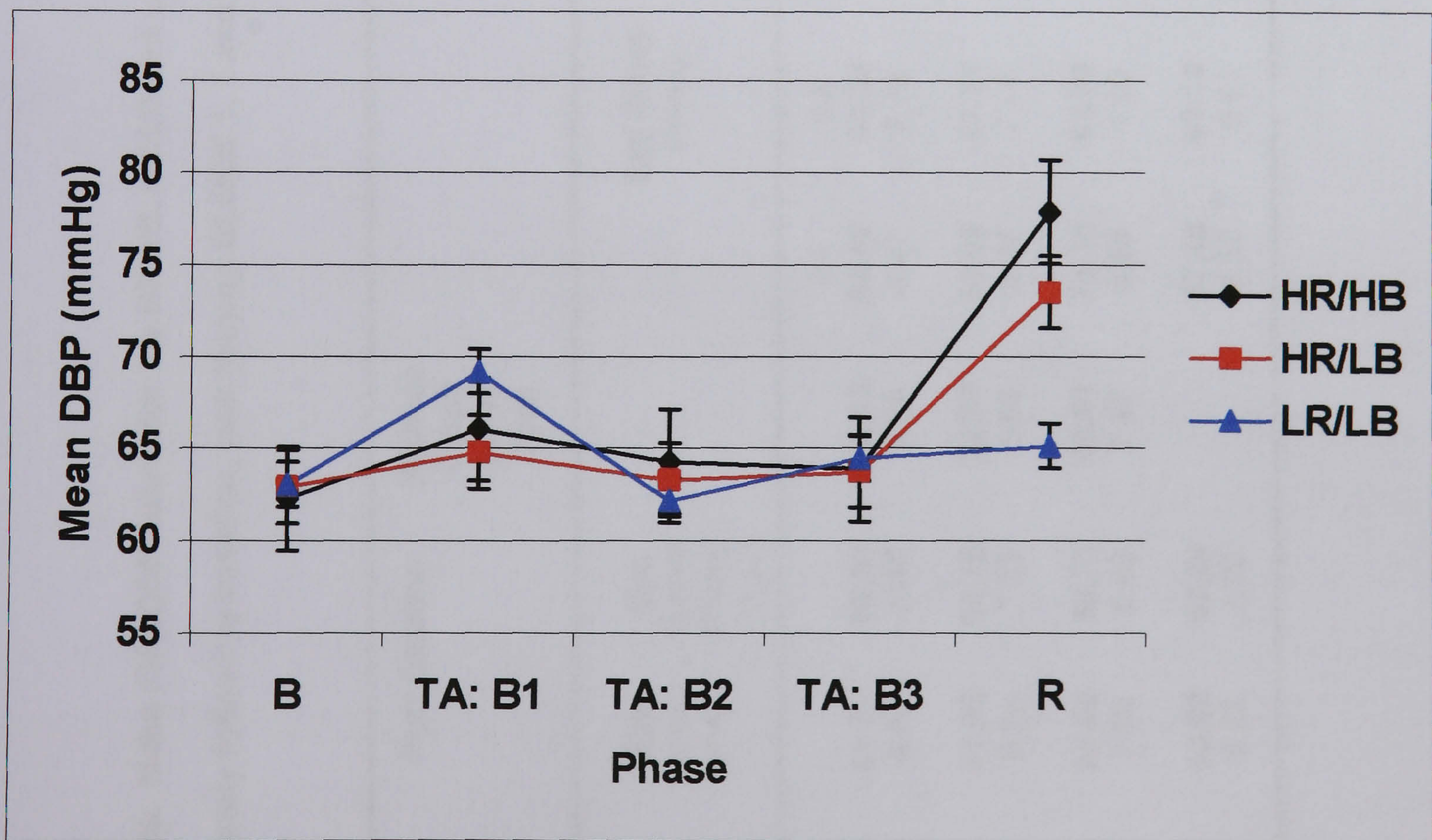


**Table 36. Mean (SD) DBP values for the HR/HB, HR/LB and LR/LB groups in the ego and ego recall Stroop conditions measured immediately following baseline, task (Stroop BLOCK 1, 2 and 3) and recovery phases.**

| | | Post Baseline | | Baseline Phase Mean Total | Post Task | | | | | | Task Phase Mean Total | Post Recovery | | Recovery Phase Mean Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego Stroop (n=42) | Ego Recall Stroop (n=37) | | Ego Stroop (n=42) | | | Ego Recall Stroop (n=37) | | | | Ego Stroop (n=42) | Ego Recall Stroop (n=37) | |
| | | | | | B1 | B2 | B3 | B1 | B2 | B3 | | | | |
| HR/HB | Mean | 61.67 | 62.89 | 62.13 | 65.40 | 64.33 | 64.60 | 66.67 | 64.22 | 63.11 | 64.72 | 77.93 | 77.78 | 77.88 |
| | *SD* | *9.70* | *6368* | *8.55* | *8.67* | *7.72* | *8.79* | *9.31* | *5.85* | *6.25* | *7.77* | *5.97* | *1.72* | *4.77* |
| HR/LB | Mean | 61.75 | 64.09 | 62.87 | 64.00 | 62.33 | 62.50 | 65.64 | 64.27 | 65.00 | 63.96 | 73.92 | 73.09 | 73.52 |
| | *SD* | *6.24* | *7.23* | *6.83* | *5.34* | *7.25* | *5.77* | *7.35* | *7.28* | *7.32* | *6.72* | *3.26* | *7.87* | *5.80* |
| LR/LB | Mean | 65.40 | 60.71 | 62.91 | 73.33 | 62.73 | 64.27 | 66.00 | 61.65 | 64.65 | 65.44 | 68.27 | 62.00 | 64.94 |
| | *SD* | *7.99* | *6.42* | *7.47* | *8.66* | *4.99* | *6.52* | *9.51* | *5.21* | *7.75* | *7.11* | *8.43* | *5.68* | *7.67* |
| Column | Mean | 63.02 | 62.24 | | 67.48 | 63.19 | 63.88 | 66.05 | 63.05 | 64.38 | | 73.33 | 69.14 | |
| | SD | *8.22* | *6.80* | | *8.52* | *6.61* | *7.12* | *8.64* | *6.01* | *7.13* | | *7.52* | *8.93* | |

**Table 37. DBP: post-hoc analyses.**

| | Mean difference | *P* |
|---|---|---|
| **HR/HB Group** | | |
| B vs TA (B1) | -1.56 | NS |
| B vs TA (B2) | .02 | NS |
| B vs TA (B3) | .27 | NS |
| B vs R | -13.57 | **<0.001** |
| TA (B1) vs (B2) | 1.58 | NS |
| TA (B1) vs (B3) | 1.83 | NS |
| TA (B1) vs R | -12.01 | **<0.001** |
| TA (B2) vs (B3) | .25 | NS |
| TA (B2) vs R | -13.59 | **<0.001** |
| TA (B3) vs R | -13.84 | **<0.001** |
| **HR/LBGroup** | | |
| B vs TA (B1) | -.94 | NS |
| B vs TA (B2) | .58 | NS |
| B vs TA (B3) | .14 | NS |
| B vs R | -9.68 | **<0.001** |
| TA (B1) vs (B2) | 1.52 | NS |
| TA (B1) vs (B3) | 1.08 | NS |
| TA (B1) vs R | -8.74 | **<0.001** |
| TA (B2) vs (B3) | -.44 | NS |
| TA (B2) vs R | -10.26 | **<0.001** |
| TA (B3) vs R | -9.82 | **<0.001** |
| **LR/LB Group** | | |
| B vs TA (B1) | -3.37 | NS |
| B vs TA (B2) | 3.44 | NS |
| B vs TA (B3) | 1.13 | NS |
| B vs R | .66 | NS |
| TA (B1) vs TA (B2) | 6.81 | NS |
| TA (B1) vs TA (B3) | 4.50 | NS |
| TA (B1) vs R | 4.03 | NS |
| TA (B2) vs TA (B3) | -2.31 | NS |
| TA (B2) vs R | -2.78 | NS |
| TA (B3) vs R | -.47 | NS |

There were no significant group differences in DBP values at B or TA [B1, B2, B3] phases (all *p*'s>.8). There was no significant change in DBP values from baseline to task. During food ingestion (recovery period) both the HR/HB and HR/LB groups had significantly *elevated* DBP values in comparison the control group, in comparison to baseline values, and in comparison to task values.

In summary, irrespective of task type or level of eating pathology, a similar pattern emerged; there was no change in DBP responding from baseline to task. However, DBP during the recovery period (including food ingestion) for both the HR/HB and HR/LB group was significantly elevated over both baseline and task values, and significantly elevated over the recovery values of LR/LB females. For

LR/LB females, there was no significant change in DBP values across the baseline, task or recovery phase, with all comparisons failing to reach the adjusted alpha level of .005.

#### 8.3.7.3 Cardiovascular reactivity: BPM

A 3 (Group: HR/HB, HR/LB, LR/LB) x 2 (Condition: ego vs ego recall Stroop) univariate ANOVA examining baseline heart rate values revealed no significant main or interaction effects.

Table 38 shows Mean (SD) Heart Rate (BPM) values for the HR/HB, HR/LB and LR/LB groups during the three experimental phases (B, TA [Stroop B1, B2 and B3], R) of the ego and ego recall Stroop tasks.

A 5 (Phase: B/TA [Stroop B1, B2, B3] /R) x 3 (Group: HR/HB, HR/LB, LR/LB) by 2 (Condition: ego vs ego recall Stroop) mixed factorial ANOVA with phase as the within subjects factor and group and condition as the between subjects factors revealed a significant main effect of phase, $F(2.96,216.20) = 11.33$, $p<0.001$, $Eta^2 = .134$ (see Figure 17). There were no other significant main or interaction effects. Figure 18 shows Mean (+ SE) Heart Rate (BPM) values for experimental phase (Baseline, Task (Stroop B1, B2, B3) and Recovery). Table 39 shows a summary of post-hoc analyses for heart rate (BPM).

**Table 38. Mean (SD) Heart Rate (BPM) values for the HR/HB, HR/LB and LR/LB groups in the ego and ego recall Stroop conditions measured immediately following baseline, task (Stroop BLOCK 1, 2 and 3) and recovery phases.**

| | | Post Baseline | | Baseline Phase Mean Total | Post Task | | | | | | Task Phase Mean Total | Post Recovery | | **Recovery Phase Mean Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego Stroop (n=42) | Ego Recall Stroop (n=37) | | Ego Stroop (n=42) | | | Ego Recall Stroop (n=37) | | | | Ego Stroop (n=42) | Ego Recall Stroop (n=37) | |
| | | | | | B1 | B2 | B3 | B1 | B2 | B3 | | | | |
| **HR/HB** | **Mean** | **74.82** | **72.38** | **73.91** | **81.70** | **81.31** | **80.15** | **80.65** | **79.16** | **79.92** | **80.48** | **82.86** | **80.45** | **81.96** |
| | *SD* | *9.67* | *8.33* | *9.08* | *10.61* | *10.36* | *9.99* | *12.16* | *13.13* | *12.52* | *11.46* | *9.55* | *14.40* | *11.36* |
| **HR/LB** | **Mean** | **71.54** | **75.77** | **73.57** | **76.59** | **74.60** | **74.55** | **80.80** | **80.20** | **79.91** | **77.78** | **77.78** | **77.61** | **77.70** |
| | *SD* | *9.62* | *9.03* | *9.38* | *13.47* | *12.24* | *12.24* | *9.20* | *9.67* | *7.93* | *10.79* | *8.34* | *5.65* | *7.02* |
| **LR/LB** | **Mean** | **73.14** | **75.97** | **74.64** | **83.04** | **81.07** | **81.91** | **83.22** | **86.70** | **84.93** | **83.48** | **77.47** | **77.53** | **77.50** |
| | *SD* | *7.38* | *5.53* | *6.51* | *10.10* | *10.19* | *10.30* | *10.14* | *22.67* | *13.87* | *11.20* | *9.32* | *9.82* | *9.43* |
| **Column** | **Mean** | **73.28** | **75.04** | | **80.72** | **79.31** | **79.18** | **81.87** | **82.93** | **82.22** | | **79.48** | **78.26** | |
| | SD | *8.78* | *7.35* | | *11.37* | *11.02* | *10.95* | *10.18* | *17.47* | *12.02* | | *9.27* | *9.97* | |

**Figure 17. Mean (+ SE) Heart Rate (BPM) values for experimental phase (Baseline, Task (Stroop B1, B2, B3) and Recovery).**

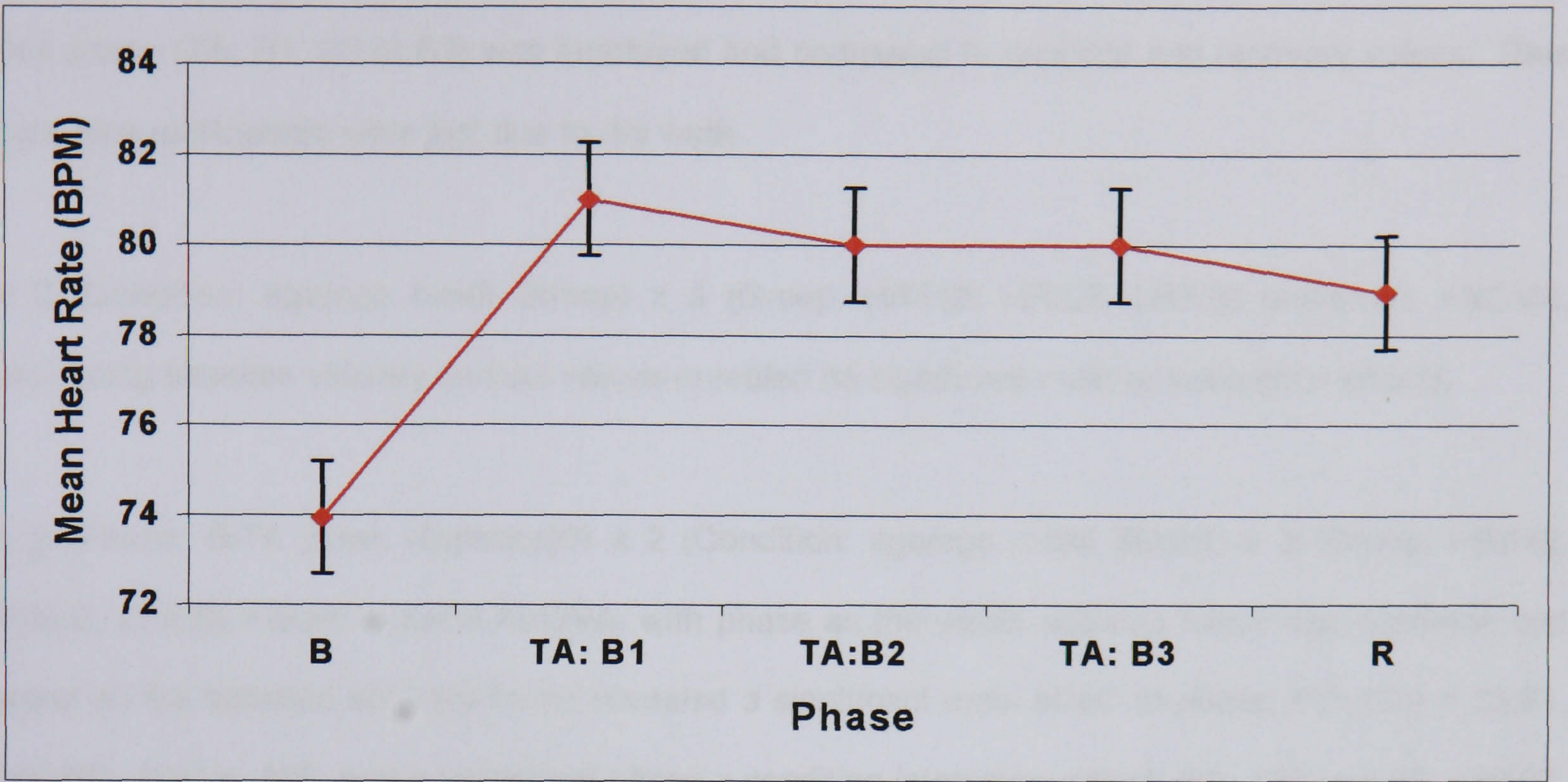



**Table 39. Summary of post-hoc analyses for heart rate (BPM).**

| | Mean difference | *P* |
|---|---|---|
| B vs TA (B1) | -7.061 | <0.001 |
| B vs TA (B2) | -6.568 | <0.001 |
| B vs TA (B3) | -6.288 | <0.001 |
| B vs R | -5.012 | <0.001 |
| TA (B1) vs (B2) | .493 | NS |
| TA (B1) vs (B3) | .773 | NS |
| TA (B1) vs R | 2.049 | NS |
| TA (B2) vs (B3) | .280 | NS |
| TA (B2) vs R | 1.556 | NS |
| TA (B3) vs R | 1.276 | NS |

In summary, in terms of heart rate reactivity, both tasks exerted a similar effect, and there was no significant difference between the three groups. Irrespective of task type or level of eating pathology, there was a significant elevation in heart rate values from baseline to task (B1, B2 and B3), and no significant difference in values during the task phase. Recovery phase values were not significantly different to task values, but remained significantly elevated over baseline values.

### 8.3.8 Biochemical Measurement: Salivary Cortisol

Research evidence shows that in terms of individual differences in cortisol reactivity there appears to be variation in the size, direction and timing of cortisol response (see Section 4.4.2). Examples of this can be viewed in Figure 18, Thus, for the purpose of analyses, peak cortisol response during the task phase (TA: B1, B2 or B3) was employed and compared to baseline and recovery values. Data from nine participants were lost due to dry wells.

A 2 (Condition: ego/ego recall Stroop) x 3 (Group: HR/HB, HR/LB, LR/LB) univariate ANOVA, examining baseline salivary cortisol values revealed no significant main or interaction effects.

A 3 (Phase: B/TA [peak response]/R x 2 (Condition: ego/ego recall Stroop) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA, with phase as the within subjects factor and condition and group as the between subjects factor revealed a significant main effect of phase, $F(2,128) = 35.91$, $p<0.001$, $Eta^2 = .359$, and a significant phase x condition interaction effect, $F(2, 128) = 4.67$, $p<0.05$, $Eta^2 = .068$. There was no other significant main or interaction effect.

Table 40 shows Mean (SD) cortisol response (nmol/l) for the HR/HB, HR/LB and LR/LB group following the three experimental phases (B/TA(peak response B1, B2 or B3)/R) of the ego and ego recall Stroop tasks. Figure 19 shows two-way interaction between phase and condition on the measure of salivary cortisol. Table 41 shows post-hoc analyses for salivary cortisol.

Figure 18. Examples of individual differences in cortisol reactivity

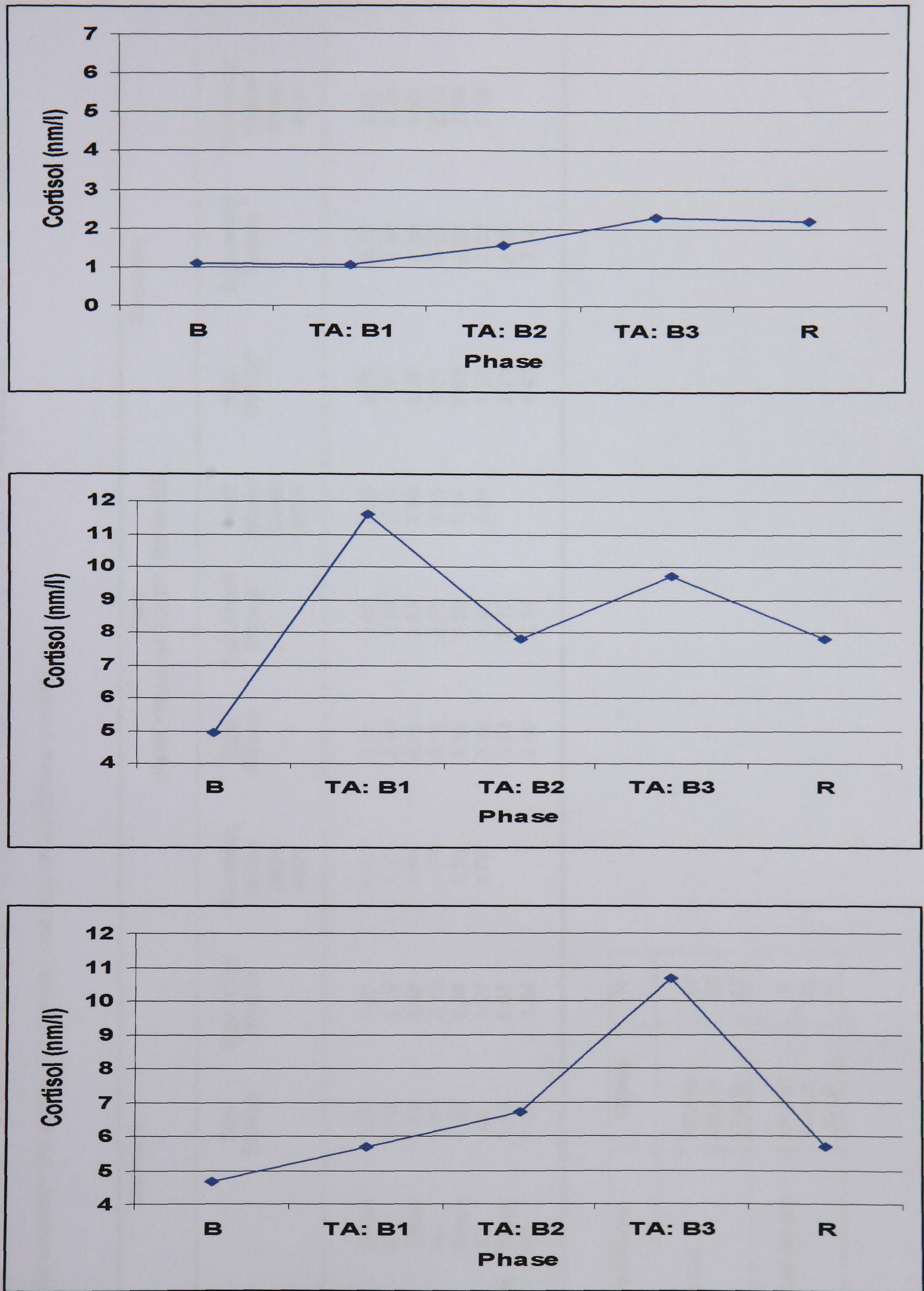


**Table 40. Means (SD) for cortisol values (nm/l) for the HR/HB, HR/LB and LR/LB groups for the baseline (B), task (peak response) (TA), and recovery (R) phase, for the ego and ego recall Stroop conditions.**

| | | Baseline | | | Task (Peak response for B1, B2 or B3) | | | Recovery | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego Stroop | Ego recall Stroop | Baseline phase Mean total | Ego Stroop | Ego recall Stroop | Task phase Mean total | Ego Stroop | Ego recall Stroop | Recovery phase Mean total |
| **HR/HB** | Mean | **1.40** | **1.57** | **1.47** | **3.41** | **3.02** | **3.25** | **2.70** | **2.77** | **2.72** |
| | *SD* | *1.09* | *1.19* | *1.11* | *2.49* | *1.31* | *2.07* | *1.67* | *2.28* | *1.88* |
| **HR/LB** | Mean | **1.52** | **2.28** | **1.90** | **4.11** | **3.69** | **3.90** | **2.75** | **4.35** | **3.55** |
| | *SD* | *1.37* | *2.13* | *1.78* | *3.32* | *2.95* | *3.06* | *2.41* | *3.01* | *2.78* |
| **LR/LB** | Mean | **1.46** | **1.34** | **1.39** | **3.18** | **2.92** | **3.04** | **2.69** | **4.25** | **3.56** |
| | *SD* | *.94* | *1.21* | *1.08* | *2.18* | *1.99* | *2.04* | *1.96* | *3.93* | *3.25* |
| **Column** | Mean | **1.45** | **1.68** | | **3.53** | **3.17** | | **2.71** | **3.89** | |
| | *SD* | *1.11* | *1.54* | | *2.60* | *2.14* | | *1.93* | *3.28* | |

| Condition | Group | N |
|---|---|---|
| Ego Stroop | HR/HB | 14 |
| | HR/LB | 10 |
| | LR/LB | 12 |
| Ego recall Stroop | HR/HB | 9 |
| | HR/LB | 10 |
| | LR/LB | 15 |

**Figure 19. Mean (±SE) cortisol reactivity (nm/l) following the three experimental phases (B/TA (peak of B1, B2, or B3)/R) for the ego and ego recall Stroop tasks.**

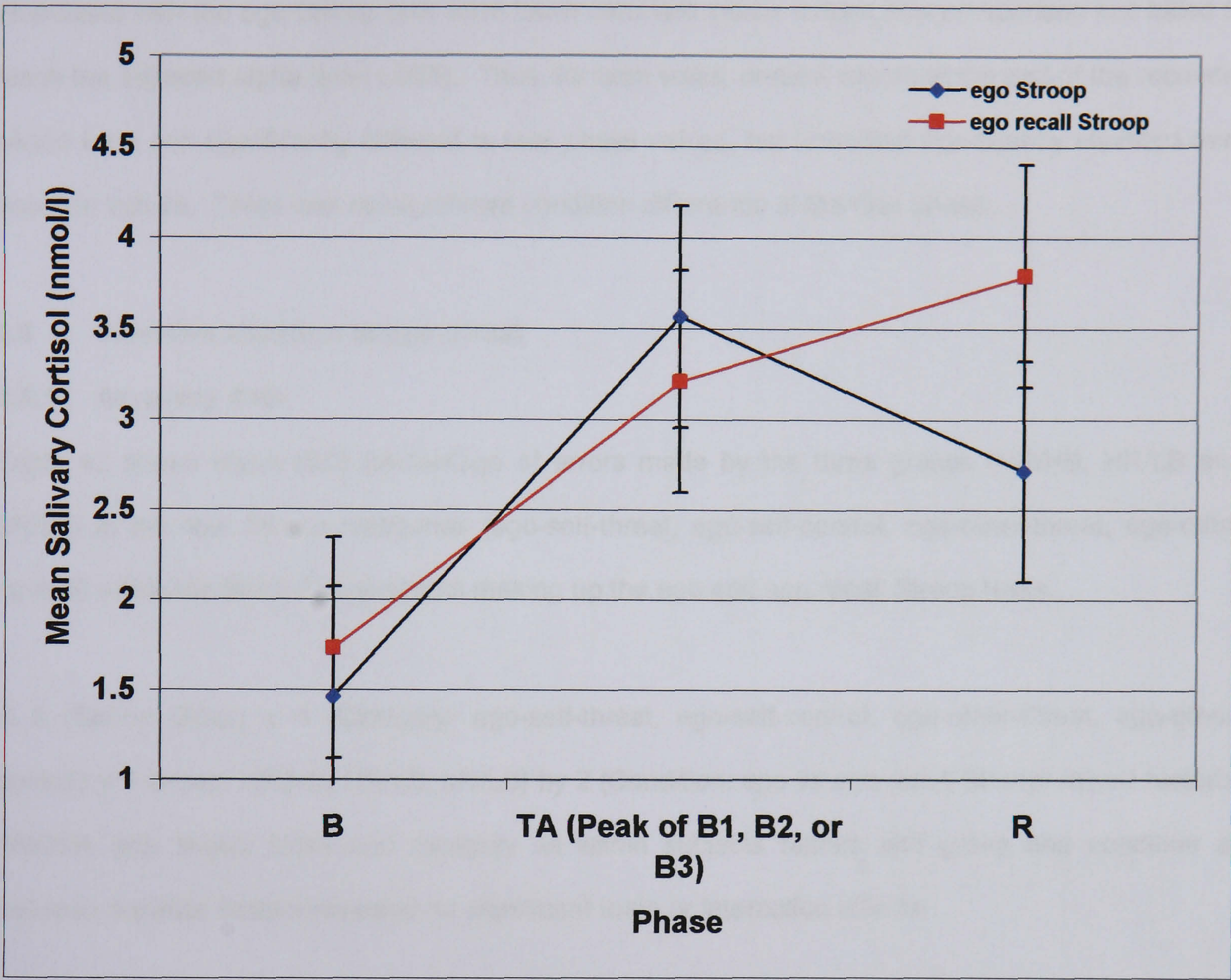



**Table 41. Salivary Cortisol (nmol/l): post-hoc analyses.**

| | Mean difference | *P* |
|---|---|---|
| **Ego Stroop** | | |
| B vs TA | -2.08 | <0.001 |
| B vs R | -1.26 | <0.001 |
| TA vs R | .82 | = 0.008 (NS) |
| **Ego recall Stroop** | | |
| B vs TA | -1.49 | <0.001 |
| B vs R | -2.21 | <0.001 |
| TA vs R | -.72 | NS |
| **Ego vs Ego Recall Stroop** | | |
| TA | .35 | NS |
| R | .95 | <0.005 |

In summary, irrespective of level of eating pathology, the following pattern emerged: For both tasks, there was no significant difference in cortisol reactivity at baseline, but there was a significant elevation in cortisol reactivity from baseline to task. Although cortisol values for the recovery phase associated with the ego Stroop task were lower than task phase values, this comparison just failed to reach the adjusted alpha level (.005). Thus, for both tasks, cortisol values at the end of the recovery period were non-significantly different to task phase values, but remained significantly elevated over baseline values. There was no significant condition difference at the task phase.

### 8.5 Selective attention to ego-threat

#### 8.5.1 Accuracy data

Table 42 shows Mean (SD) percentage of errors made by the three groups (HR/HB, HR/LB and LR/LB) in the four Stroop categories (ego-self-threat, ego-self-control, ego-other-threat, ego-other control) within the three Stroop blocks making up the ego and ego recall Stroop tasks.

A 3 (Stroop Block) x 4 (Category: ego-self-threat, ego-self-control, ego-other-threat, ego-other-control) x 3 Group: HR/HB, HR/LB, LR/LB) by 2 (Condition: ego vs ego recall Stroop) mixed factorial ANOVA with stroop block and category as within subjects factors and group and condition as between subjects factors revealed no significant main or interaction effects.

In summary, in terms of accuracy of response to ego threat and neutral stimuli contained within both the ego and ego recall Stroop tasks, there was no significant group difference.

#### 8.5.2 Raw Scores: Median response times

Table 43 shows Mean (SD) (median) response times of the HR/HB, HR/LB and LR/LB group to threat and neutral words contained within the three Stroop blocks making up the ego and ego recall Stroop task.

**Table 42.** **Mean (SD) percentage of errors made in response to threat and neutral words in each of the four Stroop categories (ego-self-threat, ego-self-control, ego-other-threat, ego-other control) in each of the three Stroop blocks for the two Stroop tasks (ego vs ego recall).**

**Ego Stroop**

| | | Stroop Block 1 | | | | Stroop Block 2 | | | | Stroop Block 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control |
| **HR/HB** | **Means** | **26.87** | **27.00** | **28.00** | **27.00** | **27.50** | **26.87** | **26.98** | **27.10** | **27.27** | **27.40** | **27.28** | **27.41** |
| | ***SD*** | *4.05* | *3.98* | *3.96* | *3.98* | *3.68* | *4.06* | *4.35* | *3.89* | *3.75* | *3.59* | *3.74* | *3.59* |
| **HR/LB** | **Means** | **28.17** | **28.19** | **28.21** | **28.17** | **28.19** | **28.18** | **28.28** | **28.19** | **28.19** | **28.17** | **28.10** | **28.17** |
| | **SD** | **3.66** | **3.68** | **3.65** | **3.66** | **3.79** | **3.69** | **3.78** | **3.55** | **3.77** | **3.66** | **3.69** | **3.68** |
| **LR/LB** | **Means** | **27.47** | **27.59** | **27.49** | **27.47** | **27.43** | **27.35** | **27.43** | **27.23** | **28.36** | **27.43** | **27.46** | **27.43** |
| | ***SD*** | *2.10* | *2.13* | *2.09* | *2.09* | *2.24* | *2.17* | *2.17* | *2.86* | *2.19* | *2.09* | *2.05* | *2.13* |

**Ego recall Stroop**

| | | Stroop Block 1 | | | | Stroop Block 2 | | | | Stroop Block 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control |
| **HR/HB** | **Means** | **28.67** | **28.62** | **28.62** | **28.77** | **27.56** | **27.89** | **28.55** | **28.67** | **28.60** | **28.63** | **28.63** | **28.54** |
| | ***SD*** | *4.74* | *4.70* | *4.75* | *4.40* | *4.62* | *4.12* | *4.09* | *4.71* | *4.95* | *4.46* | *4.24* | *4.13* |
| **HR/LB** | **Means** | **26.73** | **26.74** | **26.72** | **25.73** | **26.70** | **26.73** | **26.70** | **26.73** | **26.72** | **26.74** | **26.70** | **26.79** |
| | **SD** | **2.37** | **2.37** | **2.31** | **3.39** | **2.47** | **2.48** | **2.02** | **2.47** | **2.22** | **2.27** | **2.20** | **2.17** |
| **LR/LB** | **Means** | **28.71** | **28.82** | **28.94** | **28.28** | **28.51** | **28.80** | **28.90** | **28.72** | **28.71** | **28.81** | **28.90** | **28.82** |
| | ***SD*** | *5.35* | *5.35* | *5.40* | *5.52* | *5.35* | *5.32* | *5.14* | *5.39* | *5.40* | *5.30* | *5.30* | *5.49* |

**Table 43.** Reaction times (median values) made in response to threat and neutral words in each of the four Stroop categories (ego-self-threat, ego-self-control, ego-other-threat, ego-other control), in each of the three Stroop blocks for the two Stroop tasks (ego vs ego recall).

**Ego Stroop**

| | | Stroop Block 1 | | | | Stroop Block 2 | | | | Stroop Block 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control |
| HR/HB | Means | 644.34 | 580.40 | 588.09 | 599.76 | 664.34 | 582.40 | 581.42 | 586.43 | 651.01 | 580.40 | 568.09 | 586.43 |
| | *SD* | *77.22* | *103.13* | *92.29* | *98.31* | *80.21* | *103.00* | *95.84* | *109.85* | *88.89* | *102.13* | *95.20* | *89.74* |
| HR/LB | Means | 573.26 | 526.78 | 536.51 | 554.87 | 581.60 | 526.80 | 536.51 | 529.87 | 573.26 | 526.78 | 553.18 | 554.87 |
| | SD | 67.17 | 102.75 | 84.04 | 90.20 | 68.48 | 101.00 | 65.48 | 49.35 | 85.39 | 101.75 | 76.21 | 90.20 |
| LR/LB | Means | 599.92 | 573.81 | 554.07 | 567.59 | 566.58 | 574.00 | 567.40 | 567.59 | 573.25 | 573.81 | 567.40 | 567.59 |
| | *SD* | *38.95* | *26.99* | *45.47* | *28.63* | *37.08* | *26.52* | *30.97* | *28.63* | *31.03* | *26.99* | *30.97* | *28.63* |

**Ego recall Stroop**

| | | Stroop Block 1 | | | | Stroop Block 2 | | | | Stroop Block 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control | Ego-self-threat | Ego-self-control | Ego-other-threat | Ego-other-control |
| HR/HB | Means | 679.57 | 598.07 | 592.72 | 599.58 | 635.13 | 598.07 | 626.06 | 621.81 | 635.13 | 598.07 | 592.72 | 588.47 |
| | *SD* | *88.19* | *71.59* | *64.47* | *70.64* | *85.64* | *71.59* | *79.29* | *95.66* | *85.64* | *71.59* | *36.80* | *60.52* |
| HR/LB | Means | 704.06 | 650.52 | 640.45 | 644.26 | 676.79 | 650.52 | 649.74 | 653.35 | 676.79 | 650.52 | 640.65 | 644.26 |
| | SD | 104.73 | 113.40 | 93.72 | 97.71 | 106.49 | 113.40 | 102.37 | 111.62 | 103.49 | 113.40 | 93.72 | 97.71 |
| LR/LB | Means | 582.34 | 597.31 | 593.42 | 590.71 | 582.34 | 597.31 | 599.31 | 597.58 | 582.34 | 596.32 | 587.54 | 584.82 |
| | *SD* | *79.92* | *59.88* | *60.50* | *63.54* | *79.92* | *59.88* | *56.05* | *53.71* | *79.92* | *59.89* | *53.60* | *58.02* |

*Ego Stroop*

Utilizing raw scores, a 3 (Stroop block) x 4 (Stroop category: ego-threat-self, ego-threat-other plus matched neutral words) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA, with Stroop block and category as the within subjects factors and group as the between subjects factors revealed a significant main effect of category, $F(2.25, 87.93) = 4.20$, $p<0.005$, $Eta^2 = .097$, and a significant category x group interaction effect, $F(4.51, 87.93) = 2.22$, $p<0.005$, $Eta^2 = .103$. Figure 20 shows two-way interaction between Stroop category and group on the measure of raw (median) reaction times for the ego Stroop task. Table 44 shows post-hoc analyses for the Ego Stroop task on the measure of raw reaction times (median values).

**Figure 20. Mean response times (median values) made by the HR/HB, HR/LB and LR/LB groups in the four Stroop categories (ego-self threat, ego-other-threat and controls).**

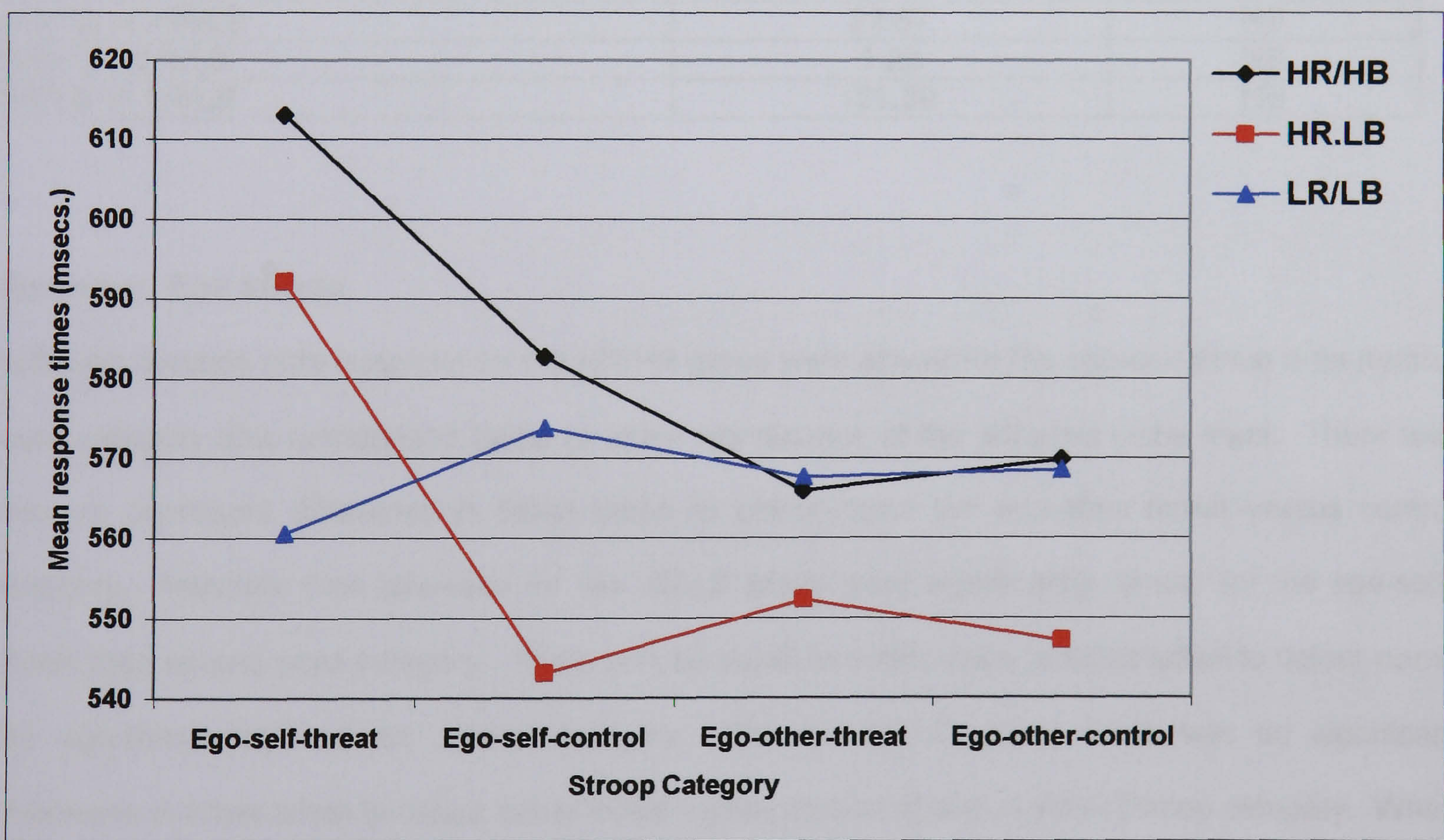


**Table 44. Ego Stroop task: Raw reaction times (median value): post-hoc analyses.**

| | Mean difference | *P* |
|---|---|---|
| **HR/HB** | | |
| Ego-self threat vs ego-self-neutral | 30.45 | (NS) |
| Ego-other threat vs ego-other-neutral | -3.89 | NS |
| **HR/LB** | | |
| Ego-self threat vs ego-self-neutral | 49.02 | <0.005 |
| Ego-other threat vs ego-other-neutral | 5.25 | NS |
| **LR/LB** | | |
| Ego-self threat vs ego-self-neutral | -13.18 | NS |
| Ego-other threat vs ego-other-neutral | -.85 | NS |
| | | |
| **Ego-self-threat words** | | |
| HR/HB vs HR/LB | 20.92 | NS |
| HR/HB vsLR/LB | 52.47 | <0.005 |
| HR/LB vs LR/LB | 31.55 | (NS) |
| **Ego-self-neutral words** | | |
| HR/HB vs HR/LB | 39.49 | NS |
| HR/HB vsLR/LB | 8.84 | NS |
| HR/LB vs LR/LB | -30.65 | NS |
| **Ego-other-threat words** | | |
| HR/HB vs HR/LB | 13.53 | NS |
| HR/HB vsLR/LB | -1.76 | NS |
| HR/LB vs LR/LB | -15.29 | NS |
| **Ego-other-neutral words** | | |
| HR/HB vs HR/LB | 22.67 | NS |
| HR/HB vsLR/LB | 1.28 | NS |
| HR/LB vs LR/LB | -21.39 | NS |

**Summary: *Ego Stroop***

Although reaction time latencies for the HR/HB group were *slower* for the ego-self-threat than neutral word category, this comparison failed to attain significance at the adjusted alpha level. There was also no significant difference in times taken to colour-name the ego-other-threat versus control category. Reaction time latencies for the HR/LB group were significantly *slower* for the ego-self-threat than neutral word category. There was no significant difference in times taken to colour-name the ego-threat-other versus control category. For the LR/LB group, there was no significant difference in times taken to colour name threat versus neutral stimuli in either Stroop category. When comparing group differences for each of the Stroop threat and control categories, the only comparison to attain significance was between the HR/HB and LR/LB group in the ego-self-threat category.

*Ego recall Stroop*

Utilizing raw scores, a 3 (Stroop block) x 4 (Stroop category: ego-threat-self, ego-threat-other plus matched neutral words) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA, with Stroop block and category as the within subjects factors and group as the between subjects factors revealed no significant main or interaction effects.

**Manipulation check: Comparison of response times for ego-self threat words: high vs low cognitive load.**

A 3 (Group: HR/HB, HR/LB, LR/LB) x 2 (Condition: ego/ego recall) univariate ANOVA examining raw latencies for ego-self threat words (average of Stroop B1, B2, and B3) revealed a significant main effect of group, $F(2,73) = 7.36$, $p<0.001$, $Eta^2 = .168$, and condition, $F(1,73) = 15.07$, $p<0.001$, $Eta^2 = .177$. There was no significant group x condition interaction effect.

Response time for ego-self threat stimuli contained within the ego recall Stroop task were significantly *slower* than response time for ego-self threat stimuli contained within the ego Stroop task. (Mean difference = 38.58). Regardless of condition, HR/HB females were significantly slower than LR/LB females to respond to ego-self threat stimuli (Mean difference = 67.11). Although HR/LB females were slower than LR/LB females to respond to self-directed ego threat stimuli, this comparison failed to reach significance in accordance with the adjusted alpha level (Mean difference = 49.82). There was also no significant difference between median response latencies for the HR/HB and HR/LB females (Mean difference = 17.29).

### 8.5.3 Interference scores

Further analyses were undertaken using interference scores. A higher interference score indicates a *slower* response.

*Ego Stroop*

A 3 (Stroop block) x 2 (Stroop category: Interference score) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with Stroop block and interference score as the within subjects factors and group as the between subjects factor revealed a significant main effect of group, $F(2,39) = 4.08$, $p<0.05$, $Eta^2 = .173$, and a significant Stroop category: interference score x group interaction effect,

$F(2, 39) = 3{,}75$, $p<0.05$, $Eta^2 = .161$. Table 45 shows post-hoc tests for Stroop interference scores for the ego Stroop task. Figure 21 shows Mean interference scores for the HR/HB, HR/LB and LR/LB group for the two Stroop categories.

**Figure 21. Mean interference score for the HR/HB, HR/LB and LR/LB group for the ego-self and ego-other Stroop categories.**

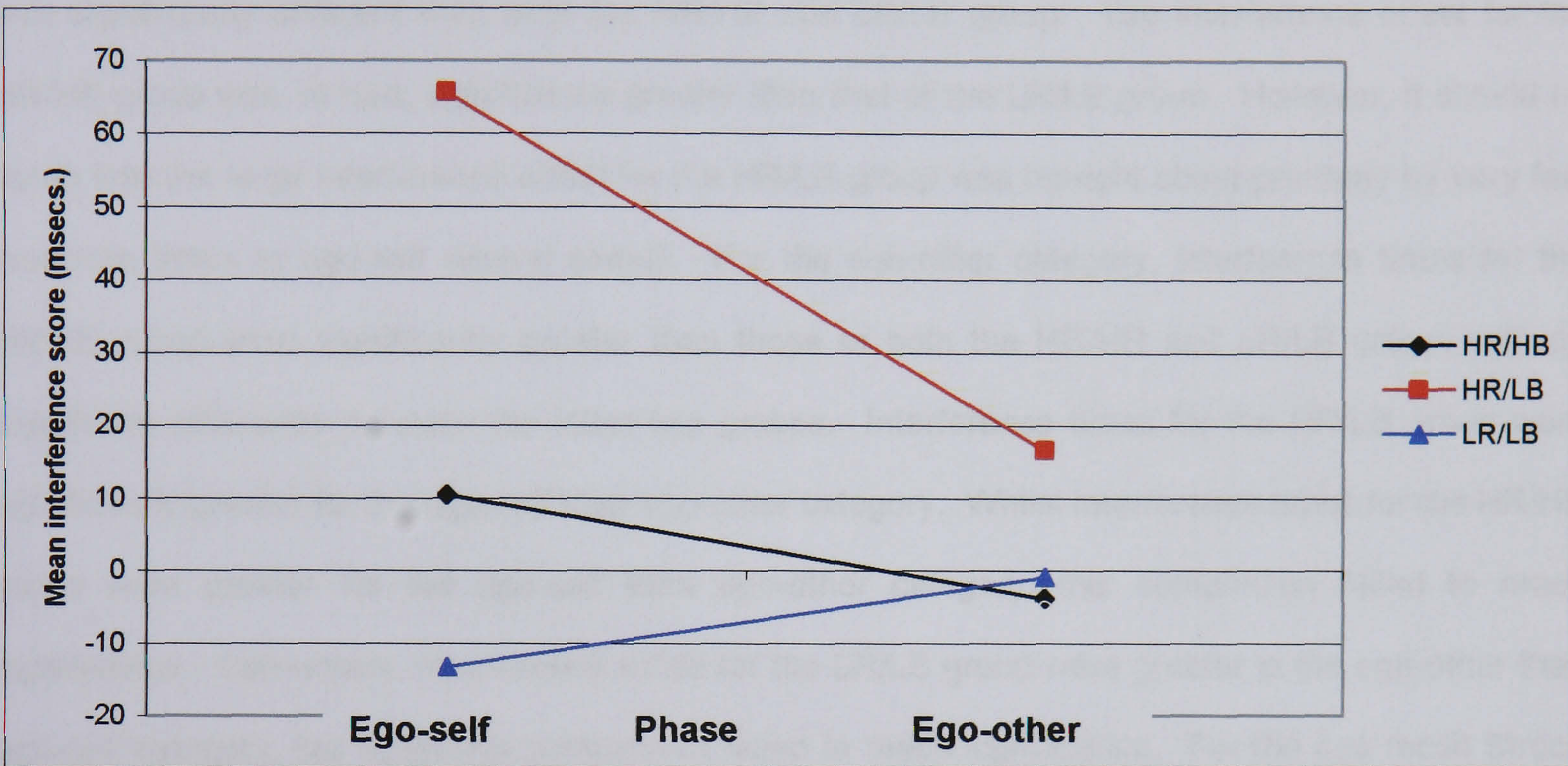



**Table 45. Follow up tests: Ego Stroop interference scores: Ego Stroop task.**

| | Mean difference | p |
|---|---|---|
| Ego-self (interference scores) | | |
| HR/HB vs HR/LB | -55.22 | <0.001 |
| HR/HB vs LR/LB | 23.64 | <0.005 |
| HR/LB vs LR/LB | 78.86 | <0.001 |
| Ego-other (interference scores) | | |
| HR/HB vs HR/LB | -20.49 | <0.005 |
| HR/HB vs LR/LB | -3.03 | NS |
| HR/LB vs LR/LB | 17.47 | <0.005 |
| | | |
| Ego-self vs Ego other: HR/HB | 14.34 | NS |
| Ego-self vs Ego other: HR/LB | 49.07 | <0.001 |
| Ego-self vs Ego other: LR/LB | -12.33 | NS |

***Ego recall Stroop***

A 3 (Stroop block) x 2 (Stroop category: Interference score) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with Stroop block and interference score as the within subjects factors and group as the between subjects factor revealed only a significant main effect of Stroop category, $F(1,34) = 6.17$, $p<0.05$, $Eta^2 = .154$. Means indicate that interference times for the ego-self Stroop category were higher (indicating a slower responding) than those of the ego-other Stroop category (Mean difference = 40.25). There was no other significant main or interaction effect.

In summary, results of ANOVA analyses employing interference scores for the two Stroop threat categories (ego-self and ego-other) for the ego Stroop task revealed a significant group difference for the ego-self category. The largest interference effect was observed for the HR/LB group. This effect was significantly different than both the HR/HB and LR/LB group. The interference effect for the HR/HB group was, in turn, significantly greater than that of the LR/LB group. However, it should be noted that the large interference effect for the HR/LB group was brought about primarily by very fast response times to ego-self neutral stimuli. For the ego-other category, interference times for the HR/LB group were significantly greater than those of both the HR/HB and LR/LB group, with no significant difference between the latter two groups. Interference times for the HR/LB group were significantly greater for the ego-self than ego-other category. Whilst interference times for the HR/HB group were greater for the ego-self than ego-other category, this comparison failed to reach significance. Conversely, interference times for the LR/LB group were greater in the ego-other than ego-self category, but again this comparison failed to reach significance. For the ego recall Stroop task, results revealed a significantly greater interference score for the ego-self than ego-other category.

### 8.5.4 Correlation Analyses: Ego Stroop task

Next, correlations were undertaken to examine a) the relationship between level of eating pathology and interference scores for self-directed ego threat stimuli, anxiety (STAI ratings, HR, BP and cortisol reactivity) and self-esteem ratings, b) the relationship between total food and water intake, measures of dietary restraint and bulimic symptoms, anxiety (TA – B: difference values), self-esteem ratings (TA – B: difference values), and raw and interference[13] scores for the ego-self threat category, physiological (SBP, DBP, HR) and biological (salivary cortisol) reactivity for the ego Stroop task (see Table 46), and the ego recall Stroop task (see Table 47).

[13] Interference is the difference between the time taken to colour-name the threat and neutral stimuli

### *Ego Stroop task*

### *Total Food Intake*

There was a significant positive relationship between BMI, the three classification scales (RS_R, DEBQ, and BULIT-R), anxiety, ego-self threat raw (median values) and total food intake. This suggests that a higher body mass, a greater level of dietary restraint, and more severe bulimic tendencies, together with higher self-reported anxiety levels, and slower responses to ego-self threat stimuli were associated with greater food intake. There was also a significant negative correlation between total intake of ice cream and self-esteem, whereby lower perceptions of self-esteem following exposure to the ego Stroop task were associated with greater consumption of ice cream.

### *Total Water Intake*

There was a significant positive correlation between BMI, the three classification scales (RS_R, DEBQ, and BULIT-R), and ego-self threat raw (median) values. This suggests that a higher body mass, restraint level, bulimic tendencies and a slower reaction-time to self-directed ego threat stimuli are associated with greater water intake.

For the ego Stroop task, eating psychopathology was found to be positively and significantly associated with raw (median) response times for the ego-self category [RS-S: $r = .42$; DEBQ: $r = .43$; BULIT-R: $r = .37$]. Similarly, interference scores for this category were found to be positively and significantly related to both the RS-R ($r = .39$) and the DEBQ ( $r = .49$), but not the BULIT-R. In terms of arousal responses, self-reported anxiety ratings were positively and significantly related to each of the three classication scales (RS-R: $r = .60$, DEBQ:, $r = .52$, BULIT-R: $r = .49$), and perceptions of self-esteem were negatively and significantly related to each of the three classification scales (RS-R: $r = -.47$, DEBQ:, $r = -.29$, BULIT-R: $r = -.30$). In terms of correlations undertaken between physiological or biological reactivity and eating pathology, only HR reactivity was positively and significantly associated with the bulimia scale (BULIT-R: $r = .60$).

### *Ego recall Stroop task*

Results for the ego recall Stroop task mirrored those of the ego Stroop task.

***Total Food Intake***

There was a significant positive relationship between BMI, the three classification scales (RS_R, DEBQ, and BULIT-R), anxiety, ego-self threat raw (median values) and total food intake. This suggests that a higher body mass, dietary restraint, greater bulimic tendencies, higher self-

**Table 46.** Correlations (Pearson's *r*) between total food and water intake, the RS-R, DEBQ, BULIT-R, anxiety (STAI: TA – B: difference values), self-esteem (SSES: TA - B: difference values), raw and interference scores for ego-self threat, and physiological (SBP, DBP, HR) and biological (salivary cortisol) reactivity (peak task response) for the ego Stroop task (N = 42).

| | BMI | RS-R | DEBQ | STAI | SSES | Ego-self threat (raw values) | Ego-self threat (interference scores) | SBP | DBP | HR | Total food | Total water | BULIT-R | Cortisol |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BMI | | .45** | .41** | NS | NS | NS | NS | NS | NS | NS | .44** | NS | NS | NS |
| RS-R | | | .90** | .60** | -.47** | .42** | .39* | NS | NS | NS | .79** | .58** | .87** | NS |
| DEBQ | | | | .52** | -.29* | .43** | .49** | NS | NS | NS | .75** | .75** | .83** | NS |
| STAI | | | | | -.32* | NS | NS | NS | NS | NS | .34* | NS | .49** | .42** |
| SSES | | | | | | NS | NS | NS | NS | NS | -.34* | NS | -.30* | NS |
| Ego-self threat (raw values) | | | | | | | .49** | NS | NS | NS | .40** | .35* | .37* | NS |
| Ego-self threat (interference scores | | | | | | | | NS | NS | NS | NS | NS | NS | NS |
| SBP | | | | | | | | | .40** | .41** | NS | NS | NS | .34* |
| DBP | | | | | | | | | | -.53** | NS | NS | NS | NS |
| HR | | | | | | | | | | | NS | NS | NS | .36* |
| Total food | | | | | | | | | | | | .41** | .60** | NS |
| Total water | | | | | | | | | | | | | .69** | NS |
| BULIT-R | | | | | | | | | | | | | | NS |

**$p<0.01$; *$p<0.05$ (2-tailed)

Table 47. Correlations (Pearson's *r*) between total food and water intake, the RS-R, DEBQ, BULIT-R, anxiety (STAI: TA – B: difference values), self-esteem (SSES: TA - B: difference values), raw and interference scores for ego-self threat, and physiological (SBP, DBP, HR) and biological (salivary cortisol) reactivity (peak task response) for the ego recall Stroop task (N = 37).

| | BMI | RS-R | DEBQ | STAI | SSES | Ego-self threat (raw values) | Ego-self threat (interference scores) | SBP | DBP | HR | Total food | Total water | BULIT-R | Cortisol |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BMI | | .58** | .40** | NS | NS | NS | NS | NS | NS | NS | .42** | NS | NS | NS |
| RS-R | | | .75** | .58** | -.40* | .45** | .42** | NS | NS | NS | .63** | .59** | .77** | NS |
| DEBQ | | | | .50** | -.36* | .37* | .48** | NS | NS | NS | .81** | .71** | .85** | NS |
| STAI | | | | | -.31* | NS | NS | NS | NS | NS | .39* | NS | .48** | .35* |
| SSES | | | | | | NS | NS | NS | NS | NS | -.38* | NS | NS | NS |
| Ego-self threat (raw values) | | | | | | | .47** | NS | NS | NS | .40* | .38* | NS | .35* |
| Ego-self threat (interference scores | | | | | | | | .47** | NS | NS | NS | NS | NS | NS |
| SBP | | | | | | | | | .59** | .60** | NS | NS | .42** | NS |
| DBP | | | | | | | | | | -.58** | NS | NS | NS | NS |
| HR | | | | | | | | | | | NS | NS | NS | NS |
| Total food | | | | | | | | | | | | .54** | .67** | NS |
| Total water | | | | | | | | | | | | | .82** | NS |
| BULIT-R | | | | | | | | | | | | | | NS |

$^{**}p<0.01$; $^{*}p<0.05$ (2-tailed)

reported anxiety levels, and slower responses to ego-self threat stimuli were associated with greater food intake. There was also a significant negative correlation between total intake of ice cream and self-esteem, whereby lower perceptions of self-esteem following exposure to the ego Stroop task are associated with greater consumption of ice cream.

***Total Water Intake***

There was a significant positive correlation between BMI, the three classification scales (RS_R, DEBQ, and BULIT-R), ego-self threat raw (median) values and intake of chilled water. This suggests that a higher body mass, restraint level, bulimic tendencies and a slower reaction-time to self-directed ego threat stimuli are associated with greater water intake.

For both tasks, there was no significant association between total food and water intake and physiological (SBP, DBP, HR) or biological (Salivary cortisol) reactivity, nor was there a significant correlation between self-reported anxiety and physiological (SBP, DBP, HR) reactivity. There was, however, a significant positive correlation between self-reported anxiety and salivary cortisol reactivity, suggesting that higher levels of cortisol reactivity are associated with higher self-reported negative affect.

For the ego-recall Stroop task, eating pathology was found to be positively and significantly related to both raw (median) and interference scores associated with the the ego-self category, for each of the dietary restraint scales (RS-R: $r = .42$, DEBQ: $r = .37$; RS-R: $r = .42$, DEBQ, $r =.48$), but not the bulimia scale (BULIT-R). In terms of arousal responses, self-reported anxiety ratings were positively and significantly related to each of the three classication scales (RS-R: $r = .58$, DEBQ:, $r = .50$, BULIT-R: $r = .48$), and perceptions of self-esteem were negatively and significantly related to each of the two dietary restraint classification scales (RS-R: $r = -.40$, DEBQ:, $r = -.36$), but to the bulimia scale (BULIT-R). In terms of correlations undertaken between physiological or biological reactivity and eating pathology, only SBP reactivity was positively and significantly associated with the bulimia scale (BULIT-R: $r = .42$).

### 8.5.5 Multiple Regression Analyses

Next, standard multiple regression analyses were performed to identify significant predictors of total food and water intake following the ego and ego recall Stroop task. The three classification scales (RS_R, DEBQ, BULIT-R) were highly inter-correlated ($p<0.01$). Therefore scores on these scales were standardized (converted to z scores) and averaged prior to entry into multiple regression analyses to provide a composite measure of dietary restraint/bulimic symptoms (Comp-RB). All variables entered into the analyses were z scores (Cohen et al., 2003).

***Stroop task: Total Food Intake***

Table 48 shows standard multiple regression of Comp-RB, anxiety (STAI: TA – B: difference values), self-esteem (SSES: TA – B: difference values), and ego-self threat raw (median) values on to total ice cream intake. Table 49 shows standard multiple regression of restraint plus bulimic symptoms (Comp-RB) and ego-self threat raw (median) values on to total water intake for the ego Stroop task.

**Table 48. Standard multiple regression of restraint plus bulimic symptoms (Comp-RB), anxiety (STAI), self-esteem (SSES), and ego-self threat raw (median) values regressed on to total ice cream intake for the ego Stroop task.**

| Variables | Beta | t | Sig t | $R^2$ | $AdjR^2$ |
|---|---|---|---|---|---|
| Comp-RB | .80 | 3.89 | <0.001 | | |
| Ego-self threat raw values | .42 | 3.01 | <0.05 | | |
| Self-esteem (SSES) | -.19 | -.67 | .51 | | |
| Anxiety (STAI) | .15 | 1.16 | .07 | .32 | .30 |
| ANOVA: $F(5,36) = 3.44$, $p<0.05$ | | | | | |

*Ego Stroop task: Total Water Intake*

**Table 49. Standard multiple regression of restraint plus bulimic symptoms (Comp-RB) and ego-self threat raw (median) values regressed onto total water intake for the ego Stroop task.**

| Variables | Beta | t | Sig t | $R^2$ | Adj$R^2$ |
|---|---|---|---|---|---|
| Comp-RB | .40 | 2.28 | <0.05 | | |
| Ego-self threat raw values | .33 | 2.29 | <0.05 | .39 | .31 |
| ANOVA: $F(5,36) = 4.68$, $p<0.01$ | | | | | |

*Ego recall Stroop task: Total Food Intake*

Table 50 shows standard multiple regression of Comp-RB, anxiety (STAI: TA – B: difference values), self-esteem (SSES: TA – B: difference values), and ego-self threat raw (median) values on to total ice cream intake. Table 51 shows standard multiple regression of restraint plus bulimic symptoms (Comp-RB) and ego-self threat raw (median) values on to total water intake for the ego recall Stroop task.

**Table 50. Standard multiple regression of restraint plus bulimic symptoms (Comp-RB), anxiety (STAI), self-esteem (SSES), and ego-self threat raw (median) values regressed on to total ice cream intake for the ego recall Stroop task.**

| Variables | Beta | t | Sig t | $R^2$ | Adj$R^2$ |
|---|---|---|---|---|---|
| Comp-RB | .62 | 3.90 | <0.001 | | |
| Anxiety (STAI) | .11 | .67 | 0.51 | | |
| Self-esteem (SSES) | -.21 | -.90 | .18 | | |
| Ego-self threat raw values | .19 | 1.15 | 0.26 | .48 | .39 |
| ANOVA: $F(5,31) = 5.70$, $p<0.001$ | | | | | |

***Ego recall Stroop task: Total Water Intake***

**Table 51. Standard multiple regression of restraint plus bulimic symptoms (Comp-RB) and ego-self threat raw (median) values regressed onto total water intake for the ego recall Stroop task.**

| Variables | Beta | t | Sig t | $R^2$ | $AdjR^2$ |
|---|---|---|---|---|---|
| Comp-RB | .41 | 2.47 | <0.05 | | |
| Ego-self threat raw values | .22 | 1.12 | 0.27 | .25 | .13 |
| ANOVA: $F(5,31) = 2.06$, $p<0.05$ | | | | | |

***Summary of Multiple Regression Results:***

***Ego Stroop task***

***Total food intake***: controlling for BMI, results of the multiple regression analysis showed that two of the predictor variables (Comp-RB and ego-self threat raw values) contributed significantly to the prediction of total food intake. Collectively, low prediction was available; 32% (30% adjusted) of the variability in total food intake was predicted by knowing scores on the four predictor variables (Comp-RB, STAI (difference scores), and SSES (difference scores), and ego-self threat raw values). The overall ANOVA model was significant.

***Total water intake:*** controlling for BMI, results of the multiple regression analysis showed that two of the predictor variables (Comp-RB and ego-self threat raw values) contributed significantly to the prediction of total water intake. Collectively, 39% (31% adjusted) of the variability in total water intake was predicted by knowing scores on the two predictor variables (Comp-RB and ego-self threat raw values). The overall ANOVA model was significant.

***Ego recall Stroop task***

***Total food intake***: controlling for BMI, results of the multiple regression analysis showed that only one of the predictor variables (Comp-RB) contributed significantly to the prediction of total food intake. Collectively, moderate prediction was available; 48% (39% adjusted) of the variability in total food intake was predicted by knowing scores on the four predictor variables (Comp-RB, STAI (difference scores), and SSES (difference scores), and ego-self threat raw values). The overall ANOVA model was significant.

***Total water intake:*** controlling for BMI, results of the multiple regression analysis showed that only one of the predictor variables (Comp-RB) contributed significantly to the prediction of total water intake. Collectively, 25% (13% adjusted) of the variability in total water intake was predicted by knowing scores on the two predictor variables (Comp-RB, and ego-self Stroop interference scores). The overall ANOVA model was significant.

### 8.5.6 Memory bias for ego threat words

Table 52 shows Mean (SD) number of words recalled in the four Stroop categories (ego-self threat; ego-self control; ego-other threat; ego-other control) by the HR/HB, HR/LB, and LR/LB females in the ego and ego recall Stroop tasks.

A 4 (Stroop category: ego-threat self; ego-threat self controls; ego-other threat; ego-other controls) x 3 (Group: HR/HB, HR/LB, LR/LB) x 2 (Condition: ego vs ego recall Stroop) mixed factorial ANOVA, with Stroop category as the within subjects factor, and group and condition as the between subjects factors, examining number of words correctly recalled from each of the four Stroop categories revealed a significant main effect of category, $F(3,219) = 2.88$, $p<0.05$, $\text{Eta}^2 = .038$, group, $F(2,73) = 10.95$, $p<0.001$, $\text{Eta}^2 = .231$, and condition, $F(1,73) = 20.72$, $p<0.001$, $\text{Eta}^2 = .221$. There was also a significant group x condition interaction effect, $F(2,73) = 6.05$, $p<0.005$, $\text{Eta}^2 = .142$. There was no other significant interaction effect. For the main effect of Stroop category, although inspection of mean values suggests that participants recalled more ego-self threat than control words, this comparison failed to attain significance at the adjusted alpha level of .005 ($p = 0.014$). There was also no significant difference between the number of words correctly recalled for ego-other threat versus control categories. Figure 22 shows the two-way interaction between group and Stroop condition on the measure of number of Stroop words correctly recalled. Table 53 shows the summary table for follow-up tests for the number of words correctly recalled.

**Table 52. Mean (SD) number of words correctly recalled from the four Stroop categories (ego-self threat, ego-self control, ego-other threat, ego-other control) by the HR/HB, HR/LB and LR/LB group for the ego and ego recall Stroop task.**

| | | Ego Stroop | | | | Row Means/SD | Ego recall Stroop | | | | Row Means/SD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ego-self threat | Ego-self control | Ego-other threat | Ego-other control | | Ego-self threat | Ego-self control | Ego-other threat | Ego-other control | |
| **HR/HB** | **Mean** | **4.07** | **3.20** | **3.40** | **4.00** | **3.67** | **4.11** | **4.33** | **3.67** | **3.56** | **3.92** |
| | *SD* | *.88* | *1.15* | *1.12* | *1.07* | *1.06* | *.93* | *1.32* | *1.23* | *1.01* | *1.12* |
| **HR/LB** | **Mean** | **3.58** | **2.75** | **3.25** | **3.42** | **3.25** | **4.18** | **3.91** | **3.45** | **3.73** | **3.82** |
| | *SD* | *.52* | *1.22* | *.87* | *.90* | *1.76* | *1.33* | *1.87* | *1.64* | *1.79* | *1.66* |
| **LR/LB** | **Mean** | **1.93** | **2.00** | **2.07** | **2.07** | **2.02** | **4.12** | **3.35** | **3.24** | **3.94** | **3.66** |
| | *SD* | *.88* | *.93* | *1.16* | *1.03* | *1.00* | *1.45* | *1.58* | *1.48* | *1.44* | *1.49* |
| **Column** | **Mean** | **3.17** | **2.64** | **2.88** | **3.14** | | **4.14** | **3.76** | **3.41** | **3.78** | |
| | *SD* | *1.23* | *1.19* | *1.21* | *1.30* | | *1.27* | *1.62* | *1.44* | *1.44* | |

**Figure 22. Mean number of words correctly recalled by the HR/HB, HR/LB and LR/LB group in the ego and ego recall Stroop task.**

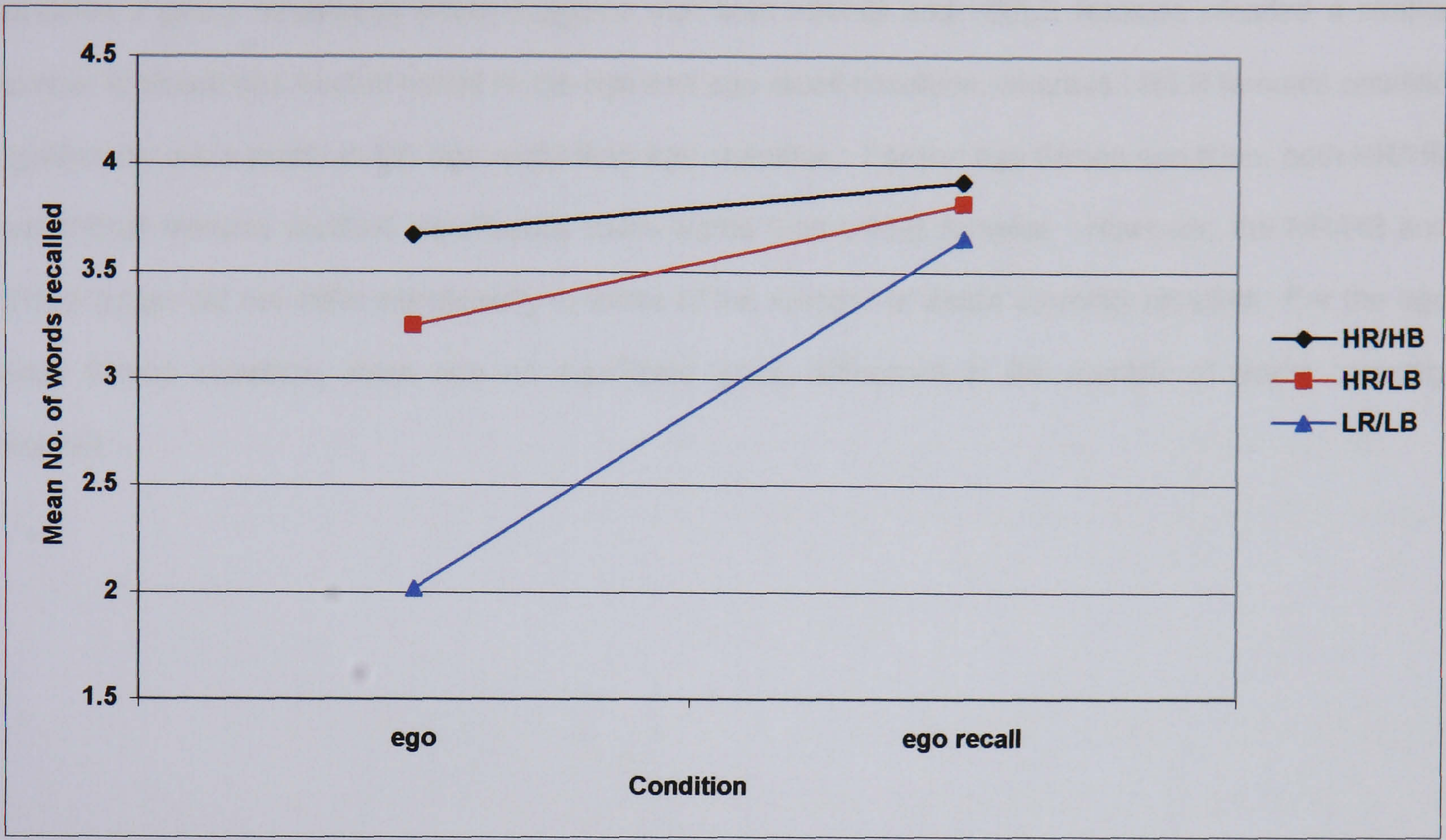



**Table 53. Summary of follow-up tests: Number of words correctly recalled**

| | Mean difference | *p* |
|---|---|---|
| **Condition** | | |
| **HR/HB** | | |
| Ego vs ego recall | .11 | NS |
| **HR/LB** | | |
| Ego vs ego recall | -.23 | NS |
| **LR/LB** | | |
| Ego vs ego recall | -1.92 | <.0.001 |
| **Group** | | |
| **Ego Stroop** | | |
| HR/HB vs HR/LB | .42 | NS |
| HR/HR vs LR/LB | 1.65 | <0.001 |
| HR/LB vs LR/LB | 1.23 | <0.001 |
| **Ego recall Stroop** | | |
| HR/HB vs HR/LB | .10 | NS |
| HR/HR vs LR/LB | .25 | NS |
| HR/LB vs LR/LB | .16 | NS |

In summary, results show that, although more ego-self threat than control words were correctly recalled, this comparison failed to reach significance according to the adjusted alpha level. There was also no significant difference between ego-other threat and neutral words correctly recalled. A significant condition x group interaction effect suggests that both HR/HB and HR/LB females recalled a similar number of threat and neutral words in the ego and ego recall condition, whereas LR/LB females recalled significantly more words in the ego recall than ego condition. For the ego Stroop condition, both HR/HB and HR/LB females recalled significantly more words than LR/LB females. However, the HR/HB and HR/LB group did not differ significantly in terms of the number of words correctly recalled. For the ego recall Stroop condition, there was no significant group difference in the number of words correctly recalled.

## 8.6 Discussion

This study compared the effects of two laboratory stress manipulations that were equal in terms of emotional content, but that differed in terms of cognitive load (amount of cognitive effort required to complete each task). Both tasks required an *active* behavioural response, but condition 2 required participants to *strategically* process the words within the Stroop task, whereas condition 1 did not. The effects of an emotional Stroop task, containing ego threat stimuli (also used in study 1 of this thesis) was tested under two conditions: with and without pre-test instructions for immediate free word recall. Female restrained eaters with bulimic symptoms and restrained eaters without bulimic symptoms were compared to a control population on measures of ice cream intake and mood (anxiety and self-esteem). Physiological and biological reactivity measures were also obtained during a protocol consisting of distinct baseline, task and recovery phases. Participants undertook a 'taste-test' during the recovery period (see Section 2.4.5).

In consideration of the results of study 1 of this thesis, it was expected that condition 1 (high emotional loading, but low cognitive load) would induce greater anxiety and food intake (of vanilla, chocolate and strawberry ice cream), and lower feelings of self-esteem in females with bulimic symptoms when compared to controls. It was also expected that a similar pattern might be observed for restrained eaters, without bulimic symptoms, and that results obtained might exist as a function of level of eating psychopathology. Given the construction of the task contained within condition 2 [involving both high emotional and cognitive loading], it was also predicted that this condition would provoke stronger effects than condition 1 [high emotional loading, but low cognitive load] in the two target populations, when compared to controls. In addition, participants in Condition 2 were required to consciously and *strategically* process the stimuli contained within the task.

Also building on study 1 of this thesis, the present study also examined whether an information processing and memory bias for ego-self threat stimuli existed for the two target populations when compared to neutral stimuli and a control population. Results of study 1 suggest that females with bulimic symptoms demonstrate a *slowing* in terms of responding (colour-naming) to self-directed ego threat stimuli (but not ego-threat from others). In addition, the pattern of results (mean values) derived from an *incidental* and *delayed* free word recall task intimated the possibility of the existence of an explicit memory bias for self-directed ego threat words in women with bulimic symptoms. However, follow-up tests were found to be non-significant in accordance with the adjusted alpha level. Clarification of this finding was therefore sought within the present study. In the present study, participants were required to undertake an *immediate* free recall of words contained within the ego Stroop task that was either *incidental* (condition 1) or *cued* (condition 2).

Preliminary analyses revealed no significant group difference in terms of oral contraceptive use and time of day of experimental testing; factors that could potentially affect results of cortisol analyses. Groups were also similar in terms of age, perceived control over the tasks (Stroop *plus* word recall) undertaken, and BMI, with all three groups falling within the *normal* weight category (BMI = 20-25).

***Self-reported anxiety ratings (STAI) following stress***

In this study, ratings on the STAI were obtained after participants had completed *both* the Stroop and word recall task. In the period separating the two tasks, to avoid interruption of recall, no words were spoken to the participant by the experimenter. Participants were simply handed a sheet of paper containing the instructions for the word recall task, and the experimenter promptly returned to behind a screen. The instructions read "Now write down as may words as you can remember from the Stroop task your performed earlier. You have 3 minutes to perform this task."

In terms of self-reported negative affect, both conditions were efficient in provoking a significant rise in ratings from baseline. At the task phase, after completing both the Stroop task involving the strategic processing of stimuli, plus the word recall task, participants in this condition (condition 2) self-reported significantly higher ratings of anxiety than did participants in condition 1 who completed the Stroop task in the normal way, plus the word recall task. This effect existed irrespective of level of eating pathology. Thus, both task combinations were efficient in provoking a significant cognitive stress response. The effect was further enhanced when participants were instructed to *strategically* process the information contained within the task, and when the task was higher in terms of cognitive load. There were no significant group differences. This finding conflicts with that of Lattimore & Maxwell (2004). These researchers found similar anxiety responses to an ego Stroop task, with and without high cognitive loading, with restrained eaters generally more anxious than unrestrained eaters. In relation to an ego Stroop task, an incongruent colour Stroop task and a control task (Stroop task containing neutral stimuli), Wallis & Hetherington (2004) reported no significant main effects or interactions in respect of anxiety ratings. However, females classified as both restrained and emotional eaters were found to self-report a significant decrease in positive affect over time in relation to the ego Stroop task. Lattimore (2001) reported a significant condition difference in post task anxiety responses, with significantly higher anxiety ratings for both binge-eaters and non-binge-eaters following exposure to an ego Stroop task when compared to a general stressor (a fearful film). In Lattimore's (2001) study, although anxiety ratings following exposure to the ego Stroop task were higher for binge-eaters than for non-binge-eaters, no statistical comparison of these group means was undertaken.

***Self-reported self-esteem (SSES) following stress***

Self-reported self-esteem ratings also relate to an assessment made following both the Stroop task *plus* the word recall task. Preliminary analyses revealed that, as with study 1 of this thesis, females with bulimic tendencies (who were also restrained eaters) had significantly *lower* feelings of self-esteem than control females prior to experimentation. In the present study, self-esteem ratings for restrained eaters, without bulimic symptoms, occupied an intermediate position between females with bulimic symptoms and controls. However, means difference comparisons involving this group did not achieve significance. Further, participants in the ego Stroop condition were found to have significantly lower baseline self-esteem ratings than participants in the ego-recall condition.

Analyses of self-esteem scores, employing baseline ratings as co-variate revealed only a significant main effect of group. Both females with bulimic symptoms and restrained eaters were found to have significantly lower perceptions of self-esteem compared to the control group, and with no significant difference between the first two groups.

Analyses of change scores (TA-B values) revealed that each experimental condition (Stroop task plus incidental immediate word recall task (condition 1) and Stroop task plus cued immediate recall task (condition 2)) exerted a similar effect. Scores representing a change in ratings from baseline to task were significantly lower than scores representing a change in ratings from baseline to post-recovery (following food ingestion). This suggests that perceptions of self-esteem were significantly higher following the ingestion of ice cream than they were immediately following exposure to stress. This analysis also confirmed that females with bulimic symptoms and restrained eaters had significantly lower self-esteem ratings compared to the control group, with no significant difference between the first two groups. These findings are in line with those of Koo-Loeb et al. (2000) who reported that non-clinical women who scored in the highest distribution of the Eating Disorder Inventory bulimia subscale (HEDI) reported significantly lower perceptions self-esteem following exposure to stress that could be perceived as ego-threatening (an interpersonal speech task) compared to LEDI women who scored in the lowest distribution of the EDI).

Findings in relation to self-esteem are important, given that perceptions of self-esteem have been found to further moderate the dietary restraint level-stress-eating relationship. For example, a study undertaken by Heatherton et al., (1991) (reviewed in Section 2.7.6), designed to compare physical versus ego threat manipulations, revealed that only the individuals classified as high restraint, low self-esteem consumed significantly more in the ego conditions (failure on the concept formation task and anticipatory speech). These results are consistent with the findings of studies that indicate that there is a negative correlation between restraint score and self-esteem (self-esteem decreases as dietary restraint level increases) (e.g., Paa & Larson, 1998). Within the present research, a negative and significant correlation was also found between self-esteem ratings and each of the restraint scales for both the ego Stroop condition (RS-R: $r$ = -.47; DEBQ; $r$ = -.29), and the ego-recall Stroop condition (RS-R: $r$ = -.40; DEBQ; $r$ = -.36). In addition, for the ego Stroop condition only, a negative and significant association was found in relation to scores on the BULIT-R ($r$ = -.30). This suggests that the more severe the symptoms of bulimia, the lower the perceptions of self-esteem for women in condition 1. In the present research, lower perceptions of self-esteem that existed in populations prior to experimentation increases the likelihood that disinhibition will be disrupted in response to stress in these populations.

***Physiological reactivity during stress***

Analyses of cardiovascular (HR and BP) reactivity involve values obtained during performance on the Stroop task in each experimental condition only, and *do not* include performance during the word recall task undertaken immediately after completion of the Stroop task.

In terms of a physiological stress response, regardless of task type, HR reactivity and SBP values were significantly elevated over baseline values. Moreover, HR and SBP, values during the task phase (B1, B2, and B3) were non significantly different, suggesting a sustained response throughout the task phase (of approximately 20 minutes in duration), with no habituation effects, but also with no increase in responding between trials. This finding contradicts to that of researchers who have found the effects of 'threat' content within a task to build during the experimental session (e.g., Broadbent & Broadbent, 1988).

There was no significant difference in DBP values between the baseline and the task phase, suggesting that neither task was efficient in provoking a DBP response. For both heart rate and blood pressure reactivity, there was no significant difference between the three groups at either the baseline or task phase. The physiological reactivity pattern observed is in line with what one might expect from an active coping task. Active coping tasks are associated with increases in systolic blood pressure, heart rate, cardiac output, and stroke volume; shortened pre-ejection periods and decreases in total peripheral resistance (Obrist, 1979; Sherwood, Dolan & Light, 1990; Buhler, Bolli, Huthu & Kiowski, 1983).

Taken together, these results suggest that both tasks were efficient in provoking significant and sustained cardiovascular reactivity responses, in comparison to baseline values. This suggests activation of the SNS and SAM axes (see Section 4.4.1). These results are in line with previous studies where unmasked Stroop tasks have been found to provoke significant elevations in physiological responding and self-reported negative affect over baseline values (e.g., Blair et al., 1991; Renaud & Blondin, 1997; Silva & Leite, 2000; Tulen et al., 1989; Ruddell et al., 1988).

However, in the present study no significant group differences were observed. These results therefore conflict with those of existing studies where researchers have found that the presentation of emotionally salient stimuli is accompanied by a significant increase in autonomic arousal in target populations, when compared to controls. Perpina, et al., (1998), for example, showed that anorexic patients responded with higher skin conductance to food- and body-related information than did patients with bulimia and controls. Similarly, Vitousek & Orimoto (1993), using a dot-probe task, reported that women with BN showed enhanced physiological reactivity to information relevant to their concerns. In addition, Koo-Loeb et al. (2000) reported that non-clinical women who scored in the highest distribution of the Eating Disorder Inventory bulimia subscale (HEDI) exhibited increased blood pressure and heart rate reactivity to an interpersonal speech task (that could be regarded as ego-threatening) compared to women who scored in the lowest distribution of the EDI bulimia sub-scale (LEDI).

However, the results of the present study are in line with those of Tuschen-Caffier & Vogele (1999). These researchers reported no substantial group differences in physiological reactivity (HR, BP, respiration-rate and electrodermal activity) in response to mental arithmetic task (plus audio distraction noises), a Stroop test, consisting of incongruent colour words, and interpersonal stress provoking feelings of loneliness and social rejection (film and imagery tasks) between patients with BN, restrained eaters and controls. The results of the present study are also in line with those of Rutledge & Linden (1998) also reported a significant elevation in physiological reactivity (HR and BP) for all participants (restrained eaters and controls) in response to 3 active coping tasks (a mental arithmetic task, a Stroop task (incongruent colour), and a word scramble task).

***Biological reactivity during stress***

Analyses of biological reactivity values (salivary cortisol) involve values obtained during performance on the Stroop task only and *do not* include performance during the word recall task.

Clinically eating disordered women with AN, BN, BED, and the night eating syndrome have been found to exhibit higher basal levels of cortisol (Putignano et al., 2001; Pirke et al., 1992; Gluck et al., 2004a; Birkentvedt et al., 1999), in comparison to controls. In non-clinical women, both salivary and urinary cortisol have been shown to be either increased in individuals high in dietary restraint (Anderson et al., 2002; McLean et al, 2001), or not different between restrained and unrestrained individuals (Beiseigel & Nickols-Richardson, 2004). In the present study, there was no significant difference between females with bulimic symptoms (who were also restrained eaters), restrained eaters, without bulimic symptoms and controls in terms of baseline salivary cortisol values.

Salivary cortisol values were found to have risen significantly in comparison to the baseline phase for both of the experimental tasks. Results from the present study also revealed no significant group difference in cortisol reactivity at the baseline or task phase. These results conflict with those of prior studies, where researchers have reported exaggerated cortisol reactivity in non-clinical women with high bulimic tendencies (Koo-Loeb et al., 2000), and in restrained eaters (Stroud et al., 2000), in comparison to a control population. For example, Koo-Loeb et al. (2000) showed that non-clinical women with bulimic symptoms showed increased 24-hour urinary cortisol, but decreased 24-hour ambulatory blood pressure levels, to an interpersonal speech stressor (that could be regarded as ego threatening, in that it contains an evaluative component).

***Total ice cream and water intake and intake by flavour following stress***

Results in relation to total ice cream intake and intake by flavour revealed only a significant main effect of group. Irrespective of condition or ice cream flavour, females with bulimic symptoms were found to consume significantly more ice cream than controls. The number of grams of ice cream consumed by restrained eaters following stress occupied an intermediate position between the amount consumed by females with relatively bulimic attitudes and controls. The difference in consumption between restrained eaters and controls was significant. However, the difference in consumption by the two target populations did not achieve the adjusted alpha level.

Analysis of ice cream 'liking' ratings, obtained during the bogus taste-test revealed only a significant main effect of flavour. Participants in both conditions rated the flavour of the chocolate ice cream served significantly higher than both the vanilla and strawberry ice cream served. There was no significant difference in flavour ratings for the vanilla and strawberry flavoured ice cream. In line with the results of experiment 1 of this thesis, these results suggest that intake of ice cream for females with bulimic symptoms (and restrained eaters) does not fully map onto flavour preference or liking (perceived palatability of food ingested).

Results in relation to total water intake also revealed only a significant main effect of group. Irrespective of experimental condition, females with bulimic symptoms consumed significantly more chilled water than restrained eaters and than control participants. There was no significant difference between the latter two groups.

To summarise, ice cream intake following stress for the two target populations was similar, and significantly different to the control population. Females with bulimic symptoms consumed significantly more chilled water than did either of the other two groups. Findings of the present study are in line with the findings of study 1, where an unmasked Stroop task provoked significant increase in ice cream intake in females with bulimic symptoms, when compared to a control population. It was also expected that a similar pattern might be observed for restrained eaters, without bulimic symptoms. These predictions were also supported, and these results are in line with other researchers who have reported overeating in females with bulimic symptoms (Lattimore, 2001) and restrained and emotional eaters (Wallis & Hetherington, 2004) in response to an ego-threat Stroop task. These findings are also in line with other researchers who have reported that emotional cues unrelated to eating can induce greater levels of eating in non-clinical women with bulimic attitudes. (Lattimore, 2001; Patton, 1992; Waller & Mijatovich, 1998; Meyer & Waller, 1999).

However, given that condition 2 was high in terms of both emotional and cognitive loading, and also required participants to strategically process the emotional words contained within the task, it was predicted that this task would provoke stronger effects. This prediction was not supported. Both tasks exerted a similar effect in terms of disrupting cognitive control over eating behaviour. This finding conflicts with that of Lattimore & Maxwell (2004) where restrained eaters were found to consume significantly more when the ego Stroop task contained high cognitive load when compared to restrained eaters who completed an ego Stroop task with low cognitive load.

However, a potential problem with this study is that eight participants consumed all 300 grams of ice cream served. Six were classified as HR/HB, four of these were in the ego Stroop condition, and 2 were in the ego-recall condition. Two were classified as HR/LB, with one person in the ego- and the other in the ego-recall Stroop condition (see also Section 9.2). In order to test whether or not this had an impact on the results obtained, a further analysis was undertaken with food intake data from these eight individuals removed. The pattern of results was similar, with only a highly significant main effect of group obtained. Both high restraint groups consumed significantly more than control group ($p$'s<0.001) and the comparison between the two high restraint groups was non significant ($p = 0.08$).

***Self-reported anxiety ratings (STAI) following food ingestion***

Results showed that self-reported anxiety ratings following food ingestion were similar for the two experimental conditions and for the three populations. Ratings obtained following food ingestion were significantly lower than ratings obtained immediately following exposure to stress, but remained significantly higher than baseline ratings. Given that no significant group differences were observed, these results conflict with those of study 1 of this thesis.

***Self-reported self-esteem ratings (SSES) following food ingestion***

Self-reported self-esteem change scores were significantly elevated following food ingestion during the recovery phase than when tested after exposure to stress. This suggests that ingestion of a highly palatable food (ice cream) served to increase perceptions of self-esteem. In addition, females with bulimic symptoms and restrained eaters, without bulimic symptoms, had significantly lower ratings of self-esteem than control participants. These results are similar to those obtained in study 1 of this thesis.

***Physiological reactivity during food ingestion***

SBP reactivity values following food ingestion remained as high as task phase values (B1 and B2). However, post-recovery SBP values were significantly lower than those obtained during B3, and remained significantly elevated over baseline values. This pattern was observed for each experimental condition, and no significant group differences were observed. Similarly, for HR reactivity, values obtained during food ingestion were similar to those obtained at the task phase, and this effect existed irrespective of level of eating pathology. The only significant group difference obtained was in relation to DBP values. DBP values obtained during food ingestion were significantly higher for the two target populations (females with bulimic symptoms and restrained eaters) than baseline values, task values, and than values obtained for the control population during food ingestion.

***Biological reactivity during food ingestion***

Salivary cortisol values obtained post-food ingestion were similar to those obtained during the task phase, and significantly elevated over baseline values. This pattern was observed for each of the experimental conditions, and there were no significant group differences.

To summarise, perceptions of self-esteem were significantly elevated in both target populations and controls, when compared to perceptions immediately following exposure to stress. As in study 1, this suggests that the consumption of ice cream served to improve low levels of self-esteem induced by exposure to laboratory stress, for all participants. In terms of self-reported anxiety responses and physiological and biological reactivity during food ingestion, the two target populations differed from the control population in respect of only one variable (DBP). DBP values were found to be significantly higher in females with bulimic symptoms and restrained eaters than those of the control population. In addition, these raised DBP values occurred *only* during food ingestion, and were not in evidence during baseline or stress phase recordings.

***Information processing of ego threat***

A further aim of this study was to build on the finding in study 1 of this thesis that an information processing bias for self-directed ego threat existed for females with bulimic tendencies. The present study also includes a population of restrained eaters who *do not* display symptoms of bulimia. In accordance with the continuum model of eating pathology, it was predicted that in condition 1 responding to ego-self threat stimuli would become progressively *slower* with increasing symptom severity. It was also predicted that participants would be significantly slower to respond to stimuli contained in condition 2, given that this condition involved the additional task of memorizing stimuli for later recall. It was also anticipated that the addition of pre-test instructions for later word recall in condition 2 might serve to eliminate any bias in processing that may otherwise exist, given that participants in this condition were required to *strategically* process the words for meaning, as well as respond to the colour of the word.

This study also aimed to add clarity to the inconclusive findings obtained in study 1 of this thesis in relation to whether an explicit memory bias for self-directed ego-threat stimuli exists for target populations. Participants in the present study were asked to recall words contained within the Stroop task undertaken immediately upon completion of the Stroop task. Therefore, words recalled were accessed from short-term memory. For participants in condition 1, the free word recall task was *incidental*, for participants in condition 2, the free word recall task was *cued.*

Preliminary analyses revealed no significant group or condition differences in the percentage of response errors made by the three groups for threat and neutral stimuli contained within the four Stroop categories (ego-self threat, ego-other threat, and their respective matched neutral words), in the ego and ego recall Stroop task.

For the ego Stroop task, contrary to findings in study 1 of this thesis, analyses employing raw latency scores revealed that, for the HR/HB group, although response latencies for ego-self threat stimuli were higher (indicating a *slower* response) than ego-self neutral stimuli, this comparison failed to attain significance at the adjusted alpha level. However, in line with the findings of study 1 of this thesis, response times towards ego-self threat stimuli by this group were significantly higher than those of the control population. Although response times for ego-self threat for restrained eaters did lie between those of the HR/HB and LR/LB group, times for the HR/LB group were non significantly different from both the HR/HB and LR/LB group. Thus, for condition 1, only two significant comparisons were obtained when raw (median) values were analysed; restrained eaters were significantly slower to respond to self-directed ego-threat than neutral stimuli, and females with bulimic symptoms were significantly slower to respond to self-directed ego-threat stimuli than controls.

When interference scores for condition 1 were analysed, in relation to interference scores for the ego-self category, significant group differences occurred wherein interference scores for restrained eaters were significantly higher (indicating a *slowing* in responding) than those of females with bulimic tendencies and controls. Interference scores for females with bulimic symptoms were significantly higher than those of controls. Further, interference scores in relation to the ego-other category also revealed a greater *slowing* of responding by restrained eaters, compared to females with bulimic symptoms and controls. In addition interference scores for restrained eaters for the ego-self category were significantly higher than interference scores for the ego-other category. For females with bulimic symptoms and controls, there was no significant difference in interference scores for either threat category. However, a problem that complicates the interpretation of results based on interference scores is the fact that interference scores for restrained eaters in relation to the ego-self category were obtained as a consequence of very fast responses to ego-self neutral word stimuli, rather than a greater slowing of response in relation to ego-self threat stimuli. Therefore, results obtained in relation to interference scores should be interpreted with caution.

For the ego-recall Stroop task, utilizing raw latency scores, results revealed no significant group differences in times taken to colour-name stimuli contained within the four Stroop categories, within the three Stroop blocks, making up the Stroop task. In line with predictions, this suggests that the addition of a secondary task (cued and immediate free word recall) served to extinguish the information processing bias in relation to ego-self threat stimuli found for the ego Stroop task within this study and in study 1 of this thesis. For the ego-other category, interference times for restrained eaters were significantly greater than those of females with bulimic symptoms and the control group, with no significant difference between the latter two groups. Finally, also in line with predictions, analysis of raw response times for ego-self threat stimuli revealed that times for the ego recall Stroop task were significantly *slower* than those of the ego Stroop task.

***Memory bias for ego threat stimuli***

Results in relation to number of words correctly from each of the four stroop categories (ego-self threat, ego-other threat and their respective matched neutral words) recalled following condition 1 (Stroop task with incidental and immediate free word recall) and condition 2 (Stroop task with cued and immediate free word recall) revealed a significant condition by group interaction effect. When no pre-test instruction for later word recall were issued (condition 1) the two target populations recalled a similar number of words, and significantly more words than controls. In addition, the two target populations recalled a similar number of words following condition 1 and condition 2. When pre-test instructions for later word recall were issued (condition 2), each of the three populations recalled a similar number of words. The control population recalled significantly more words when they were informed that a memory task would follow (condition 2) than when they were not informed that a memory task would follow (condition 1). This might suggest that females with bulimic symptoms and restrained eaters processed the *meaning* of the stimuli contained within the Stroop task strategically, whether they were instructed to do so or not. It should also be noted that results in respect of number of words correctly recalled existed irrespective of Stroop category, suggesting that no specific bias exists for ego-self threat words for the two target populations.

***Relationship between mood and bingeing***

Next, correlation analyses were undertaken to examine the relationship between total food and water intake, measures of BMI, dietary restraint, bulimic symptoms, anxiety, physiological and biological reactivity, self-esteem and attention bias towards ego-self threat for the ego and ego recall Stroop tasks.

***Total food intake: Condition 1 (ego Stroop)***

Results revealed a significant, positive association between BMI, the three classification scales (RS_R, DEBQ, and BULIT-R), anxiety, ego-self threat raw latency values and total food intake. This suggests that a higher BMI, dietary restraint level, greater bulimic tendencies, higher self-reported anxiety levels, and slower responses to ego-self threat stimuli were associated with greater food intake. There was also a significant negative correlation between total ice cream intake and self-esteem, suggesting that lower perceptions of self-esteem following exposure to the ego Stroop task were associated with greater consumption of ice cream. Controlling for BMI, results of multiple regression analysis showed that, although the composite variable for the three classification scales (Comp-RB), anxiety and self-esteem ratings, and raw response times to ego-self threat stimuli resulted in significant ANOVA model (accounting for 30% of the variance when adjusted), only the Comp-RB variable and ego-self threat raw response latency values contributed independently and significantly to the prediction of total ice cream intake.

***Total water intake: Condition 1 (ego Stroop)***

There was a significant positive correlation between BMI, the three classification scales (RS_R, DEBQ, and BULIT-R), ego-self threat (raw values) and total water intake. This suggests that a higher BMI, restraint level, more bulimic symptoms and a slower reaction-time response to self-directed ego threat stimuli were associated with greater water intake. Controlling for BMI, results of multiple regression analysis showed that both the Comp-RB variable and ego-self threat (raw) response times were significant independent predictors of total water intake, accounting for 31% of the variance (adjusted). The overall ANOVA model was significant.

***Total food intake: Condition 2 (ego-recall Stroop)***

Results of correlation analyses for the ego recall Stroop task mirrored those of the ego Stroop task. However, controlling for BMI, results of multiple regression analysis showed that, although collectively the Comp-RB variable, anxiety, self-esteem and ego-self threat raw response latency values resulted in a significant overall ANOVA model, accounting for 39% of the variance (adjusted), the only significant independent predictor of total food intake was the Comp-RB variable.

***Total water intake: Condition 2 (ego-recall Stroop)***

Results of correlation analyses for the ego recall Stroop task mirrored those of the ego Stroop task. However, controlling for BMI, results of multiple regression analysis showed that, although collectively the Comp-RB variable and raw response latencies to ego-self threat words resulted in a significant overall ANOVA model, accounting for 13% of the variance (adjusted), the only significant independent predictor of total water intake was the Comp-RB variable.

To summarise, for the ego Stroop task two significant independent predictors of total food and water intake emerged: Comp-RB and raw latency scores (median response times) for self-directed ego threat stimuli. For the ego recall Stroop task, the only significant independent predictor for both food and water intake was the Comp-RB variable.

***Summary of study findings***

To summarise, in line with the findings of experiment 1 of this study, it was expected that condition 1 (high emotional loading, but low cognitive load) would induce greater intake in females with bulimic symptoms than controls. It was also expected that a similar pattern might be observed for restrained eaters, without bulimic symptoms. These predictions were supported. However, it was also predicted that condition 2 (high emotional loading and high cognitive load) would provoke greater intake than condition 1, given that it involved the strategic processing of ego-threat information. This prediction was not supported. The two tasks provoked very similar effects. Compared to baseline values, there was a significant increase in self-reported anxiety, HR, SBP and cortisol reactivity. Taken together, these results suggest that both tasks were efficient in provoking SNS reactivity, activating both the SAM and HPA axes, for all three populations. There was no significant group difference in reactivity. In response to stress, both target populations (females with bulimic symptoms and restrained eaters) consumed significantly more ice cream when compared to the control population. This finding existed irrespective of ice cream flavour. These findings are in line with prior research undertaken by the present author, where restrained responders (in terms of HR reactivity) to an active coping task (involving an aversive auditory stimulus and a monetary reward, dependent on performance) consumed significantly more food than unrestrained eaters who showed a similar stress response ($p<.001$) (Lattimore & Caswell, 2004).

Results of the present study suggest that females with bulimic symptoms and restrained eaters seem capable of overriding SNS reactivity that should suppress appetite/ingestive behaviour. As with study 1, consideration of results when analysed both categorically and dimensionally suggests that self-directed ego-threatening information (but not ego-threat from others) triggered a highly aversive emotional state from which females with bulimic symptoms *and* restrained eaters were motivated to escape (Heatherton & Baumeister, 1991). This is evidenced by the fact that, although alterations in mood, physiological and biological responding following stress were similar to changes seen in the control population, behaviourally the two target populations differed from the control population in that they overate in response to stress.

In the present study, the two tasks employed provoked very similar reactivity. Given that participants completed measures of perceived control, anxiety, self-esteem, and performed the taste-test after completing the unexpected word recall task in condition 1, this may have served to equate the two conditions in terms task difficulty. In other words, responses in respect of mood and food intake represented *both* completion of the Stroop task *and* the word recall task, for both conditions. Moreover, results obtained from the word recall task suggest that the two target populations were attending to the words within the Stroop task in terms of their meaning in condition 1, even when instructed to override the meaning of the word and respond as quickly and accurately as possible to the colour in which the word is printed. Therefore, it may be the case that for the two target populations, condition 1 and condition 2 involved the *strategic* processing of information contained within the Stroop task. This may explain similarities observed in terms of physiological and biological responding between the three groups and the two conditions. In study 1, participants were able to recall some of the words contained within the Stroop task undertaken 30 minutes after completing the task. This suggests that words were recalled from long-term memory, and therefore also consciously processed to some extent.

In study 1, no significant group or category difference was observed in respect of the number of words correctly recalled. In the present study, there were also no significant condition or category differences for the two target populations in respect of the number of words they correctly recalled. However, in both study 1 and in condition 1 of study 2, target populations exhibited a *slowing* in terms of responding in respect of self-directed ego threat stimuli, but not ego-threat from others. Taken together, this may intimate that target populations were demonstrating cognitive avoidance in terms of completing both the Stroop tasks, and the word recall tasks. In condition 2 of the present study, when target populations were issued with pre-task instructions to attend to the words within the task at the outset, there was no evidence of a slowing in responding in respect of self-directed ego threat words, and all participants demonstrated slower response times for condition 2 than condition 1. However, for both condition 1 and condition 2, raw (median) response times for self-directed ego threat stimuli were found to be positively and significantly related to measures of dietary restraint and to food intake.

In line with study 1 of this thesis, and in line with prior research (Lattimore, 2001; Lattimore & Maxwell, 2004; Patton, 1992; Waller & Mijatovich, 1998; Meyer & Waller, 1999; Wallis & Hetherington, 2004) it would appear that overeating can be triggered in response to threat unrelated to eating and, as in study 1, overeating in this instance served as a coping mechanism to deal with negative feelings once activated (Waller – submitted for publication – in Mountford et al., 2004). In addition, this study demonstrated that overeating by females with bulimic symptoms and restrained eaters takes place following the *strategic* processing of ego-threat information, when compared to a control population. Also in line with study 1, and with prior research, in condition 1, females with bulimic symptoms, and restrained eaters were *slower* to respond to self-directed ego-threat stimuli, but not ego-threat from others, when compared to a control population (Waller et al., 1996; Quinton, 1998).

In terms of post-ingestion cardiovascular (HR, SBP, and DBP) and cortisol reactivity, the two target populations demonstrated significantly higher heart rate, blood pressure and cortisol reactivity, compared to their baseline responding. This could indicate a sustained response to stress. Alternatively, it could relate to psychologically mediated sympathetic responses to the palatable food served, given that restrained eaters have been found to label foods such as ice cream as 'illegal' (King et al., 1997). However, with the exception of DBP reactivity, the control population exerted a similar response to that of the two target populations. It could be then that exaggerated responses observed during food ingestion are a consequence of the properties of the food itself. For example, both food composition and meal size can affect postprandial haemodynamics (e.g., Kearney, Cowley, & Macdonald, 1995).

# Chapter 9. A further psychophysiological investigation of the effects ego-threat stress with restrained eaters and females with bulimic symptoms.

## 9.1 Study overview

The present study involved a further psychophysiological comparison of experimental manipulations that vary in terms of emotional and cognitive loading. This experiment differs from that of study 2 in terms of type of design and task employed, the mode of presentation of ego-threat stimuli, and also in terms of food items served. A within subjects design was employed in order to minimize participant variation. Participants were required to complete a mental arithmetic task adapted from a method originally described by Ruddel, et al., (1988), that has been shown to provoke a significant rise in physiological and biological reactivity (e.g. Roy, 2004) (see Section 6.7.4 for details of MAT task). All participants first completed condition 1, the MAT, with no distraction tape. The order of conditions 2 and 3 was randomised. Both cognitive demand and emotional content were increased in condition 2 (over condition 1) with the addition of an audio distraction tape, containing ego-threat words. Cognitive load alone was increased in condition 3 (over condition 1) with the addition of an audio distraction tape containing neutral stimuli. Words contained within the two audio distraction tapes were taken from Waller et al. (1996), and were employed in the emotional Stroop task used in study 1 and 2 of this thesis. MAT conditions 2 and 3 were followed by a *cued* and *immediate* free word recall task, wherein participants were required to freely recall as many words as they could remember of the threat and neutral words contained within the audio distraction tape. The addition of pre-test instructions for later recall of words in condition 2 and 3 also ensured that words contained within the audio tapes were purposefully attended to and therefore conditions 2 and 3 involve the *strategic* processing of ego-threat (self-directed and ego-threat from others) and the matched neutral words that relate to each of the threat categories, contained within the audio tapes.

## 9.2 Single versus multiple test food items

As in experiment 1 and 2 of this thesis, the majority of laboratory studies that have reported an interaction between stress and dietary restraint in respect of the amount of food consumed have utilized a single test food, typically ice cream (see also Table 1). The food type in the present experiment was switched from a single item food (ice cream) to an abundant amount of snack food items for the following reasons:

Firstly, a review of the stress-eating literature reveals that the quantity of single food items served during the taste-test paradigm has varied considerably from 100g (Oliver et al., 2001) to 2700g (Polivy & Herman, 1989). Some researchers have provided only a 'description' of the amount served. For example Heatherton et al., (1998) specify that they presented three different flavours of ice cream in "very large bowls". Ruderman (1983) failed to specify the amount of ice cream served to participants at all. However, the largest cell mean reported in this study was 167.85 grams, but the standard deviation figure was omitted. Others have served up an amount of ice cream that *equals* the quantity given to participants in study 1 and study 2 of this thesis (300g) (e.g., Lattimore, 2001; Rotenberg et al., 2005).

However, inspection of the raw data derived from experiment 1 and 2 within this thesis revealed that although none of the participants consumed the entire 300 grams of ice cream served to them in study 1, eight participants in study 2 consumed the full amount of ice cream served (300 grams). Thus, the *quantity* of ice cream served to participants in study 2 was found to be insufficient, and could potentially have influenced the pattern of results obtained (see Chapter 8 – Discussion section).

Secondly, many stress-eating researchers have used a single item test food within the taste-test paradigm. For example, ice cream (Boone et al., 2002; Heatherton et al., 1991; 1993; 1998; Herman & Polivy, 1975, Herman et al., 1987; Rotenberg et al., 2005; Ruderman, 1983; Tanofsky-Kraff et al., 2000), crackers/biscuits (Abraham & Wunderlich, 1972; Baucom & Aiken, 1981; Bleu, 1996; Eldredge, 1993; McFarlane et al., 1998; Polivy & Herman, 1999; Rotenberg & Flood, 1999; Rutledge & Linden, 1998; Schachter et al., 1968; Urbszat et al., 2002), chocolate (Chua et al., 2004; Frost et al., 1982; Reznick & Balch, 1977; Slochower et al., 1981; Wallis & Hetherington, 2004), nuts (Pine, 1985; Slochower, 1976; Steere & Cooper, 1993), popcorn (Cools et al., 1992; Schotte et al., 1990; Sheppard-Sawyer et al., 2000), and yoghurt (Mitchell & Epstein, 1996). Some researchers have used two different food items, such as M&Ms and potato chips (Cavallo & Pinto, 2001) or M&Ms and peanuts (Strauss et al., 1994).

The use of a single or even a two-item test meal may limit our understanding of stress-induced eating because in the natural environment many food classes are accessible.

Only a limited number of laboratory studies have used three or more food items in order to examine stress-induced eating. When multiple food items have been served, these have been categorized in terms of palatability (McKenna, 1972; Polivy et al., 1994; Yeomans et al., 2004), whether they are sweet, salty, bland, or savoury (Epel et al., 2001; Grunberg & Straub, 1992; Haynes et al., 2003; Lattimore & Caswell, 2004; Mitchell & Perkins, 1998; Oliver et al., 2000; 2001), or whether they are forbidden versus permitted foods, or high or low in fat content (Bleu, 1996; Epel et al., 2001; Oliver et al., 2000; Shapiro & Anderson, 2005). Some researchers have presented results in terms of macronutrient intake, such as carbohydrates, proteins (and fats) (Levine & Marcus, 1997; McCann et al., 1990; Pollard et al., 1995; Roemmich et al., 2002), and some researchers have served multiple foods that could be subsumed within one or more of the above mentioned categories, but have reported only *total* intake (e.g. Lattimore & Caswell, 2004; Lattimore & Maxwell, 2004; Tice, Bratslavsky, & Baumeister, 2001; Ward & Mann, 2000).

Previous research has documented a hyperphagic effect when dietary variety is provided (see Raynor & Epstein, 2001 for review). However, within the laboratory, some stress-eating researchers have found no effect for restraint status when multiple food items have been presented (e.g., Tice et al., 2001), whereas others *have* found an effect. For example, Ward & Mann (2000) used a variety of foods and found differences in the amount of consumption between restrained and non-restrained eaters; however all of the foods served were high in fat and sugar. Lattimore & Caswell (2004) found that the total intake of sweet, salty, and bland snack food items was significantly greater for restrained eaters following exposure to an active than passive coping task, and significantly greater than unrestrained eaters following the active coping task (see also Section 4.4.9). However, no results were reported for intake in terms of food class or macronutrients in this study.

Epel et al. (2001) invited their participants to eat foods that were classified as high fat sweet and salty and low fat sweet and salty. Results showed that, after controlling for dietary status, bulimic status and

BMI, high cortisol reactors [to stress] were found to have consumed more calories than low reactors. They also consumed significantly more sweet food across test days. Dieting was not related to consumption following stress, but was significantly related to lower consumption after resting on the control day. These correlations were unchanged when controlling for BMI. However, in this study dietary restraint, bulimic symptoms and oral control measures were obtained from the EAT: Garner et al., 1982). Data from seven women who scored >20 were removed, leaving a participant sample of females who were essentially unrestrained eaters, according to their [low] scores on the EAT (see also Section 4.4.6). Therefore, further studies employing females who are high in terms of both dietary restraint and bulimic symptoms are warranted.

Grunberg & Straub (1992) found no significant effect for overall intake in women, but a significant increase for sweet and bland food items following exposure to stress, compared to women in the no-stress condition. However, dietary restraint status was not assessed at all in this study. Lattimore & Maxwell (2004) found that restrained eaters consumed more snack food (crisps, chocolate and dried fruit) following exposure to a high cognitive load task that contained ego-threat stress than a high cognitive load task that did not contain ego-threat stress, and significantly more than unrestrained eaters in the high cognitive load plus ego threat stress condition.

Haynes et al., (2003) found no effect of stress on total energy intake when participants were classified in terms of restraint status alone, but there was evidence of effects of stress when participants were classified in terms of both restraint and disinhibition according to the TFEQ-R and TFEQ-D. The HR-HD group had the largest difference [increase] in intake between stress and no-stress conditions. In addition, both high disinhibition groups (LR-HD and HR-HD) consumed more sweet food in the conditions in which they increased food intake (i.e. the no stress and stress conditions, respectively).

Other researchers have also found a restraint x stress effect for only *one* of the food classes presented. For example, a study by Mitchell & Perkins (1998) revealed a significant main effect of restraint for intake of salty food items only, with restrained individuals consuming significantly more than non-restrained eaters. No significant main or interaction effects were found for sweet or high-fat food groups. In a very recent study, Shapiro & Anderson (2005) tested whether the restraint x disinhibition interaction was still evident when multiple foods were offered, and if so, the food choices that restrained and non-restrained eaters make when under stress. Female students (N=153) were randomly assigned to either a stress condition (unsolvable anagrams) or no stress condition, where they were required to read a short story and to circle any letter "e's" they could find. Several foods (i.e., M&M candies and Oreo cookies, grapes, potato chips, pretzels and baby carrots) were served. These foods were chosen to encompass a variety of food categories (i.e., high fat/high sugar; low fat/high sugar; high fat/low sugar; low fat/low sugar, respectively). Participants were required to taste and rate each of the food items. Results showed no significant difference in total food intake between restrained and non-restrained eaters. However, further analyses found that restrained eaters under stress consumed more potato chips (highly palatable, energy dense food) than those who were not under stress.

Outside of the laboratory, several naturalistic studies, examining real life stressors, have failed to find an interaction between restraint and amount of food consumed (Ball et al., 1999; Conner et al., 1999), whereas others *have* found an effect. For example, Wardle et al (2000) found that department store workers consumed more sweet and fatty foods in the high work stress period, particularly for those who perceived more stress. A study by Roemmich et al. (2002) revealed that a group of children, classified as both high restraint and high reactors to stress, consumed more total energy (grams) and more grams of protein and carbohydrates than comparison groups.

Only two laboratory studies of stress-induced eating behaviour have been conducted with non-clinical females possessing 'significant bulimic symptoms', where food intake has been measured. Levine & Marcus (1997) also used several food classes and found that symptomatic females did *not* increase their overall intake following interpersonal stress, compared to controls, although both bulimic and control women increased their consumption of carbohydrates significantly following the stressor. (see also Section 2.7.8). Conversely, Lattimore (2001) reported a significant intake in dieters who self-reported binge eating tendencies (BULIT-R; Smith & Thelan, 1984), when compared to controls, when only a single food item was used (ice cream).

The results of experiment 1 and 2 of this thesis are in line with the findings of Lattimore (2001) in that they show that non-clinical females with bulimic tendencies overeat in response to stress, relative to controls, when a *single food item* is presented. Experiment 3 therefore examined the effects of stress in females with bulimic symptoms (and restrained eaters) using multiple food options that were classified as sweet, salty and bland.

Two additional aims of the present study was to assess arousal responses to post-stress food ingestion, and to assess habituation/temporal responding, when [ego-threatening] stimuli are presented over several matrices.

## 9.3 Method

### 9.3.1 Participants

Seventy prospective participants were initially recruited. Two participants did not meet the requirements of the screening process and therefore did not take part in the study (see Section 4.2). Data from fourteen participants who failed to complete all three conditions were not subjected to analyses. Individual differences were assessed using the classification shown in Table 54. Data obtained from individuals who did not conform to classification criteria was omitted from statistical analyses (N=2). Both of the omitted individuals had low scores on both the RS-R and DEBQ, but high scores on the BULIT-R (unrestrained eaters *with* bulimic tendencies). As far as possible, time of testing for each of the three experimental conditions was separated by 1 week, with time of day held constant.

**Table 54. Participant classification information and ethnicity details**

| Instrument | | | Classification | Currently dieting to lose/maintain weight | N |
|---|---|---|---|---|---|
| RS_R median split | DEBQ median split | BULIT_R | | | |
| >14 | >2.7 | >80 | High restraint/high bulimic (HR/HB) | 87.5% (n=14) | 16 |
| >14 | >2.7 | ≤80 | High restraint/low bulimic (HR/LB) | 66.7% (n=8) | 12 |
| ≤14 | ≤2.7 | ≤80 | Low restraint/low bulimic (LR/LB) | 8.3% (n=2) | 24 |

| Ethnicity | HR/HB (N) | HR/LB (N) | LR/LB (N) |
|---|---|---|---|
| English/British | 14 | 10 | 24 |
| English/Scottish | 1 | 0 | 0 |
| English/Irish | 1 | 0 | 0 |
| Asian/British | 0 | 1 | 0 |
| Chinese/British | 0 | 1 | 0 |

**9.3.2 Oral contraceptive use. A Chi-square test revealed no significant group differences.**

**9.3.3 Design, Materials, and Procedure** (See Chapter 5 and Figure 6).

## 9.4 Results

### 9.4.1 Preliminary Analysis

Inspection of a series of one-way ANOVA (Table 55) reveals that groups were well matched in terms of age and BMI[14]. Groups differed significantly in terms of the three classification instruments (see Table 56 for Tukey's HSD post hoc tests.). For all three scales, the HR/HB group had significantly higher ratings than both the HR/LB group and the LR/LB group, and the HR/LB group had significantly higher ratings than the LR.LB group.

[14] BMI: 15-19 = underweight; 20-25 = normal weight; 26-30 = overweight; 30+ = obese

**Table 55. Participant characteristics: age, BMI, restraint and bulimic status (Means (SD) and significance value).**

| | | HR/HB (n=16) | HR/LB (n=12) | LR/LB (n=24) | p |
|---|---|---|---|---|---|
| **Age (yr)** | **Mean** | **21.00** | **19.42** | **22.25** | **NS** |
| | *SD* | *4.35* | *1.24* | *6.61* | |
| **BMI** | **Mean** | **24.59** | **23.67** | **23.99** | **NS** |
| | *SD* | *3.63* | *2.87* | *3.39* | |
| **RS-R** | **Mean** | **24.62** | **17.58** | **8.42** | **<0.001** |
| | *SD* | *5.15* | *7.05* | *3.26* | |
| **DEBQ** | **Mean** | **4.56** | **2.78** | **1.68** | **<0.001** |
| | *SD* | *.49* | *.89* | *.57* | |
| **BULIT-R** | **Mean** | **103.81** | **62.75** | **49.04** | **<0.001** |
| | *SD* | *22.30* | *14.16* | *9.98* | |

**Table 56. Tukey HSD post hoc tests: classification instruments.**

| Classification Scale | Groups | Mean difference | *p* |
|---|---|---|---|
| **RS-R** | HR/HB vs HR/LB | 7.04 | <0.001 |
| | HR/HB vs LR/LB | 16.21 | <0.001 |
| | HR/LB vs LR/LB | 9.17 | <0.001 |
| **DEBQ** | HR/HB vs HR/LB | 1.77 | <0.001 |
| | HR/HB vs LR/LB | 2.87 | <0.001 |
| | HR/LB vs LR/LB | 1.10 | <0.001 |
| **BULIT-R** | HR/HB vs HR/LB | 41.06 | <0.001 |
| | HR/HB vs LR/LB | 57.77 | <0.001 |
| | HR/LB vs LR/LB | 13.71 | <0.05 |

**9.4.2 Perceived control over task.** A 3 (Condition: MAT: no tape, ego tape, neutral tape) X 3 (Group: HR/HB, HR/LB, LR/LB) univariate ANOVA revealed no significant main or interaction effects. Table 57 shows Mean (SD) ratings of perceived control over each experimental task made by HR/HB, HR/LB, and LR/LB females.

**Table 57. Mean (SD) ratings of perceived control over each experimental task made by HR/HB, HR/LB, and LR/LB females.**

| | | No tape | Ego tape | Neutral tape | Mean total |
|---|---|---|---|---|---|
| HR/HB | Mean | **4.56** | **3.38** | **4.13** | **4.02** |
| | *SD* | *1.74* | *1.59* | *1.70* | *1.69* |
| HR/LB | Mean | **3.83** | **3.67** | **3.50** | **3.67** |
| | *SD* | *1.40* | *1.50* | *1.78* | *1.56* |
| LR/LB | Mean | **3.00** | **4.46** | **4.04** | **3.83** |
| | *SD* | *1.38* | *1.79* | *1.71* | *1.63* |
| Column | Mean | **3.67** | **3.94** | **3.94** | |
| | *SD* | *1.62* | *1.71* | *1.72* | |

### 9.4.3 MAT Performance

Table 58 shows Mean (SD) average (of M2, M3, and M4) MAT performance by the three groups for the three experimental conditions.

**Table 58. Mean (SD) average (of M2, M3, and M4) MAT performance by the HR/HB, HR/LB, and LR/LB groups during the MAT: no, ego, and neutral tape conditions.**

| | | No tape | Ego tape | Neutral tape | Mean total |
|---|---|---|---|---|---|
| HR/HB | Mean | **2.35** | **1.98** | **2.04** | **2.12** |
| | *SD* | *.58* | *.63* | *.82* | *.68* |
| HR/LB | Mean | **2.39** | **1.33** | **2.00** | **1.91** |
| | *SD* | *.85* | *.99* | *.25* | *.70* |
| LR/LB | Mean | **2.34** | **1.26** | **1.95** | **1.85** |
| | *SD* | *.59* | *.51* | *.49* | *.53* |
| Column | Mean | **2.36** | **1.50** | **1.99** | |
| | *SD* | *.64* | *.74* | *.57* | |

A 3 (Condition: MAT: no tape, ego tape, neutral tape) x 3 (Group: HR/HB, HR/LB. LR/LB) repeated measures ANOVA assessing performance (average for M2, M3, and M4) revealed a significant main effect of condition, $F(1.76,86.21) = 19.43$, $p<0.001$, Eta2 = .284. There was no other significant main or interaction effect. Simple contrasts revealed that performance in condition 1 (no tape) was significantly increased over both condition 2 (ego tape) ($p<0.001$) and condition 3 (neutral tape)($p<0.001$). Performance in condition 3 was also significantly increased over performance in condition 2 ($p<0.001$).

In summary, MAT performance in both high cognitive load conditions (condition 2 and 3) was significantly decreased over the low cognitive load condition (condition 1). However, MAT performance during the ego tape condition (high load) was also significantly decreased over the neutral tape condition (high load).

### 9.4.4 Ratings of Mood

### 9.4.5 Anxiety: STAI

Table 59 displays Means (SD) for self-reported anxiety ratings for the HR/HB, HR/LB and LR/LB groups for the baseline (B), task (TA), and recovery (R) phase, for the three experimental conditions; mental arithmetic task (MAT) with no tape (Condition 1), ego tape (Condition 2) and neutral tape (Condition 3).

**Table 59.** **Means (SD) for self-reported anxiety ratings (STAI) for the HR/HB, HR/LB and LR/LB groups for the baseline (B), task (TA), and recovery (R) phase, for condition 1 (MAT: no tape), condition 2 (MAT: ego tape), and condition 3 (MAT: neutral tape).**

| | | Baseline | | | | Task | | | | Recovery | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **No tape** | **Ego tape** | **Neutral tape** | **Baseline phase mean total** | **No tape** | **Ego tape** | **Neutral tape** | **Task phase mean total** | **No tape** | **Ego tape** | **Neutral tape** | **Recovery phase mean total** |
| **HR/HB** | Mean | **29.06** | **27.81** | **30.56** | **29.14** | **48.38** | **55.75** | **49.81** | **51.31** | **34.50** | **36.50** | **35.88** | **35.63** |
| | *SD* | *5.25* | *6.69* | *6.98* | *6.31* | *8.06* | *7.27* | *6.57* | *7.30* | *8.21* | *8.94* | *9.81* | *8.99* |
| **HR/LB** | Mean | **25.57** | **27.00** | **26.08** | **26.22** | **43.75** | **45.25** | **40.58** | **43.19** | **26.92** | **28.00** | **29.42** | **28.11** |
| | *SD* | *4.52* | *5.85* | *5.45* | *5.30* | *11.44* | *11.58* | *10.78* | *11.27* | *5.92* | *6.09* | *8.64* | *6.88* |
| **LR/LB** | Mean | **26.67** | **26.96** | **28.54** | **27.39** | **40.92** | **44.79** | **40.75** | **42.15** | **28.92** | **30.58** | **31.08** | **30.19** |
| | *SD* | *4.63* | *5.00* | *5.46* | *5.03* | *8.55* | *11.81* | *11.92* | *10.76* | *5.79* | *6.16* | *10.22* | *7.39* |
| **Column** | Mean | **27.17** | **27.23** | **28.60** | | **43.87** | **48.27** | **43.50** | | **31.17** | **31.81** | **32.17** | |
| | *SD* | *4.89* | *5.65* | *6.07* | | *9.52* | *11.52* | *10.95* | | *7.18* | *7.73* | *9.91* | |

A 3 (Conditon: MAT, no tape, ego tape, neutral tape) x 3 (Group: HR/HB, HR/LB, LR/LB) repeated measures ANOVA examining baseline anxiety ratings revealed no significant main effect of conditon or group, and no significant condition x group interaction effect.

A 3 (Condition: MAT, no tape, ego tape, neutral tape) x 3 (Phase (B, TA, R) x 3 (Group: HR/HB, HR/LB, LR/LB) repeated measures ANOVA with condition and phase as the within subjects factors and group as the between subjects factor revealed a significant main effect of condition $F(2,98) = 3.42$, $p<0.05$, Eta2 = .065, phase, $F(1.74,85.18) = 147.63$, $p<0.001$, Eta2 = .751, and group, $F(2,49) = 7.94$, $p<0.001$, Eta2 = .245, and a significant condition x phase, $F(3.10,151.86) = 4.61$, $p<0.005$, Eta2 = .086, and phase x group, $F(3.48, 85.18) = 3.49$, $p<0.05$, Eta2 = .092 interaction effect, There were no other significant interaction effects.

Figure 23 shows the two-way interaction between condition and phase on the measure of self-reported anxiety. Figure 24 shows two-way interaction between phase and group on the measure of self-reported anxiety. Table 60 shows follow-up tests for the measure of self-reported anxiety.

**Figure 23. Mean anxiety (STAI) ratings for the three experimental conditions (MAT: no tape, ego tape and neutral tape) following the three experimental phases (B, TA, and R).**

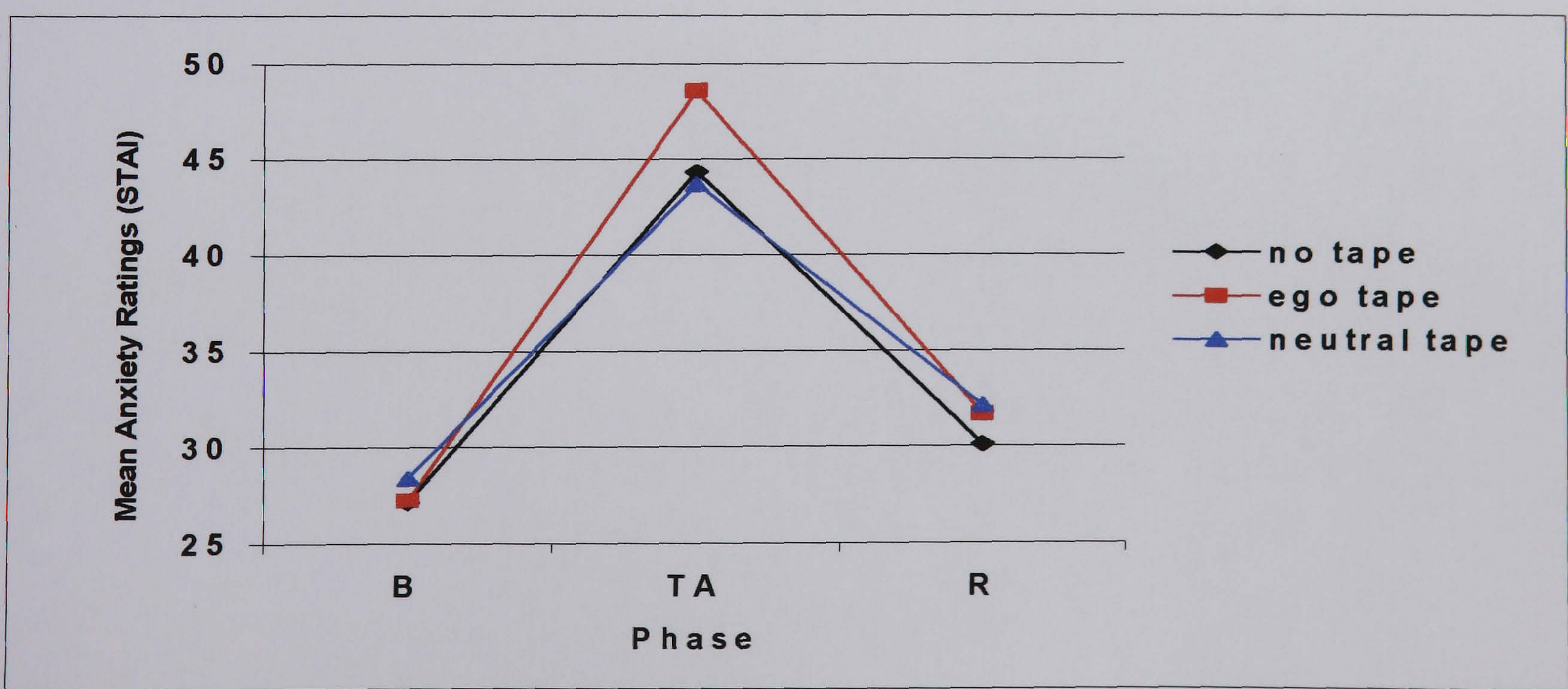


**Figure 24. Mean anxiety (STAI) ratings for the three groups (HR/HB, HR/LB and LR/LB) following the three experimental phases (B, TA, and R).**

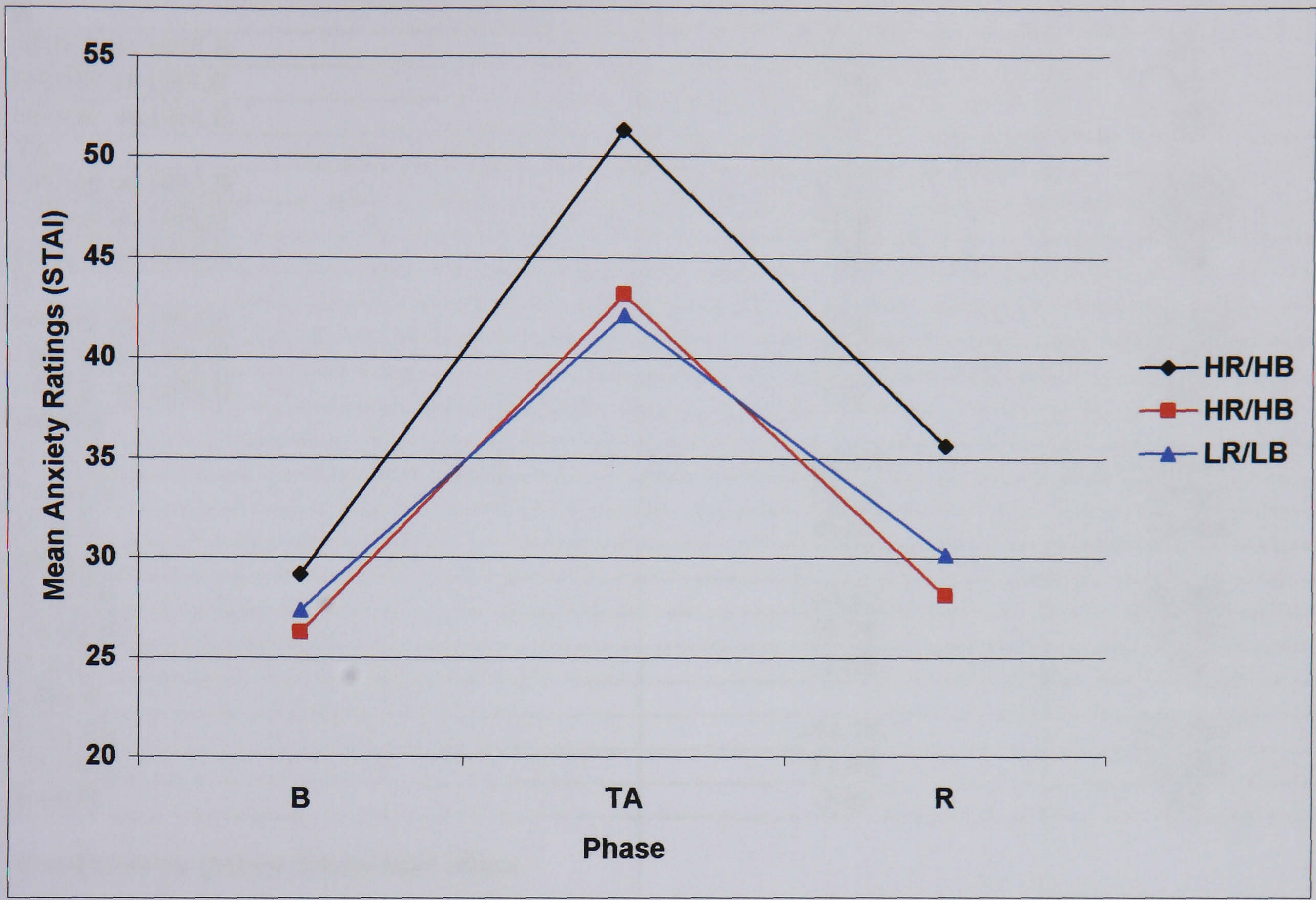


**Table 60. Follow-up tests: STAI**

| Phase x group interaction effect | Mean difference | *p* |
|---|---|---|
| **B** | | |
| HR/HB vs HR/LB | 2.92 | NS |
| HR/HB vs LR/LB | 1.75 | NS |
| HR/LB vs LR/LB | -1.17 | NS |
| **TA** | | |
| HR/HB vs HR/LB | 8.12 | <0.005 |
| HR/HB vs LR/LB | -19.41 | <0.005 |
| HR/LB vs LR/LB | 1.04 | NS |
| **R** | | |
| HR/HB vs HR/LB | 7.52 | <0.005 |
| HR/HB vs LR/LB | 5.44 | <0.005 |
| HR/LB vs LR/LB | -2.08 | NS |
| **HR/HB** | | |
| B vs TA | -22.17 | <0.001 |
| TA vs R | 15.68 | <0.001 |
| B vs R | -6.49 | <0.005 |
| **HR/LB** | | |
| B vs TA | -16.97 | <0.001 |
| TA vs R | 15.08 | <0.001 |
| B vs R | -1.89 | NS |
| **LR/LB** | | |
| B vs TA | -14.76 | <0.001 |
| TA vs R | 11.96 | <0.001 |
| B vs R | -2.80 | NS |
| **Condition by phase interaction effect** | | |
| **No tape** | | |
| B vs TA | -16.70 | <0.001 |
| TA vs R | 12.70 | <0.001 |
| R vs B | 4.00 | =0.01 (NS) |
| **Ego tape** | | |
| B vs TA | -21.04 | <0.001 |
| TA vs R | 16.46 | <0.001 |
| R vs B | 4.58 | =0.01 (NS) |
| **Neutral tape** | | |
| B vs TA | -14.90 | <0.001 |
| TA vs R | 11.33 | <0.001 |
| R vs B | 3.57 | =0.01 (NS) |
| **B** | | |
| No tape vs ego tape | -.06 | NS |
| No tape vs neutral tape | -1.43 | NS |
| Ego tape vs neutral tape | -1.37 | NS |
| **TA** | | |
| No tape vs ego tape | -4.40 | <0.005 |
| No tape vs neutral tape | .37 | NS |
| Ego tape vs neutral tape | 4.77 | <0.005 |
| **R** | | |
| No tape vs ego tape | -.64 | NS |
| No tape vs neutral tape | -1.00 | NS |
| Ego tape vs neutral tape | -.36 | NS |

In summary, for all three groups there was a significant increase in self-reported anxiety ratings from baseline to task, and a significant decrease in anxiety ratings from task to recovery. For the HR/LB and LR/LB groups anxiety ratings had returned to baseline values at the end of the recovery phase. However anxiety ratings for the HR/HB group were still significantly elevated over baseline values at the end of the recovery phase (following food ingestion). The HR/HB group reported significantly higher ratings of anxiety than both the HR/LB and LR/LB group at the end of both the task and recovery phase.

The following patterning was observed for each experimental condition (MAT: no tape, ego tape and neutral tape): there was a significant increase in anxiety ratings from baseline to task, and a significant decrease from task to recovery. Although recovery values were still elevated over baseline values, these comparisons did not attain significance according to the adjusted alpha level. There was no significant difference between the three experimental conditions at the baseline and recovery phase. However, anxiety ratings following completion of condition 2 (MAT: ego tape) were significantly elevated over those of condition 1 (MAT: no tape) and condition 3 (MAT: neutral tape).

### 9.4.6 Self-Esteem: SSES

Table 61 displays Means (SD) for self-reported self-esteem ratings for the HR/HB, HR/LB and LR/LB groups for the baseline (B), task (TA), and recovery (R) phase, for condition 1 (MAT: no tape), condition 2 (MAT: ego tape), and condition 3 (MAT: neutral tape).

A 3 (Condition: MAT, no tape, ego tape, neutral tape) x 3 (Group: HR/HB, HR/LB, LR/LB) repeated measures ANOVA examining baseline self-esteem ratings revealed no significant main effect of condition or group, and no significant condition x group interaction effect. A 3 (Condition: MAT, no tape, ego tape, neutral tape) x 3 (Phase (B, TA, R) x 3 (Group: HR/HB, HR/LB, LR/LB) repeated measures ANOVA with condition and phase as the within subjects factors and group as

the between subjects factor revealed a significant main effect of phase, $F(2,48) = 57.02$, $p<0.001$, Eta2 = .538, and group, $F(4.98) = 7.96$, $p<0.001$, Eta2 = .245. There was also a significant phase x group interaction effect, $F(2,49) = 10.13$, $p<0.001$, Eta2 = .293. There were no other significant main or interaction effects. Figure 25 shows the two-way interaction between phase and group on the measure of self-esteem. Table 62 shows follow-up tests for self-reported self-esteem.

**Table 61. Means (SD) for self-reported self-esteem (SSES) ratings for the HR/HB, HR/LB and LR/LB groups for the baseline (B), task (TA), and recovery (R) phase, for the three experimental conditions; mental arithmetic task (MAT) with no tape (Condition 1), ego tape (Condition 2) and neutral tape (Condition 3).**

| | | Baseline | | | | Task | | | | Recovery | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No tape | Ego tape | Neutral tape | Baseline phase mean total | No tape | Ego tape | Neutral tape | Task phase mean total | No tape | Ego tape | Neutral tape | Recovery phase mean total |
| **HR/HB** | Mean | **68.13** | **76.31** | **68.31** | **70.92** | **53.37** | **61.06** | **53.06** | **55.83** | **61.75** | **58.50** | **60.44** | **60.23** |
| | *SD* | *9.51* | *8.26* | *10.82* | *9.53* | *9.42* | *11.90* | *6.33* | *9.22* | *9.86* | *9.47* | *10.58* | *9.97* |
| **HR/LB** | Mean | **70.50** | **73.00** | **72.83** | **72.11** | **60.75** | **64.92** | **62.83** | **62.83** | **71.58** | **73.33** | **70.83** | **71.91** |
| | *SD* | *11.08* | *11.41* | *14.52* | *12.34* | *10.34* | *12.75* | *16.03* | *13.04* | *11.96* | *10.68* | *13.76* | *12.13* |
| **LR/LB** | Mean | **76.96** | **77.33** | **75.50** | **76.60** | **68.83** | **70.17** | **71.92** | **70.31** | **76.83** | **76.33** | **76.88** | **76.68** |
| | *SD* | *8.75* | *8.46* | *12.91* | *10.04* | *11.71* | *11.17* | *13.29* | | *7.83* | *8.35* | *11.40* | *9.19* |
| **Column** | Mean | **72.75** | **76.02** | **72.67** | | **62.21** | **66.15** | **64.02** | | **70.98** | **70.15** | **70.42** | |
| | *SD* | *10.19* | *9.13* | *12.84* | | *12.51* | *12.21* | *14.63* | | *11.40* | *12.06* | *13.54* | |

Figure 25. Mean self-esteem ratings for the HR/HB, HR/LB and LR/LB group following the three experimental phases (B, TA, R)(a lower score indicates lower self-esteem).

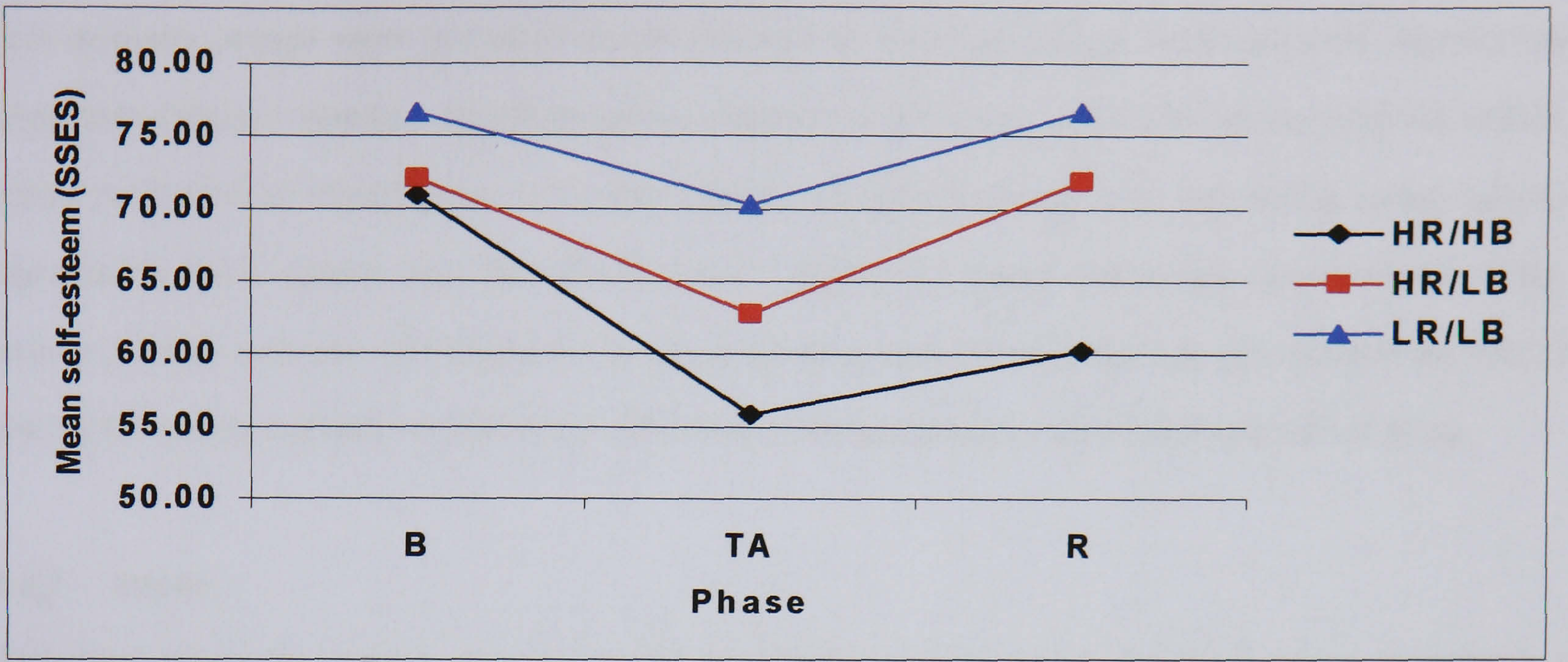



Table 62. Follow-up tests: SSES

| Group by phase interaction effect | Mean difference | *p* |
|---|---|---|
| **HR/HB** | | |
| B vs TA | 15.07 | <0.001 |
| TA vs R | -4.40 | NS |
| B vs R | 10.69 | <0.001 |
| **HR/LB** | | |
| B vs TA | 9.28 | <0.001 |
| TA vs R | -9.09 | <0.001 |
| B vs R | .19 | NS |
| **LR/LB** | | |
| B vs TA | 6.29 | <0.001 |
| TA vs R | -6.37 | <0.001 |
| B vs R | -.08 | NS |
| **B** | | |
| HR/HB vs HR/LB | -1.19 | NS |
| HR/HB vs LR/LB | -5.68 | NS |
| HR/LB vs LR/LB | -4.49 | NS |
| **TA** | | |
| HR/HB vs HR/LB | -7.00 | <0.001 |
| HR/HB vs LR/LB | -14.48 | <0.001 |
| HR/LB vs LR/LB | -7.48 | <0.001 |
| **R** | | |
| HR/HB vs HR/LB | -11.68 | <0.001 |
| HR/HB vs LR/LB | -16.45 | <0.001 |
| HR/LB vs LR/LB | -4.77 | NS |

In summary, irrespective of experimental condition undertaken, for all three groups there was a significant lowering of self-esteem ratings from baseline to task. For both the HR/LB and LR/LB females, post-recovery ratings had returned to a level similar to baseline values. However, for the HR/HB group, post-recovery ratings were non-significantly different to post-task ratings, and remained significantly lower than baseline ratings. Significant group differences occurred at the task phase, with the HR/HB group having lower ratings than both the HR/LB and LR/LB group, and the HR/LB group having significantly lower ratings than the LR/LB group. Significant group differences also occurred at the recovery phase, with the HR/HB group having significantly lower self-esteem ratings than both the HR/LB and LR/LB group, but with no significant difference in ratings between the HR/LB and LR/LB group.

### 9.4.7 Intake.

Repeated measures ANOVA, testing for pre-test differences in hunger and thirst ratings revealed no significant main or interaction effects. Analysis of food liking ratings revealed a significant main effect of type of food (peanuts, crisps, chocolate, crackers), $F(2.59,127.05) = 11.91$, $p<0.001$, $Eta^2 = .162$. There was no significant main effect of group and no significant food type X group interaction effect.

Food liking ratings for chocolate and crisps were significantly higher than for peanuts and crackers ($p$'s<0.01). There was no significant difference in food liking ratings between chocolate and crisps, and between peanuts and crackers ($p$'s >0.1).

#### 9.4.7.1 Total Food Intake

A 3 (Condition: MAT: no tape, ego tape, neutral tape) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition as the within subjects factor and group as the between subjects factor revealed a significant main effect of condition, $F(2,98) = 16.31$, $p<0.001$, $Eta^2 = .250$, and group, $F(2,49) = 87.86$, $p<0.001$, $Eta^2 = .782$, as well as a significant condition x group interaction effect, $F(2,98) = 2.87$, $p<0.05$, $Eta^2 = .105$. Figure 26 shows Mean food consumed by the HR/HB, HR/LB and LR/LB groups in the three conditions (MAT: no tape, ego tape, and neutral tape). Table 63 shows follow-up tests for the measure of total snack food intake.

Figure 26. Mean food consumed by the HR/HB, HR/LB and LR/LB groups in the three conditions (MAT: no tape, ego tape, neutral tape).

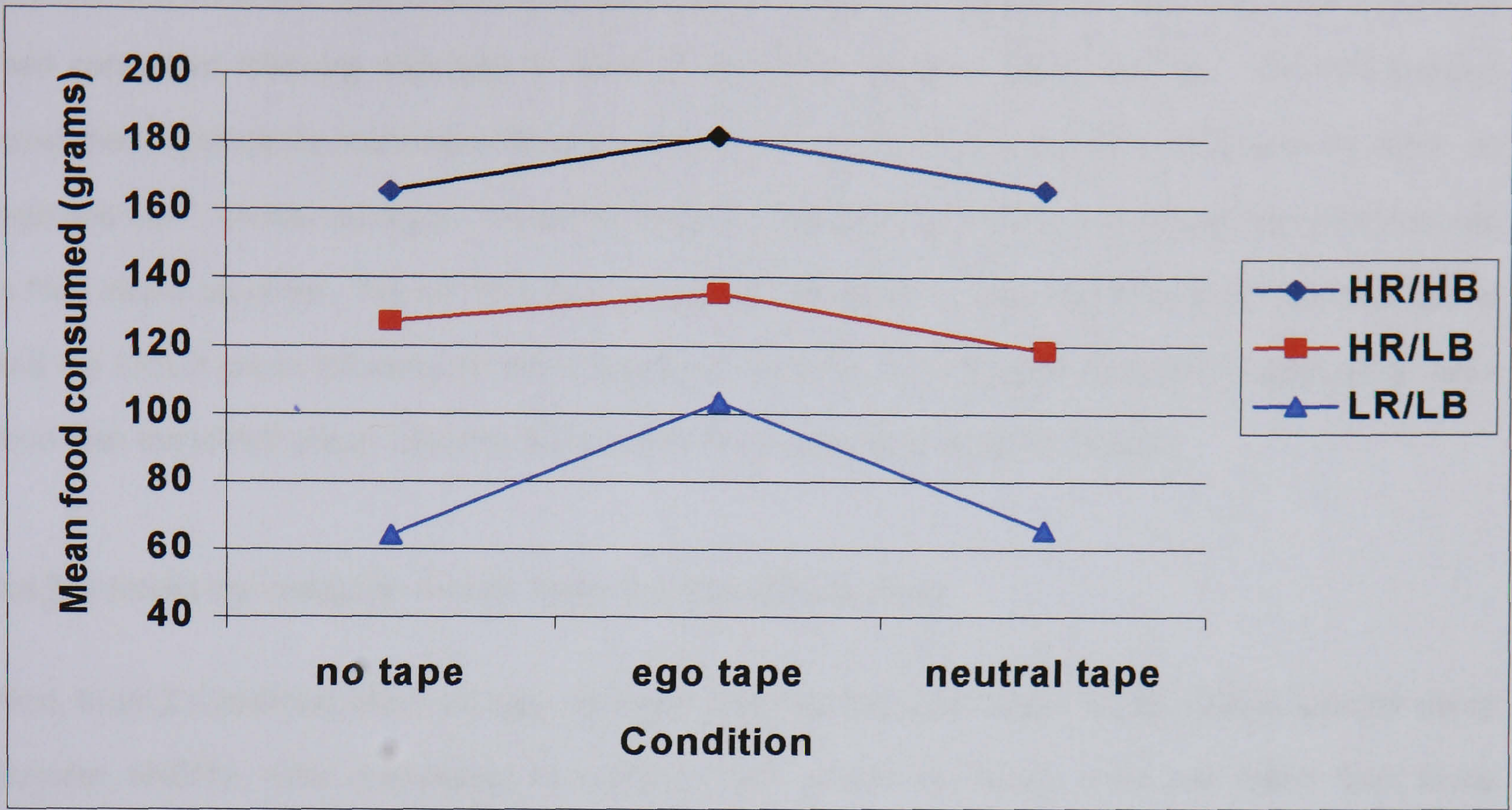



Table 63. Follow-up tests: Total snack food intake

| | Mean difference | *p* |
|---|---|---|
| **No tape** | | |
| HR/HB vs HR/LB | 38.06 | <0.001 |
| HR/HB vs LR/LB | 100.98 | <0.001 |
| HR/LB vs LR/LB | 62.92 | <0.001 |
| **Ego tape** | | |
| HR/HB vs HR/LB | 45.67 | <0.001 |
| HR/HB vs LR/LB | 77.33 | <0.001 |
| HR/LB vs LR/LB | 31.67 | <0.001 |
| **Neutral tape** | | |
| HR/HB vs HR/LB | 45.67 | <0.001 |
| HR/HB vs LR/LB | 99.75 | <0.001 |
| HR/LB vs LR/LB | 52.83 | <0.001 |
| **HR/HB** | | |
| No tape vs ego tape | -15.69 | NS |
| No tape vs neutral tape | -.19 | NS |
| Ego tape vs neutral tape | 15.50 | NS |
| **HR/LB** | | |
| No tape vs ego tape | -8.08 | NS |
| No tape vs neutral tape | 8.67 | NS |
| Ego tape vs neutral tape | 16.75 | NS |
| **LR/LB** | | |
| No tape vs ego tape | 60.66 | <0.001 |
| No tape vs neutral tape | -1.42 | NS |
| Ego tape vs neutral tape | 37.92 | <0.001 |

In summary, there were no significant group or condition differences in ratings of hunger and thirst at the outset of the experiment. Participants did report a significant preference for chocolate and crisps over peanuts and crackers. The HR/HB and HR/LB group showed no significant difference in the amount of food consumed following exposure to each of the three experimental conditions. The LR/LB group consumed significantly more food following exposure to the MAT: ego condition than both the MAT: no tape and MAT: neutral condition. However, for each experimental condition significant group differences in food intake occurred. The HR/HB group consumed significantly more food than both the HR/LB group and the LR/LB group following all three conditions, and the HR/LB group consumed significantly more food than the LR/LB group following exposure to all three experimental conditions.

#### 9.4.7.2 Intake by category: Sweet, Salty and Bland food items

Next, three 3 (Condition: MAT: no tape, ego tape, netural tape) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA were undertaken to examine total amount of sweet, salty and bland food items consumed by the three groups following the three experimental conditions.

#### 9.4.7.3 Sweet Food Items

There was a significant main effect of condition, $F(1.69,82.54) = 30.29$, $p<0.001$, $Eta^2 = .382$, and group, $F(2,49) = 31.08$, $p<0.001$, $Eta^2 = .559$. There was also a significant condition x group interaction effect, $F(3.37,82.54) = 8.58$, $p<0.001$, $Eta^2 = .259$. Figure 27 shows two-way interaction between condition and group on the measure of sweet food item consumption. Table 63 shows follow-up tests for total amount of sweet food items consumed.

**Figure 27. Mean amount of sweet food items consumed by the HR/HB, HR/LB and LR/LB groups following the three conditions (MAT: no tape, ego tape and neutral tape).**

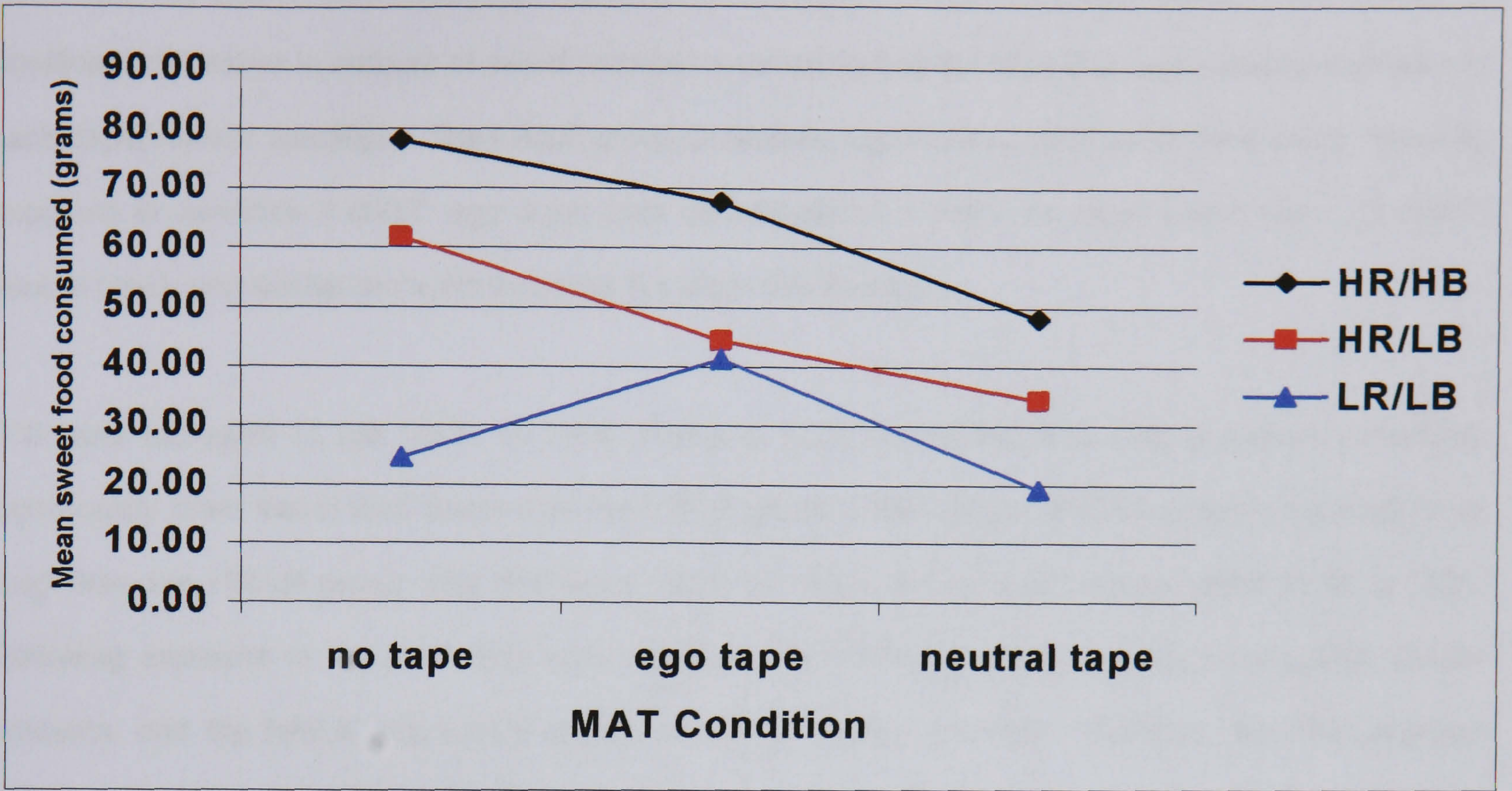



**Table 64. Follow-up tests: Total sweet food items consumed**

| | Mean difference | *p* |
|---|---|---|
| **No tape** | | |
| HR/HB vs HR/LB | 16.31 | NS |
| HR/HB vs LR/LB | 53.31 | <0.001 |
| HR/LB vs LR/LB | 37.00 | <0.001 |
| **Ego tape** | | |
| HR/HB vs HR/LB | 23.27 | <0.005 |
| HR/HB vs LR/LB | 26.35 | <0.001 |
| HR/LB vs LR/LB | 3.08 | NS |
| **Neutral tape** | | |
| HR/HB vs HR/LB | 13.69 | NS |
| HR/HB vs LR/LB | 28.85 | <0.001 |
| HR/LB vs LR/LB | 15.17 | NS |
| **HR/HB** | | |
| No tape vs ego tape | 10.37 | NS |
| No tape vs neutral tape | 29.87 | <0.001 |
| Ego tape vs neutral tape | 19.50 | <0.001 |
| **HR/LB** | | |
| No tape vs ego tape | 17.33 | NS |
| No tape vs neutral tape | 27.25 | NS |
| Ego tape vs neutral tape | 9.92 | NS |
| **LR/LB** | | |
| No tape vs ego tape | -16.58 | <0.001 |
| No tape vs neutral tape | 5.42 | NS |
| Ego tape vs neutral tape | 22.00 | <0.001 |

In summary, the HR/HB group consumed a similar amount of sweet food items following exposure to condition 1 (MAT: no tape) and condition 2 (MAT: ego tape), and significantly more following exposure to these two conditions than following exposure to condition 3 (MAT: neutral tape). There was no significant difference in amount of sweet food items consumed by the HR/LB group following exposure to each experimental condition. The LR/LB group consumed significantly more sweet food items following exposure to condition 2 (MAT: ego tape) than both condition 1 (MAT: no tape) and condition 3 (MAT: neutral tape), and similar amounts following the latter two conditions.

Following exposure to the MAT: no tape condition, both the HR/HB and HR/LB groups consumed significantly more sweet food items than the LR/LB group. Although the HR/HB group consumed more food than the HR/LB group, this difference failed to reach the adjusted critical alpha level of .005. Following exposure to the MAT: ego tape condition, the HR/HB and HR/LB groups consumed similar amounts, and the HR/LB and LR/LB groups consumed similar amounts. However, the HR/LB group consumed significantly more sweet food items than the LR/LB group.

#### 9.4.7.4 Salty food items

Table 65 shows Mean (SD) intake of salty food items by HR/HB, HR/LB and LR/LB groups following the three experimental conditions (MAT: no tape, ego tape, and neutral tape).

**Table 65. Mean (SD) intake of salty food items by HR/HB, HR/LB and LR/LB groups following the three experimental conditions (MAT: no tape, ego tape, neutral tape).**

| | | No tape | Ego tape | Neutral tape | Mean total |
|---|---|---|---|---|---|
| **HR/HB** | **Mean** | **78.50** | **89.63** | **93.63** | **87.25** |
| | *SD* | *21.25* | *17.41* | *22.05* | *20.24* |
| **HR/LB** | **Mean** | **56.67** | **79.25** | **72.42** | **69.44** |
| | *SD* | *14.20* | *12.40* | *18.44* | *15.01* |
| **LR/LB** | **Mean** | **32.33** | **53.88** | **37.96** | **41.39** |
| | *SD* | *12.40* | *18.66* | *20.55* | *17.20* |
| **Column** | **Mean** | **52.15** | **70.73** | **63.04** | |
| | *SD* | *25.56* | *23.28* | *31.89* | |

A 3 (Condition: MAT: no tape, ego tape, neutral) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition as the within subject factor and group as the between subject factor revealed a significant main effect of condition, $F(2,98) = 14.41$, $p<0.001$, $Eta^2 = .262$, and group, $F(2,49) = 64.99$, $p<0.001$, $Eta^2 = .726$. There was no other significant [interaction] effect. Table 66 shows follow-up tests for total amount of salty food items consumed.

**Table 66. Follow up tests summary table: salty food items**

| Condition | Mean difference | *P* |
|---|---|---|
| No tape vs ego tape | -18.58 | <0.001 |
| No tape vs neutral tape | -10.89 | <0.001 |
| Ego tape vs neutral tape | 7.69 | NS |
| **Groups** | | |
| HR/HB vs HR/LB | 17.81 | <0.001 |
| HR/HB vs LR/LB | 45.86 | <0.001 |
| HR/LB vs LR/LB | 28.06 | <0.001 |

In summary, significantly *less* salty food items were consumed following the MAT: no tape condition than both the MAT: ego tape condition and the MAT: neutral condition. Similar amounts of salty food items were consumed following the latter two conditions. Following exposure to stress, the HR/HB group consumed significantly more salty food items than both the HR/LB and LR/LB group, and the HR/LB group consumed significantly more salty food items than the LR/LB group.

#### 9.4.7.5 Bland food items

A 3 (Condition: MAT: no tape, ego tape, neutral) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition as the within subject factor and group as the between subject factor revealed a significant main effect of condition, $F(1.22,59.94) = 57.34$, $p<0.001$, $Eta^2 = .539$, and group, $F(2,49) = 10.32$, $p<0.001$, $Eta^2 = .296$, and a significant condition x group interaction effect, $F(2,49,59.94) = 32.01$, $p<0.001$, $Eta^2 = .566$. Figure 28 shows Mean bland food item consumption by HR/HB, HR/LB and LR/LB groups following exposure to the three experimental conditions (MAT: no tape, ego tape, neutral tape). Table 67 shows follow-up tests for total consumption of bland food items.

Figure 28. Mean bland food item consumption by HR/HB, HR/LB and LR/LB groups following exposure to the three experimental conditions (MAT: no tape, ego tape, neutral tape).

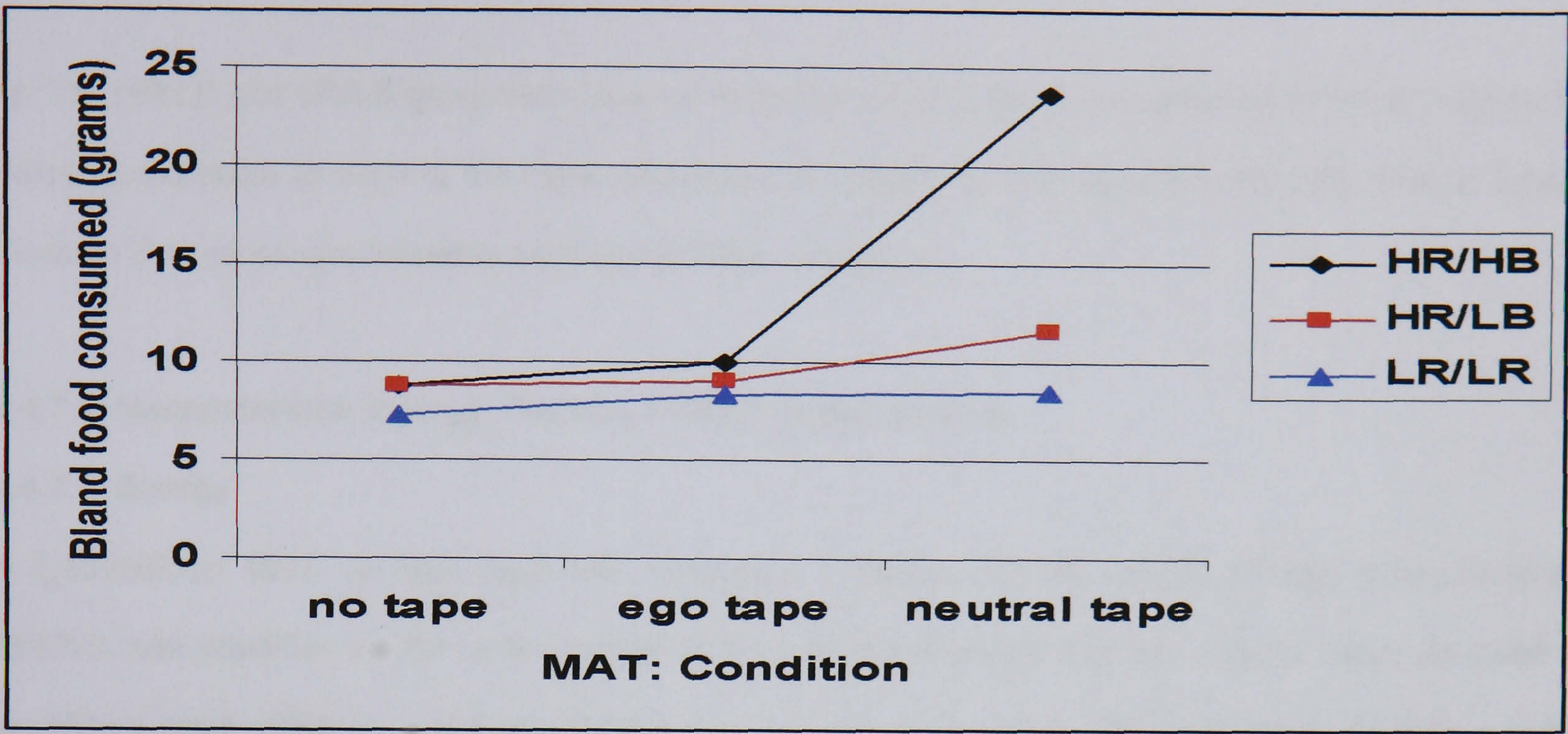



Table 67. Follow up tests summary table: bland food items

| | Mean difference | *P* |
|---|---|---|
| **HR/HB** | | |
| No tape vs ego tape | -1.25 | NS |
| No tape vs neutral tape | -14.94 | <0.001 |
| Ego tape vs neutral tape | -13.69 | <0.001 |
| **HR/LB** | | |
| No tape vs ego tape | -.17 | NS |
| No tape vs neutral tape | -2.84 | NS |
| Ego tape vs neutral tape | -2.67 | NS |
| **LR/LB** | | |
| No tape vs ego tape | -1.08 | NS |
| No tape vs neutral tape | -1.21 | NS |
| Ego tape vs neutral tape | -.13 | NS |
| **No tape** | | |
| HR/HB vs HR/LB | -.08 | NS |
| HR/HB vs LR/LB | 1.50 | NS |
| HR/LB vs LR/LB | 1.58 | NS |
| **Ego tape** | | |
| HR/HB vs HR/LB | 1.00 | NS |
| HR/HB vs LR/LB | 1.67 | NS |
| HR/LB vs LR/LB | .67 | NS |
| **Neutral tape** | | |
| HR/HB vs HR/LB | 12.02 | <0.001 |
| HR/HB vs LR/LB | 15.23 | <0.001 |
| HR/LB vs LR/LB | 3.21 | NS |

In summary, The HR/HB group consumed significantly more bland food items following exposure to the MAT: neutral tape condition than both the MAT: no tape and MAT: ego tape conditions, and than both the HR/LB group and the LR/LB group.

For the HR/LB and LR/LB group there was no significant difference in consumption of bland food items following exposure to each of the three experimental conditions, and no significant difference in intake between the two groups following each of the three conditions.

**9.4.7.6 Macronutrient: Energy, Protein, Carbohydrate, and Fat.**

**9.4.7.7 Energy**

A 3 (Condition: MAT: no tape, ego tape, neutral) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition as the within subject factor and group as the between subject factor revealed a significant main effect of condition, $F(2,98) = 14.20$, $p<0.001$, $Eta^2 = .225$, and group, $F(2,98) = 4.96$, $p<0.001$, $Eta^2 = .168$, and a significant condition x group interaction effect, $F(2,49) = 81.93$, $p<0.001$, $Eta^2 = .770$. Figure 29 shows Mean energy consumption by HR/HB, HR/LB and LR/LB groups following exposure to the three experimental conditions (MAT: no tape, ego tape, neutral tape). Table 68 shows follow-up tests for the measure of total energy intake.

**Figure 29. Mean energy consumption by HR/HB, HR/LB and LR/LB groups following exposure to the three experimental conditions (MAT: no tape, ego tape, neutral tape).**

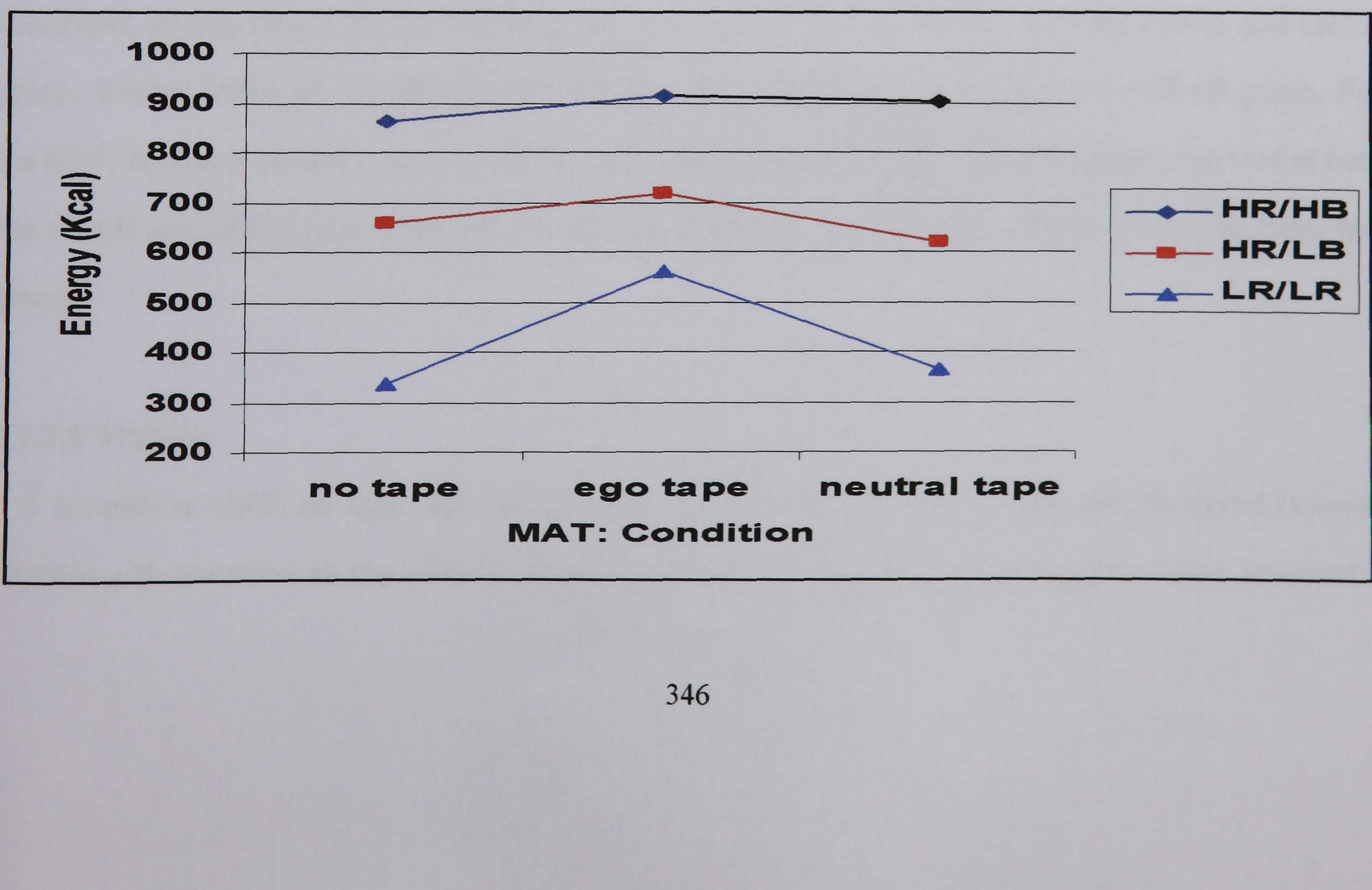


**Table 68. Follow up tests summary table: energy (Kcal) consumed**

| | Mean difference | *P* |
|---|---|---|
| **HR/HB** | | |
| No tape vs ego tape | -50.48 | NS |
| No tape vs neutral tape | -39.28 | NS |
| Ego tape vs neutral tape | 11.20 | NS |
| **HR/LB** | | |
| No tape vs ego tape | -57.69 | NS |
| No tape vs neutral tape | 41.40 | NS |
| Ego tape vs neutral tape | 99.09 | NS |
| **LR/LB** | | |
| No tape vs ego tape | -225.45 | <0.001 |
| No tape vs neutral tape | -30.37 | NS |
| Ego tape vs neutral tape | 195.08 | <0.001 |
| **No tape** | | |
| HR/HB vs HR/LB | 203.25 | <0.005 |
| HR/HB vs LR/LB | 526.47 | <0.001 |
| HR/LB vs LR/LB | 323.22 | <0.001 |
| **Ego tape** | | |
| HR/HB vs HR/LB | 196.04 | <0.005 |
| HR/HB vs LR/LB | 351.50 | <0.001 |
| HR/LB vs LR/LB | 155.46 | NS |
| **Neutral tape** | | |
| HR/HB vs HR/LB | 283.92 | <0.001 |
| HR/HB vs LR/LB | 535.38 | <0.001 |
| HR/LB vs LR/LB | 251.46 | <0.001 |

In summary, for both the HR/HB and HR/LB group there was no significant difference in energy intake following exposure to the three experimental conditions. Energy intake for the LR/LB group was significantly higher following exposure to the MAT: ego tape condition than both the MAT: no tape and MAT: neutral tape condition. Following exposure to both the MAT: no tape and MAT: neutral tape conditions, energy intake for the HR/HB group was significantly higher than both the HR/LB and LR/LB group. Energy intake for the HR/LB group was also significantly higher than that of the LR/LB group. For the MAT: ego tape condition, energy intake to the HR/HB group was significantly higher than that of both the HR/LB and LR/LB group, but with no significant difference in energy intake between the latter two groups.

### 9.4.7.8 Protein

A 3 (Condition: MAT: no tape, ego tape, neutral) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition as the within subject factor and group as the between subject factor revealed a

significant main effect of condition, $F(2,98) = 31.65$, $p<0.001$, $Eta^2 = .329$, and group, $F(2,49) = 55.50$, $p<0.001$, $Eta^2 = .694$, and a significant condition x group interaction effect, $F(4,98) = 3.41$, $p<0.05$, $Eta^2 = .122$. Figure 30 shows Mean protein consumption by HR/HB, HR/LB and LR/LB groups following exposure to the three experimental conditions (MAT: no tape, ego tape, neutral tape). Table 69 shows follow-up tests for the measure of total protein intake.

**Figure 30. Mean protein consumption by HR/HB, HR/LB and LR/LB groups following exposure to the three experimental conditions (MAT: no tape, ego tape, neutral tape).**

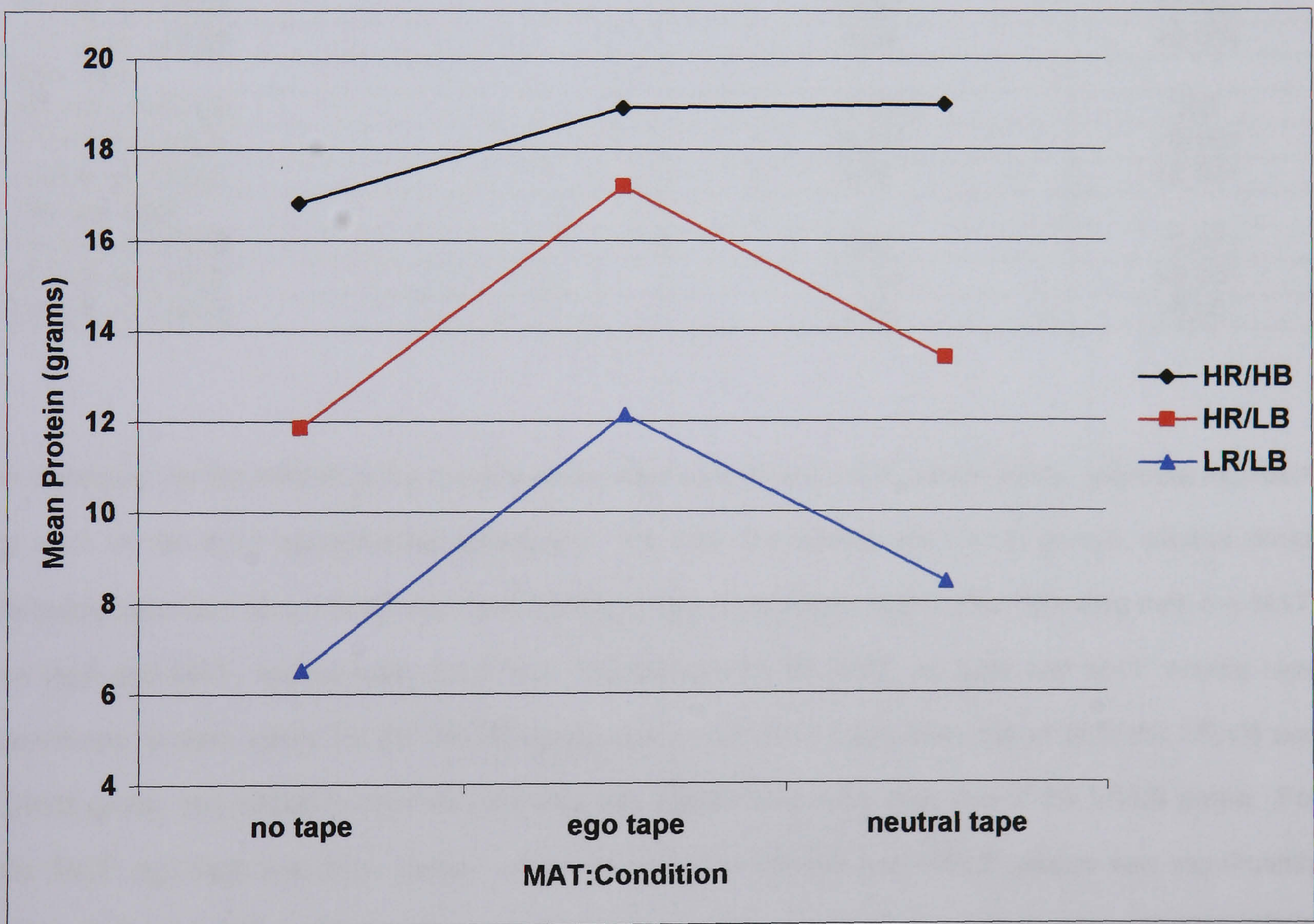


**Table 69. Follow up tests summary table: protein (grams) consumed**

| | Mean difference | *P* |
|---|---|---|
| **HR/HB** | | |
| No tape vs ego tape | -2.10 | NS |
| No tape vs neutral tape | -2.18 | NS |
| Ego tape vs neutral tape | -.08 | NS |
| **HR/LB** | | |
| No tape vs ego tape | 11.87 | <0.001 |
| No tape vs neutral tape | 17.20 | NS |
| Ego tape vs neutral tape | 13.39 | <0.001 |
| **LR/LB** | | |
| No tape vs ego tape | -5.63 | <0.001 |
| No tape vs neutral tape | -1.93 | NS |
| Ego tape vs neutral tape | 3.70 | <0.005 |
| **No tape** | | |
| HR/HB vs HR/LB | 4.95 | <0.001 |
| HR/HB vs LR/LB | 10.30 | <0.001 |
| HR/LB vs LR/LB | 5.34 | <0.001 |
| **Ego tape** | | |
| HR/HB vs HR/LB | 1.72 | NS |
| HR/HB vs LR/LB | 6.77 | <0.001 |
| HR/LB vs LR/LB | 5.05 | <0.001 |
| **Neutral tape** | | |
| HR/HB vs HR/LB | 5.61 | <0.001 |
| HR/HB vs LR/LB | 10.55 | <0.001 |
| HR/LB vs LR/LB | 4.94 | <0.001 |

In summary, for the HR/HB group there was no significant difference in protein intake following exposure to each of the three experimental conditions. For both the HR/LB and LR/LB groups, protein intake following exposure to the MAT: ego tape condition was significantly higher than following both the MAT: no tape and MAT: neutral tape conditions. Following both the MAT: no tape and MAT: neutral tape conditions, protein intake for the HR/HB group was significantly more than that of both the HR/LB and LR/LB group, and intake for the HR/LB group was significantly more than that of the LR/LB group. For the MAT: ego tape condition, protein intake for both the HR/HB and HR/LB groups was significantly higher than that of the LR/LB group, with no significant difference between protein intake for the HR/HB and HR/LB groups.

#### 9.4.7.9 Carbohydrate

A 3 (Condition: MAT: no tape, ego tape, neutral) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition as the within subject factor and group as the between subject factor revealed a

significant main effect of condition, $F(2,98) = 6.50$, $p<0.001$, $Eta^2 = .117$, and group, $F(2,49) = 59.36$, $p<0.001$, $Eta^2 = .708$, and a significant condition x group interaction effect, $F(4,98) = 5.6$-, $p<0.001$, $Eta^2 = .212$. Figure 31 shows Mean carbohydrate consumption by HR/HB, HR/LB and LR/LB groups following exposure to the three experimental conditions (MAT: no tape, ego tape, neutral tape). Table 70 shows follow-up tests for the measure of total carbohydrate intake

**Figure 31. Mean carbohydrate consumption by HR/HB, HR/LB and LR/LB groups following exposure to the three experimental conditions (MAT: no tape, ego tape, neutral tape).**

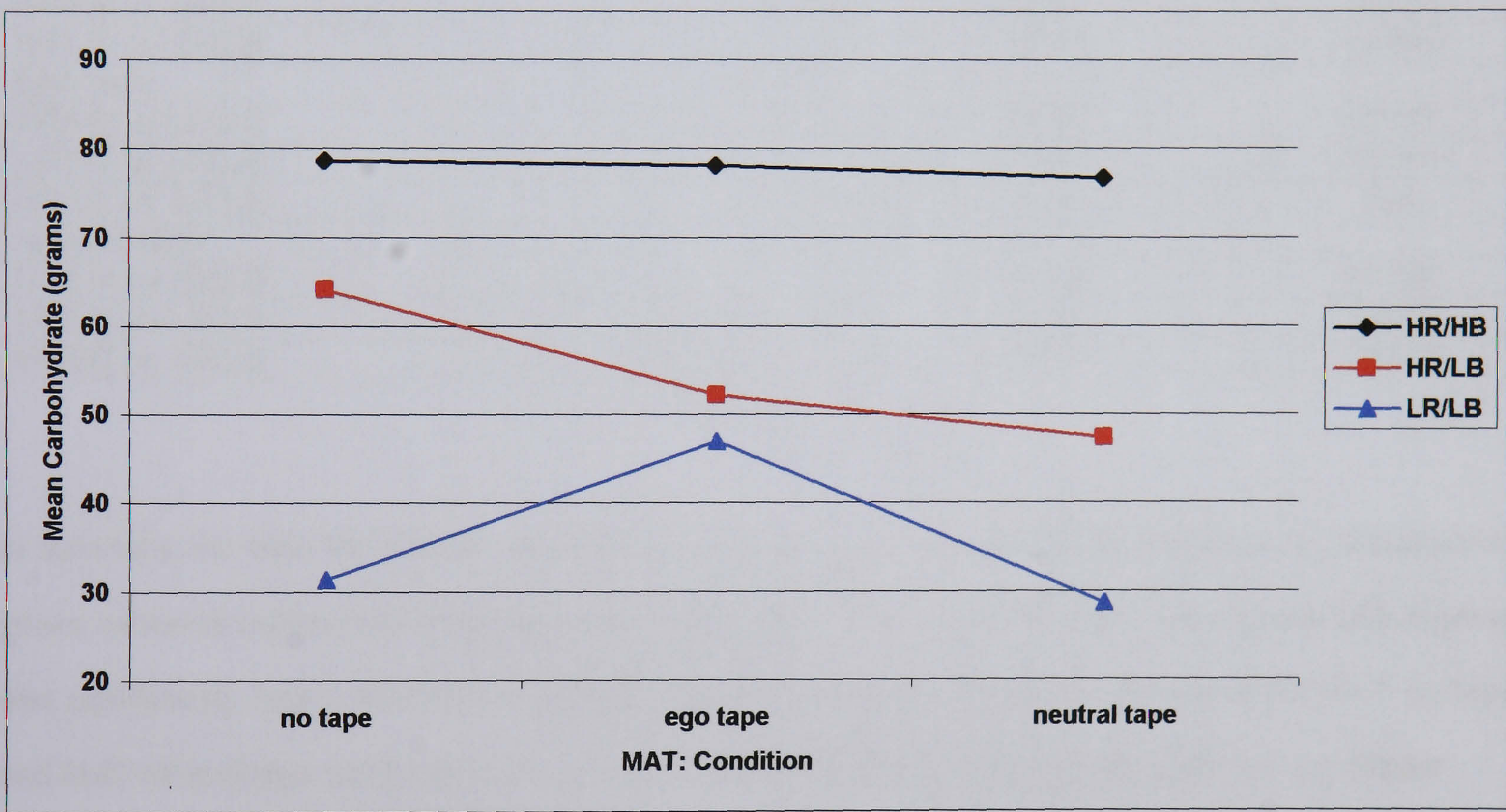


**Table 70. Follow up tests summary table: carbohydrate (grams) consumed**

| | Mean difference | *P* |
|---|---|---|
| **HR/HB** | | |
| No tape vs ego tape | .51 | NS |
| No tape vs neutral tape | 1.92 | NS |
| Ego tape vs neutral tape | 1.41 | NS |
| **HR/LB** | | |
| No tape vs ego tape | .48 | NS |
| No tape vs neutral tape | 1.92 | NS |
| Ego tape vs neutral tape | 1.41 | NS |
| **LR/LB** | | |
| No tape vs ego tape | -15.57 | <0.001 |
| No tape vs neutral tape | 2.75 | NS |
| Ego tape vs neutral tape | 18.32 | <0.001 |
| **No tape** | | |
| HR/HB vs HR/LB | 14.48 | NS |
| HR/HB vs LR/LB | 47.16 | <0.001 |
| HR/LB vs LR/LB | 32.68 | <0.001 |
| **Ego tape** | | |
| HR/HB vs HR/LB | 25.84 | <0.001 |
| HR/HB vs LR/LB | 31.09 | <0.001 |
| HR/LB vs LR/LB | 5.24 | NS |
| **Neutral tape** | | |
| HR/HB vs HR/LB | 29.28 | <0.001 |
| HR/HB vs LR/LB | 47.99 | <0.001 |
| HR/LB vs LR/LB | 18.71 | <0.001 |

In summary, for both the HR/HB and HR/LB group there was no significant difference in carbohydrate intake following exposure to the three experimental conditions. Carbohydrate intake for the LR/LB group was significantly higher following exposure to the MAT: ego tape condition than both the MAT: no tape and MAT neutral tape conditions, with no significant difference in intake for the latter two conditions.

Carbohydrate intake following exposure to the MAT: no tape condition was significantly greater for both the HR/HB and HR/LB groups than the LR/LB group, with no significant difference between the HR/HB and HR/LB groups. For the MAT: ego tape conditions, carbohydrate intake for the HR/HB group was significantly greater than the intake of both the HR/LB and LR/LB groups, with no significant difference between the latter two groups. Intake for the HR/HB group following the MAT: neutral tape condition was significantly greater than both the HR/LB group and the LR/LB group, and intake for the HR/LB group was significantly greater than that of the LR/LR group.

#### 9.4.7.10 Fat

A 3 (Condition: MAT: no tape, ego tape, neutral) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition as the within subject factor and group as the between subject factor revealed a significant main effect of condition, $F(2,98) = 20.71$, $p<0.001$, $Eta^2 = .297$, and group, $F(2,49) = 79.47$, $p<0.001$, $Eta^2 = .764$, and a significant condition x group interaction effect, $F(4,98) = 3.46$, $p<0.05$, $Eta^2 = .124$. Figure 32 shows Mean fat consumption by HR/HB, HR/LB and LR/LB groups following exposure to the three experimental conditions (MAT: no tape, ego tape, neutral tape). Table 71 shows follow-up tests for the measure of total fat intake.

**Figure 32. Mean fat consumption by HR/HB, HR/LB and LR/LB groups following exposure to the three experimental conditions (MAT: no tape, ego tape, neutral tape).**

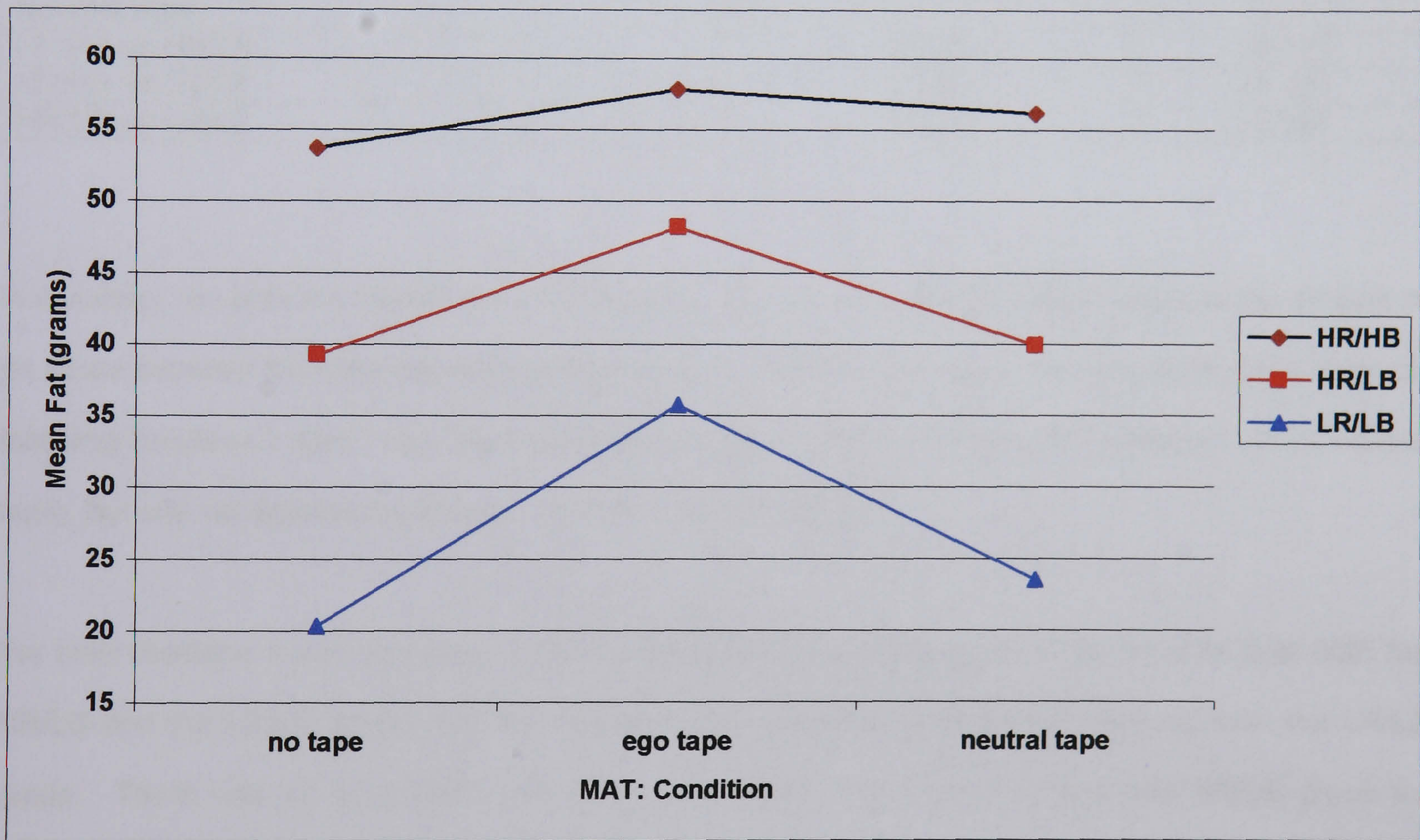


**Table 71. Follow up tests summary table: fat (grams) consumed**

| | Mean difference | *P* |
|---|---|---|
| **HR/HB** | | |
| No tape vs ego tape | -4.11 | NS |
| No tape vs neutral tape | -2.48 | NS |
| Ego tape vs neutral tape | 1.63 | NS |
| **HR/LB** | | |
| No tape vs ego tape | -8.97 | NS |
| No tape vs neutral tape | -.27 | NS |
| Ego tape vs neutral tape | 8.27 | NS |
| **LR/LB** | | |
| No tape vs ego tape | -15.42 | <0.001 |
| No tape vs neutral tape | -3.20 | NS |
| Ego tape vs neutral tape | 12.23 | <0.001 |
| **No tape** | | |
| HR/HB vs HR/LB | 14.46 | <0.001 |
| HR/HB vs LR/LB | 33.40 | <0.001 |
| HR/LB vs LR/LB | 18.94 | <0.001 |
| **Ego tape** | | |
| HR/HB vs HR/LB | 9.60 | NS |
| HR/HB vs LR/LB | 22.08 | <0.001 |
| HR/LB vs LR/LB | 12.48 | <0.001 |
| **Neutral tape** | | |
| HR/HB vs HR/LB | 16.25 | <0.001 |
| HR/HB vs LR/LB | 32.68 | <0.001 |
| HR/LB vs LR/LB | 16.44 | <0.001 |

In summary, for both the HR/HB and HR/LB group, there was no significant difference in the amount of fat intake between the three experimental conditions. The LR/LB group consumed significantly more fat following condition 2 (MAT: ego tape) than both condition 1 (MAT: no tape) and condition 3 (MAT: neutral tape), but with no significant difference between condition 1 and 3.

For both condition 1 and condition 3, the HR/HB group consumed significantly more fat than both the HR/LB and the LR/LB group, and the HR/LB group consumed significantly more fat than the LR/LB group. There was no significant difference in fat intake between the HR/HB and HR/LB group for condition 2. However, both groups consumed significantly more fat than the LR/LB group.

**9.4.7.11 Intake: Water**

A 3 (Condition: MAT: no tape, ego tape, neutral) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition as the within subject factor and group as the between subject factor revealed a

significant main effect of group, $F(2,49) = 79.47$, $p<0.001$, $Eta^2 = .764$. There was no other significant main or interaction effect. Table 72 shows Mean (SD) intake of water by HR/HB, HR/LB and LR/LB groups following the three experimental conditions (MAT: no tape, ego tape, neutral tape). Table 73 shows follow-up tests for the measure of total amount of water consumed.

**Table 72. Mean (SD) intake of water by HR/HB, HR/LB and LR/LB groups following the three experimental conditions (MAT: no tape, ego tape, neutral tape).**

| | | No tape | Ego tape | Neutral tape | Mean total |
|---|---|---|---|---|---|
| **HR/HB** | **Mean** | **378.94** | **432.81** | **378.38** | **396.71** |
| | *SD* | *80.67* | *49.69* | *85.40* | *71.92* |
| **HR/LB** | **Mean** | **258.17** | **284.42** | **241.75** | **261.44** |
| | *SD* | *97.75* | *102.40* | *117.43* | *105.86* |
| **LR/LB** | **Mean** | **182.88** | **152.58** | **145.62** | **160.36** |
| | *SD* | *141.71* | *101.68* | *96.73* | *113.37* |
| **Column** | **Mean** | **260.58** | **269.23** | **239.42** | |
| | *SD* | *142.37* | *150.01* | *139.78* | |

**Table 73. Follow up tests summary table: water consumed**

| | Mean difference | *P* |
|---|---|---|
| **Groups** | | |
| HR/HB vs HR/LB | 135.26 | <0.001 |
| HR/HB vs LR/LB | 236.35 | <0.001 |
| HR/LB vs LR/LB | 101.08 | <0.001 |

In summary, the HR/HB group consumed significantly more water than both the HR/LB and LR/LB group, and the HR/LB group consumed significantly more water than the LR/LB group.

### 9.5 Cardiovascular reactivity: SBP

For both SBP and DBP data from four participants were removed from analyses due to abnormal values (N=1) and missing data (N=3) arising from equipment failure. A 3 (Condition: MAT: no tape, ego tape, neutral tape) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA examining baseline SBP values revealed no significant main or interaction effects. Table 74 shows Mean (SD) SBP values for the HR/HB, HR/LB and LR/LB groups during the three experimental phases (B, TA, R) of the three experimental conditions (MAT: no tape, ego tape, neutral tape).

A 3 (Condition: MAT: no tape, ego tape, neutral tape) x 3 (Phase: B, TA, R) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition and phase as the within subjects factors and group as the between subjects factor revealed a significant main effect of phase, $F(2.02,90.57) = 60.23$, $p<0.001$, $Eta^2 = .572$, and group, $F(2,45) = 6.18$, $p<0.005$, $Eta^2 = .216$. There was also a significant condition x phase interaction effect, $F(3.47,163.15) = 4.47$, $p<0.005$, $Eta^2 = .090$. Figure 33 shows two-way interaction between experimental condition and phase. Table 75 shows follow-up tests for the measure of SBP.

**Figure 33. Mean (±SE) SBP values for the three experimental phases (B, TA, R) of the three experimental conditions (MAT: no tape, ego tape, neutral tape).**

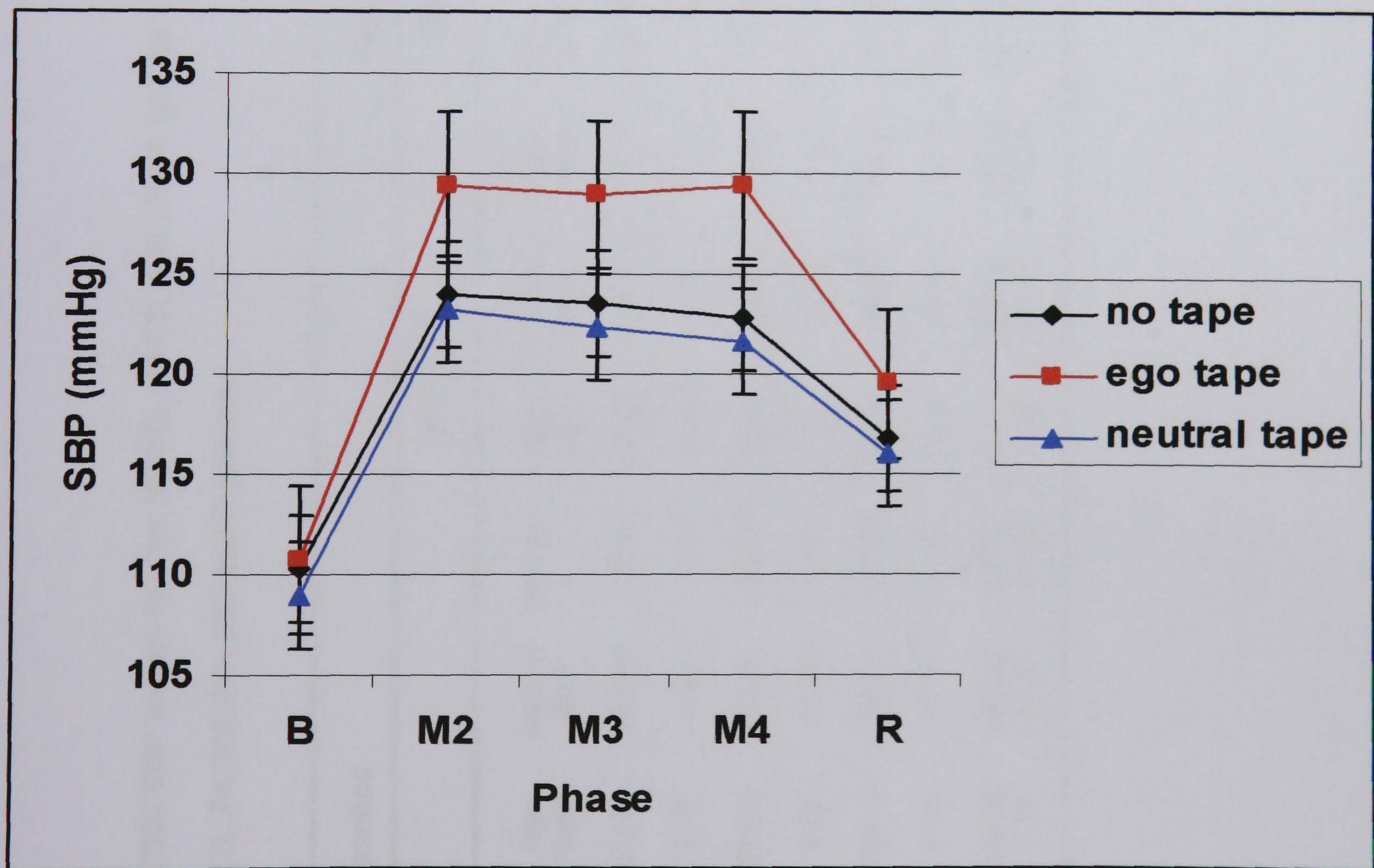


Table 74. Mean (SD) SBP values for the HR/HB, HR/LB and LR/LB groups in the three MAT conditions (no tape, ego tape, neutral tape) measured during B, TA (M2, M3, M4) and R phases.

| | | Baseline | | | Task | | | | | | | | | Recovery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M2 | | | M3 | | | M4 | | | | | |
| | | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape |
| HR/HB (N=16) | Mean | 112.06 | 112.00 | 111.69 | 127.56 | 133.87 | 128.31 | 127.31 | 132.81 | 127.38 | 127.19 | 132.69 | 127.13 | 118.50 | 124.56 | 122.25 |
| | *SD* | *5.14* | *5.75* | *6.69* | *11.58* | *7.66* | *4.47* | *11.49* | *9.60* | *4.94* | *10.97* | *10.12* | *5.73* | *12.47* | *13.56* | *10.29* |
| HR/LB (N=12) | Mean | 110.42 | 111.08 | 102.25 | 123.50 | 129.83 | 115.83 | 122.75 | 130.08 | 114.83 | 122.08 | 130.17 | 113.67 | 117.58 | 122.08 | 110.42 |
| | *SD* | *7.87* | *9.04* | *33.25* | *11.81* | *6.79* | *36.80* | *9.73* | *6.76* | *36.47* | *9.50* | *6.86* | *36.08* | *10.58* | *14.72* | *36.56* |
| LR/LB (N=24) | Mean | 107.42 | 108.12 | 99.67 | 121.04 | 123.54 | 110.17 | 120.38 | 123.29 | 109.58 | 119.42 | 124.12 | 108.88 | 113.75 | 110.96 | 101.12 |
| | *SD* | *8.55* | *8.18* | *31.54* | *11.98* | *10.30* | *34.77* | *12.90* | *10.33* | *34.62* | *11.97* | *9.30* | *34.41* | *11.29* | *12.07* | *33.34* |
| Column | Mean | 109.54 | 110.00 | 103.96 | 123.62 | 128.17 | 117.06 | 123.06 | 127.79 | 116.27 | 122.42 | 128.15 | 115.60 | 116.10 | 117.71 | 109.77 |
| | *SD* | *7.64* | *7.79* | *26.98* | *11.93* | *9.80* | *30.10* | *11.98* | *10.19* | *29.92* | *11.44* | *9.71* | *29.80* | *11.50* | *14.39* | *30.08* |

**Table 75. Follow up tests summary table: SBP (mmHg) values**

| | Mean difference | *P* |
|---|---|---|
| **Group** | | |
| HR/HB vs HR/LB | 2.40 | NS |
| HR/HB vs LR/LB | 9.11 | <0.005 |
| HR/LB/ vs LR/LB | 6.72 | NS |
| **Condition** | | |
| **M2** | | |
| No tape vs ego tape | -4.90 | <0.001 |
| No tape vs neutral tape | 1.71 | NS |
| Ego tape vs neutral tape | 6.61 | <0.001 |
| **M3** | | |
| No tape vs ego tape | -5.02 | <0.001 |
| No tape vs neutral tape | 2.00 | NS |
| Ego tape vs neutral tape | 7.02 | <0.001 |
| **M4** | | |
| No tape vs ego tape | -6.16 | <0.001 |
| No tape vs neutral tape | 2.09 | NS |
| Ego tape vs neutral tape | 8.25 | <0.001 |
| **R** | | |
| No tape vs ego tape | -1.93 | NS |
| No tape vs neutral tape | 1.90 | NS |
| Ego tape vs neutral tape | 3.38 | NS |
| **Phase** | | |
| **No tape** | | |
| B vs M2 | -14.08 | <0.001 |
| B vs M3 | -13.52 | <0.001 |
| B vs M4 | -12.88 | <0.001 |
| B vs R | -6.56 | <0.005 |
| R vs M2 | -7.52 | <0.001 |
| R vs M3 | -6.96 | <0.001 |
| R vs M4 | -6.32 | <0.005 |
| **Ego tape** | | |
| B vs M2 | -18.17 | <0.001 |
| B vs M3 | -17.79 | <0.001 |
| B vs M4 | -18.15 | <0.001 |
| B vs R | -7.71 | <0.005 |
| R vs M2 | -10.46 | <0.001 |
| R vs M3 | -10.08 | <0.001 |
| R vs M4 | -10.44 | <0.001 |
| **Neutral tape** | | |
| B vs M2 | -13.10 | <0.001 |
| B vs M3 | -12.31 | <0.001 |
| B vs M4 | -11.64 | <0.001 |
| B vs R | -5.81 | <0.005 |
| R vs M2 | -7.29 | <0.001 |
| R vs M3 | -6.50 | <0.001 |
| R vs M4 | -5.83 | <0.001 |

In summary, a significant main effect of group revealed no significant difference in SBP values between the HR/HB and HR/LB, and the HR/LB and LR/LB groups. However, the HR/HB group had significantly higher SBP values than the LR/LB group.

For all three conditions, the following pattern was observed: there was a significant rise in SBP values from baseline to task (M2, M3, and M4), and a significant reduction in SBP values from task (M2, M3, and M4) to recovery, but with recovery values still significantly elevated over baseline values.

At the task phase (M2, M3, and M4), condition 2 (MAT: ego tape) provoked a significantly higher SBP response than both condition 1 (MAT: no tape), and condition 3 (MAT: neutral tape). There was no significant difference in SBP response during condition 1 and 3 at the task phase (M2, M3, and M4). For the recovery phase, there was no significant difference between the three conditions in SBP values.

### 9.5.1 Cardiovascular reactivity: DBP

A 3 (Condition: MAT: no tape, ego tape, neutral tape) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA examining baseline DBP values revealed no significant main or interaction effects. Table 76 shows Mean (SD) DBP values for the HR/HB, HR/LB and LR/LB groups during the three experimental phases (B, TA, R) of the three experimental conditions (MAT: no tape, ego tape, neutral tape).

A 3 (Condition: MAT: no tape, ego tape, neutral tape) x 3 (Phase: B, TA, R) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition and phase as the within subjects factors and group as the between subjects factor revealed a significant main effect of condition, $F(1.44,70.71) = 4.33$, $p<0.05$, $Eta^2 = .081$, and phase, $F(2.47,121.08) = 39.34$, $p<0.001$, $Eta^2 = .445$. There was also a significant condition x phase interaction effect, $F(1.94,94.92) = 3.16$,

Table 76. Mean (SD) DBP values for the HR/HB, HR/LB and LR/LB groups in the three MAT conditions (no tape, ego tape, neutral tape) measured during B, TA (M2, M3, M4) and R phases.

| | | Baseline | | | Task | | | | | | | | | Recovery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M2 | | | M3 | | | M4 | | | | | |
| | | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape |
| HR/HB (n=16) | **Mean** | **67.00** | **61.56** | **60.38** | **83.63** | **78.81** | **73.50** | **83.19** | **70.44** | **71.94** | **68.75** | **70.44** | **71.84** | **71.56** | **67.13** | **63.94** |
| | *SD* | *3.03* | *5.30* | *5.10* | *3.32* | *7.57* | *8.03* | *3.29* | *7.85* | *6.86* | *7.63* | *7.85* | *6.86* | *6.57* | *8.76* | *7.24* |
| HR/LB (n=12) | **Mean** | **65.00** | **59.17** | **56.25** | **84.83** | **64.00** | **65.92** | **84.50** | **63.33** | **65.08** | **65.58** | **63.33** | **65.08** | **75.58** | **62.58** | **60.67** |
| | *SD* | *4.61* | *7.48* | *18.53* | *3.54* | *11.97* | *22.24* | *3.32* | *12.41* | *21.86* | *6.39* | *12.41* | *21.86* | *3.15* | *7.40* | *20.94* |
| LR/LB (n=24) | **Mean** | **62.63** | **60.83** | **55.46** | **83.42** | **69.29** | **66.67** | **82.54** | **68.25** | **64.58** | **66.58** | **68.25** | **64.58** | **75.04** | **63.83** | **59.46** |
| | *SD* | *5.17* | *7.42* | *18.38* | *3.54* | *8.23* | *21.28* | *4.62* | *8.01* | *21.01* | *6.74* | *8.00* | *21.00* | *2.63* | *7.04* | *19.27* |
| Column | **Mean** | **64.52** | **60.67** | **57.15** | **83.81** | **71.00** | **68.13** | **83.19** | **67.79** | **66.96** | **67.02** | **67.79** | **66.96** | **74.10** | **64.56** | **61.12** |
| | *SD* | *4.80* | *6.78* | *15.46* | *3.45* | *10.51* | *18.50* | *3.97* | *9.36* | *18.09* | *6.92* | *9.34* | *18.09* | *4.57* | *7.74* | *16.77* |

$p<0.05$, $Eta^2 = .061$. There was no other significant main or interaction effect. Figure 34 shows the two-way interaction between condition and phase on the measure of DBP. Table 77 shows follow-up tests for the measure of DBP.

**Figure 34. Mean (±SE) DBP values for the three experimental phases (B, TA, R) of the three experimental conditions (MAT: no tape, ego tape, neutral tape).**

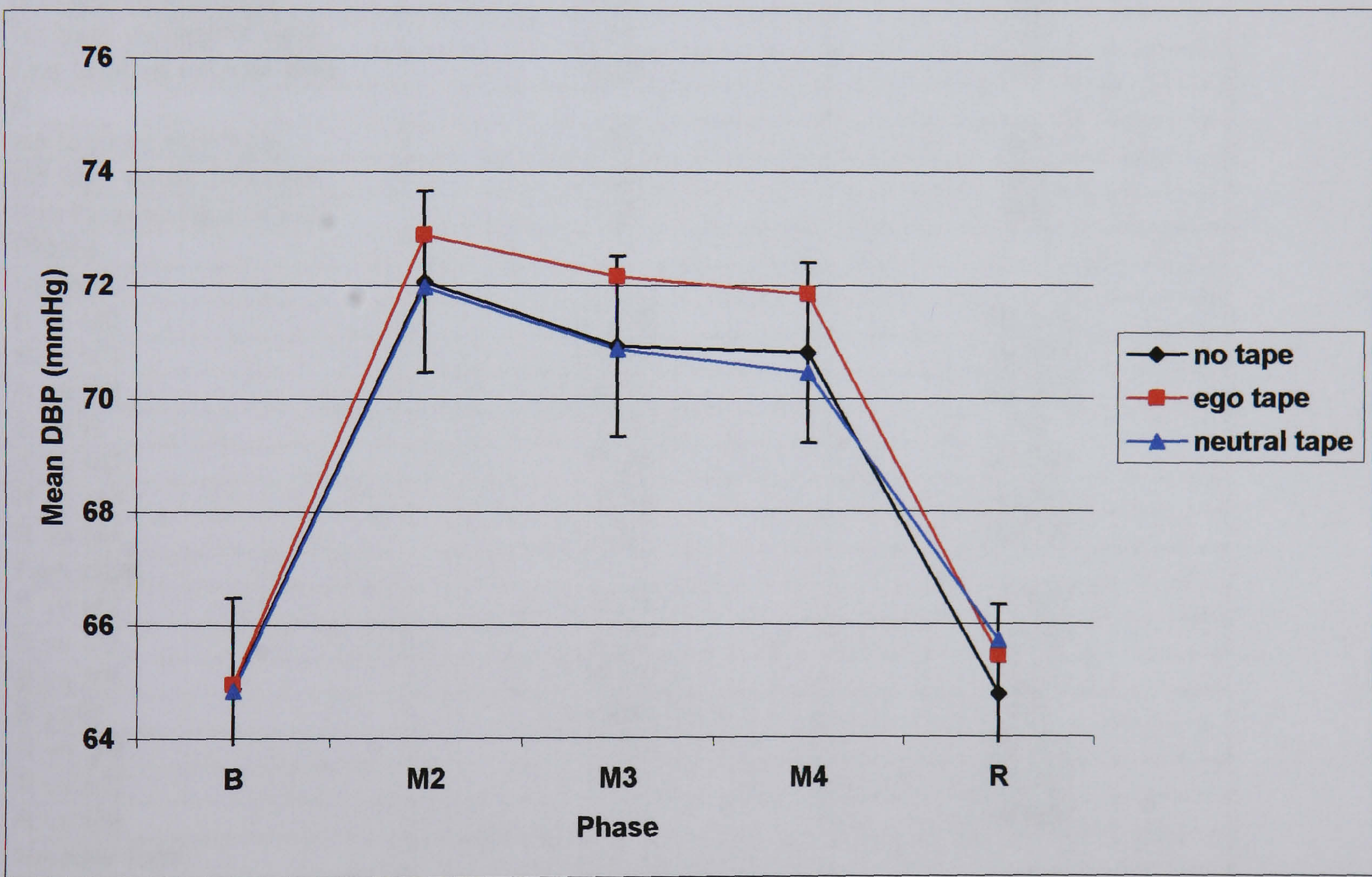


**Table 77. Follow up tests summary table: DBP (mmHg) values**

| | Mean difference | *p* |
|---|---|---|
| **Condition** | | |
| **M2** | | |
| No tape vs ego tape | -.73 | NS |
| No tape vs neutral tape | -.11 | NS |
| Ego tape vs neutral tape | .62 | NS |
| **M3** | | |
| No tape vs ego tape | -1.03 | NS |
| No tape vs neutral tape | -.03 | NS |
| Ego tape vs neutral tape | 1.00 | NS |
| **M4** | | |
| No tape vs ego tape | -.92 | NS |
| No tape vs neutral tape | .43 | NS |
| Ego tape vs neutral tape | 1.35 | NS |
| **R** | | |
| No tape vs ego tape | -.69 | NS |
| No tape vs neutral tape | -.96 | NS |
| Ego tape vs neutral tape | -.27 | NS |
| **Phase** | | |
| **No tape** | | |
| B vs M2 | -7.48 | <0.001 |
| B vs M3 | -6.35 | <0.001 |
| B vs M4 | -6.10 | <0.001 |
| B vs R | -.23 | NS |
| R vs M2 | -7.25 | <0.001 |
| R vs M3 | -6.12 | <0.001 |
| R vs M4 | -5.87 | <0.001 |
| **Ego tape** | | |
| B vs M2 | -8.11 | <0.001 |
| B vs M3 | -7.28 | <0.001 |
| B vs M4 | -6.92 | <0.001 |
| B vs R | -.82 | NS |
| R vs M2 | -7.29 | <0.001 |
| R vs M3 | -6.46 | <0.001 |
| R vs M4 | -6.10 | <0.001 |
| **Neutral tape** | | |
| B vs M2 | -7.51 | <0.001 |
| B vs M3 | -6.30 | <0.001 |
| B vs M4 | -5.59 | <0.001 |
| B vs R | -1.11 | NS |
| R vs M2 | -6.40 | <0.001 |
| R vs M3 | -5.19 | <0.001 |
| R vs M4 | -4.48 | <0.001 |

In summary, the following pattern was observed for all three conditions: there was a significant rise in DBP values from baseline to task (M2, M3, and M4), and a significant reduction in DBP values from task (M2, M3, and M4) to recovery, but with no significant difference between baseline and recovery values. There was no significant difference in DBP values between the three conditions at both the task (M2, M3, and M4) and recovery phase.

### 9.5.2 Cardiovascular reactivity: BPM

A 3 (Condition: MAT: no tape, ego tape, neutral tape) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA examining baseline heart rate (BPM) values revealed no significant main or interaction effects.

Table 78 shows Mean (SD) BPM values for the HR/HB, HR/LB and LR/LB groups during the three experimental phases (B, TA, R) of the three experimental conditions (MAT: no tape, ego tape, neutral tape).

A 3 (Condition: MAT: no tape, ego tape, neutral tape) x 3 (Phase: B, TA, R) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition and phase as the within subjects factors and group as the between subjects factor revealed a significant main effect of phase, $F(3.01,147.42) = 117.92$, $p<0.001$, $Eta^2 = .706$. There was also a significant condition x phase interaction effect, $F(5.93,290.31) = 7.66$, $p<0.001$, $Eta^2 = .135$. There were no other significant main or interaction effects. Figure 35 shows the two-way interaction between condition and phase on the measure of BPM. Table 79 shows follow-up tests for the measure of heart rate (BPM).

**Figure 35. Mean (±SE) Heart rate: BPM values for the three experimental phases (B, TA, R) of the three experimental conditions (MAT: no tape, ego tape, neutral tape).**

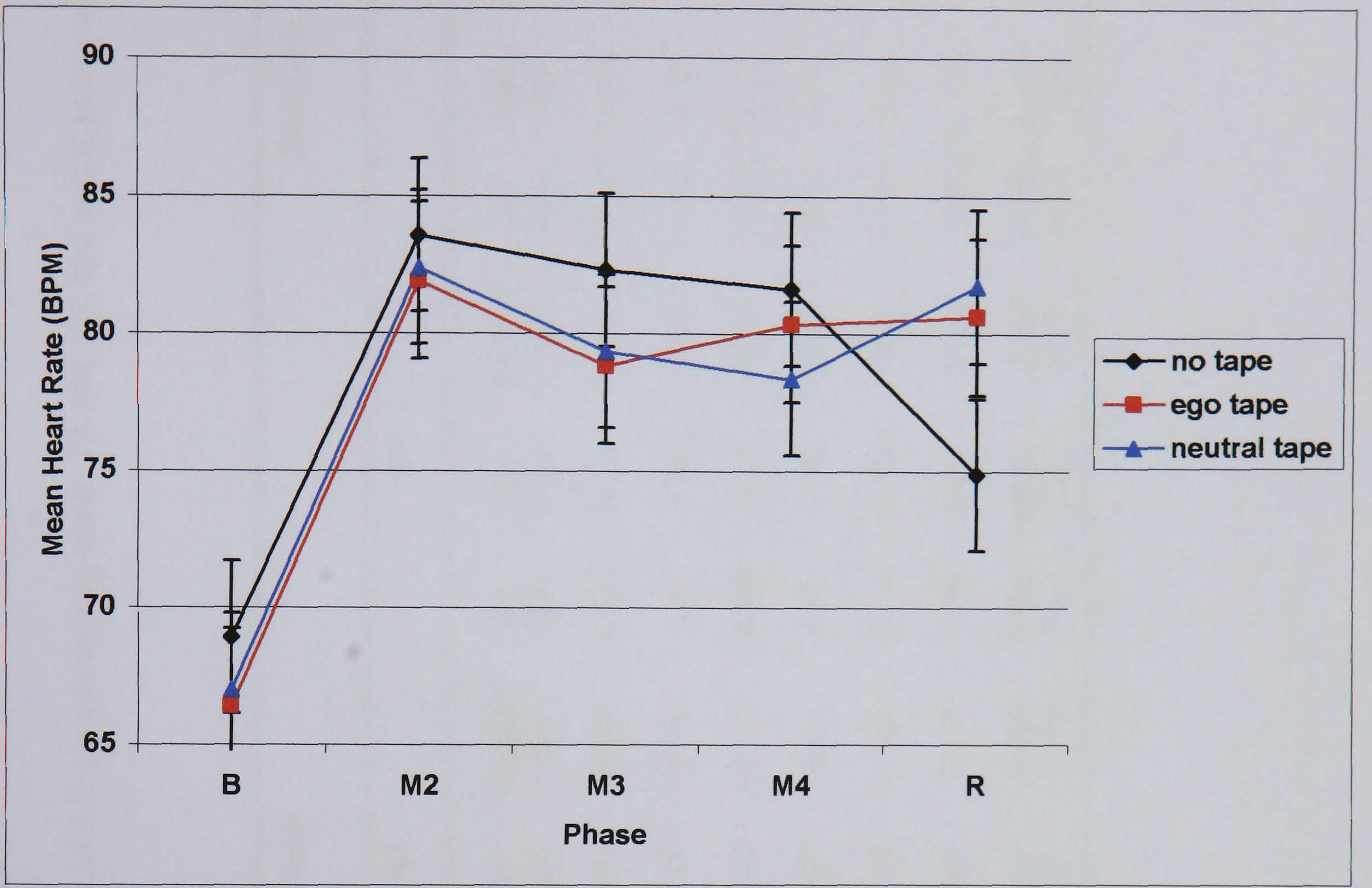


**Table 78. Mean (SD) Heart rate (BPM) values for the HR/HB, HR/LB and LR/LB groups during the B, TA (M2, M3, M4) and R phase of the three experimental conditions MAT: no tape, ego tape, neutral tape.**

| | | Baseline | | | Task | | | | | | | | | Recovery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M2 | | | M3 | | | M4 | | | | | |
| | | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape | No tape | Ego tape | Neutral tape |
| HR/HB (N=16) | Mean | 66.98 | 64.22 | 67.35 | 80.74 | 81.52 | 83.12 | 78.83 | 76.87 | 83.07 | 77.73 | 79.06 | 79.76 | 76.71 | 79.79 | 81.92 |
| | *SD* | *5.60* | *4.28* | *7.35* | *5.93* | *8.11* | *7.96* | *4.71* | *6.29* | *8.58* | *4.10* | *7.66* | *6.93* | *4.49* | *5.50* | *6.92* |
| HR/LB (N=12) | Mean | 70.10 | 66.96 | 66.94 | 86.10 | 83.38 | 83.83 | 86.44 | 78.91 | 77.23 | 85.42 | 80.79 | 79.38 | 73.16 | 82.09 | 83.40 |
| | *SD* | *4.95* | *3.35* | *5.76* | *6.56* | *6.26* | *6.97* | *7.14* | *8.37* | *8.91* | *8.97* | *9.18* | *9.66* | *6.27* | *8.49* | *6.32* |
| LR/LB (N=24) | Mean | 69.69 | 68.02 | 66.74 | 83.88 | 80.86 | 80.24 | 81.70 | 80.76 | 77.81 | 81.72 | 81.22 | 75.97 | 74.78 | 79.99 | 79.18 |
| | *SD* | *3.91* | *6.45* | *5.55* | *7.21* | *8.41* | *10.44* | *6.83* | *7.25* | *11.71* | *6.89* | *6.28* | *11.14* | *6.87* | *7.10* | *10.22* |
| Column | Mean | 68.96 | 66.61 | 66.97 | 83.43 | 81.64 | 81.96 | 81.91 | 79.14 | 79.29 | 81.34 | 80.46 | 77.92 | 74.99 | 80.41 | 80.99 |
| | *SD* | *4.82* | *5.42* | *6.08* | *6.86* | *7.79* | *8.99* | *6.81* | *7.30* | *10.35* | *7.20* | *7.36* | *9.68* | *6.12* | *6.89* | *8.54* |

Table 79. **Follow up tests summary table: Heart rate: BPM values**

| | Mean difference | *P* |
|---|---|---|
| **Condition** | | |
| **B** | | |
| No tape vs ego tape | 2.35 | NS |
| No tape vs neutral tape | 1.99 | NS |
| Ego tape vs neutral tape | -.36 | NS |
| **M2** | | |
| No tape vs ego tape | 1.79 | NS |
| No tape vs neutral tape | 1.47 | NS |
| Ego tape vs neutral tape | -.32 | NS |
| **M3** | | |
| No tape vs ego tape | 2.77 | NS |
| No tape vs neutral tape | 2.62 | NS |
| Ego tape vs neutral tape | -.15 | NS |
| **M4** | | |
| No tape vs ego tape | .88 | NS |
| No tape vs neutral tape | 3.42 | NS |
| Ego tape vs neutral tape | 2.54 | NS |
| **R** | | |
| No tape vs ego tape | -5.42 | <0.001 |
| No tape vs neutral tape | -6.00 | <0.001 |
| Ego tape vs neutral tape | -.58 | NS |
| **Phase** | | |
| **No tape** | | |
| B vs M2 | -14.47 | <0.001 |
| B vs M3 | -12.95 | <0.001 |
| B vs M4 | -12.38 | <0.001 |
| B vs R | -6.03 | <0.001 |
| R vs M2 | -8.44 | <0.001 |
| R vs M3 | -6.92 | <0.001 |
| R vs M4 | -6.35 | <0.001 |
| **Ego tape** | | |
| B vs M2 | -15.03 | <0.001 |
| B vs M3 | -12.53 | <0.001 |
| B vs M4 | -13.85 | <0.001 |
| B vs R | -13.80 | <0.001 |
| R vs M2 | -1.23 | NS |
| R vs M3 | 1.27 | NS |
| R vs M4 | -.05 | NS |
| **Neutral tape** | | |
| B vs M2 | -14.99 | <0.001 |
| B vs M3 | -12.32 | <0.001 |
| B vs M4 | -10.95 | <0.001 |
| B vs R | -14.02 | <0.001 |
| R vs M2 | -.97 | NS |
| R vs M3 | 1.70 | NS |
| R vs M4 | 3.07 | NS |

In summary, for all three conditions, the following pattern was observed: there was a significant rise in HR reactivity from baseline to task (M2, M3, and M4). For both condition 2 (MAT: ego tape) and condition 3 (MAT: neutral tape), HR values during the recovery phase remained *as* high as during the task phase, and were significantly elevated over both baseline values, and over values associated with the recovery phase of condition 1 (MAT: no tape). Although recovery HR values for condition 1 were significantly lower than both condition 2 and 3, they were still significantly elevated over baseline values.

## 9.6 Biochemical Measure: Salivary Cortisol

As for study 2, peak cortisol response during the task phase (M2, M3, and M4) was employed and compared to baseline and recovery values (see Section 7.4.7). Data from five participants was lost due to dry wells.

A 3 (Condition: MAT: no tape, ego tape, neutral tape) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA examining baseline salivary cortisol values (nmol/l) revealed no significant main or interaction effects.

Table 80 shows Mean (SD) salivary cortisol values for the HR/HB, HR/LB and LR/LB groups during the three experimental phases (B, TA, R) of the three experimental conditions (MAT: no tape, ego tape, neutral tape).

A 3 (Condition: MAT: no tape, ego tape, neutral tape) x 3 (Phase: B, TA, R) x 3 (Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with condition and phase as the within subjects factors and group as the between subjects factor revealed a significant main effect of condition, $F(1.71,75.37) = 11.04$, $p<0.001$, $Eta^2 = .201$, phase, $F(1.65,72.63) = 75.85$, $p<0.001$, $Eta^2 = .633$, and group, $F(2,44) = 18.31$, $p<0.001$, $Eta^2 = .454$. There was also a significant phase x group, $F(3.30,140.68) = 12.76$, $p<0.001$, $Eta^2 = .367$, and condition x phase, $F(3.20,140.68) = 4.96$, $p<0.005$, $Eta^2 = .101$ interaction effect. There was no other significant interaction effect. Figure 36 shows the two-way interaction between condition and phase on the measure of salivary cortisol, and Figure 37 shows the two-way interaction between phase and group on the measure of salivary cortisol. Table 81 and 82 shows follow-up tests for the measure of salivary cortisol.

**Figure 36. Mean (±SE) Salivary cortisol values for the three experimental phases (B, TA: (Peak value of M2, M3 or M4), R) of the three experimental conditions (MAT: no tape, ego tape, neutral tape).**

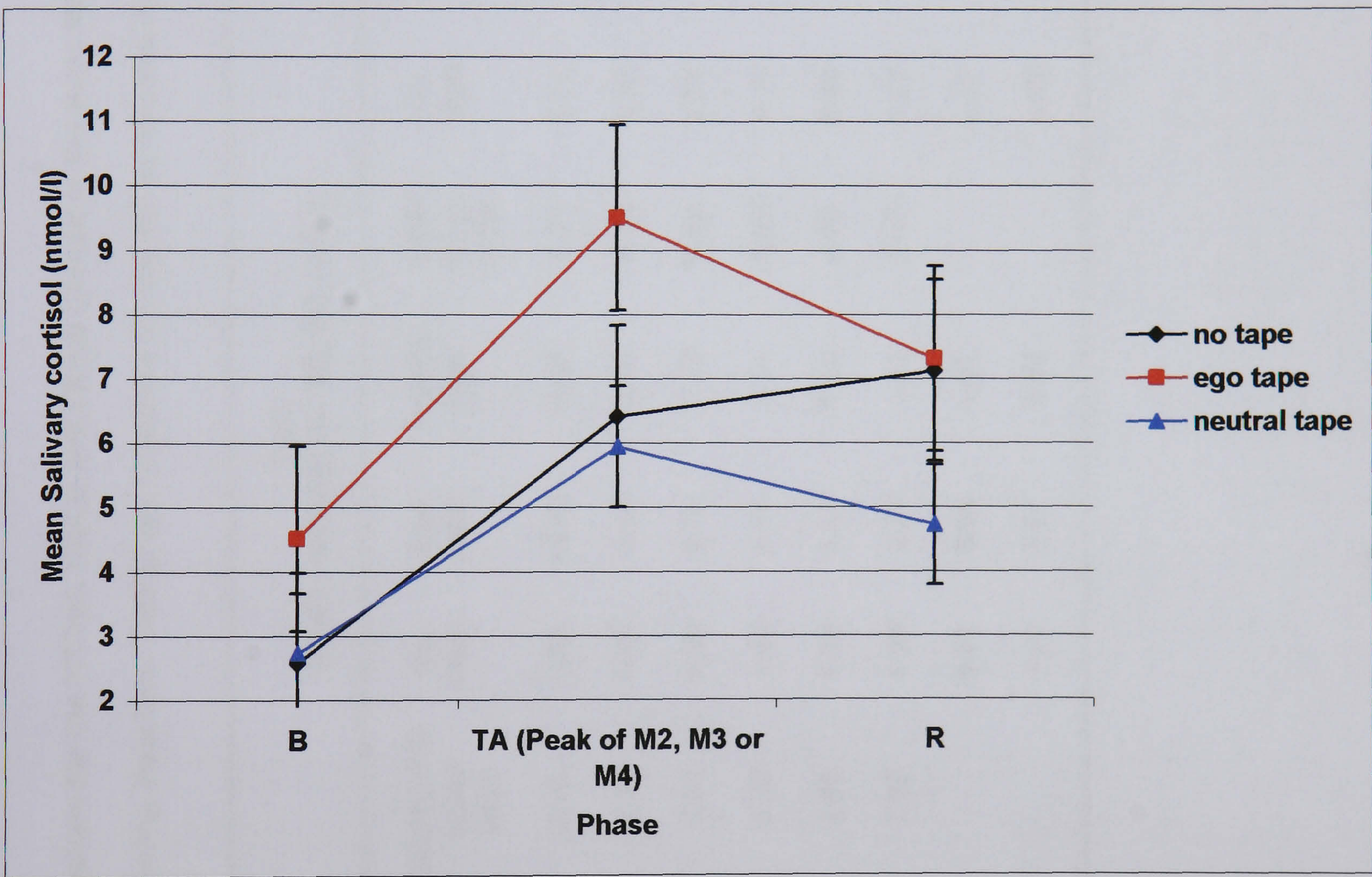


**Table 80. Mean (SD) Salivary Cortisol (nm/l) values for the HR/HB, HR/LB and LR/LB groups in the three MAT conditions (no tape, ego tape, neutral tape) measured immediately following Baseline, Task (Peak response for M2, M3 or M4) and Recovery phases.**

| | | Baseline | | | | Task (Peak response for M2, M3 or M4) | | | | Recovery | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No tape | Ego tape | Neutral tape | BASELINE Mean total | No tape | Ego tape | Neutral tape | TASK Mean total | No tape | Ego tape | Neutral tape | RECOVERY Mean total |
| HR/HB (n=15) | Mean | **2.86** | **5.08** | **2.47** | **3.46** | **7.62** | **12.02** | **6.45** | **8.70** | **9.13** | **10.78** | **5.14** | **8.35** |
| | *SD* | *1.78* | *3.75* | *1.94* | *2.49* | *3.89* | *5.36* | *3.70* | *4.32* | *5.72* | *5.69* | *4.48* | *5.30* |
| HR/LB (n=11) | Mean | **2.69** | **5.01** | **3.54** | **4.64** | **8.49** | **9.73** | **7.36** | **8.53** | **9.75** | **7.85** | **6.95** | **8.18** |
| | *SD* | *1.53* | *3.64* | *2.99* | *2.72* | *4.44* | *4.14* | *5.21* | *4.60* | *4.26* | *4.67* | *9.60* | *6.18* |
| LR/LB (n=21) | Mean | **2.18** | **3.45** | **2.18** | **2.60** | **3.13** | **6.77** | **5.04** | **4.98** | **2.49** | **3.30** | **2.08** | **2.62** |
| | *SD* | *1.88* | *2.38* | *1.19* | *1.82* | *1.99* | *3.80* | *1.51* | *2.43* | *1.99* | *2.31* | *1.58* | *1.96* |
| Column | Mean | **2.52** | **4.34** | **2.59** | | **5.82** | **9.14** | **5.58** | | **6.31** | **6.75** | **4.19** | |
| | *SD* | *1.76* | *3.20* | *2.00* | | *4.09* | *4.91* | *3.63* | | *5.26* | *5.29* | *5.60* | |

**Table 81. Follow up tests summary table: Salivary cortisol values (nmol/l)**

| | Mean difference | *P* |
|---|---|---|
| **Condition** | | |
| **TA: Peak of M2, M3 or M4** | | |
| No tape vs ego tape | -3.32 | <0.001 |
| No tape vs neutral tape | .24 | NS |
| Ego tape vs neutral tape | 3.56 | <0.001 |
| **R** | | |
| No tape vs ego tape | -.44 | NS |
| No tape vs neutral tape | 2.12 | NS |
| Ego tape vs neutral tape | 2.56 | NS |
| **Phase** | | |
| **No tape** | | |
| B vs TA (Peak of M2, M3 or M4) | -3.30 | <0.001 |
| B vs R | -3.79 | <0.001 |
| TA (Peak of M2, M3 or M4) vs R | -.93 | NS |
| **Ego tape** | | |
| B vs TA (Peak of M2, M3 or M4) | -4.80 | <0.001 |
| B vs R | -2.41 | <0.001 |
| TA (Peak of M2, M3 or M4) vs R | 2.39 | <0.001 |
| **Neutral tape** | | |
| B vs TA (Peak of M2, M3 or M4) | -2.99 | <0.001 |
| B vs R | -1.60 | <0.005 |
| TA (Peak of M2, M3 or M4) vs R | 1.39 | NS |

In summary, for the task phase, salivary cortisol values for condition 2 (MAT: ego tape) were significantly elevated over both condition 1 (MAT: no tape) and condition 3 (MAT: neutral tape), but with no significant difference in cortisol reactivity between condition 1 and 3. For the recovery phase, there was no significant condition difference in cortisol reactivity.

In terms of 'phase' reactivity, the following pattern occurred: for all three conditions there was a significant rise in cortisol reactivity from baseline to task. Cortisol values obtained following the recovery phase of both condition 1 and 3 were *as* high as task phase values and still significantly elevated over baseline values. For condition 2, recovery phase cortisol values were significantly reduced in comparison to task phase values, but remained significantly elevated over baseline values.

**Figure 37. Mean (±SE) Salivary cortisol values for the three groups (HR/HB, HR/LB, LR/LB) following the three experimental phases (B, TA (Peak value of M2, M3 or M4), R).**

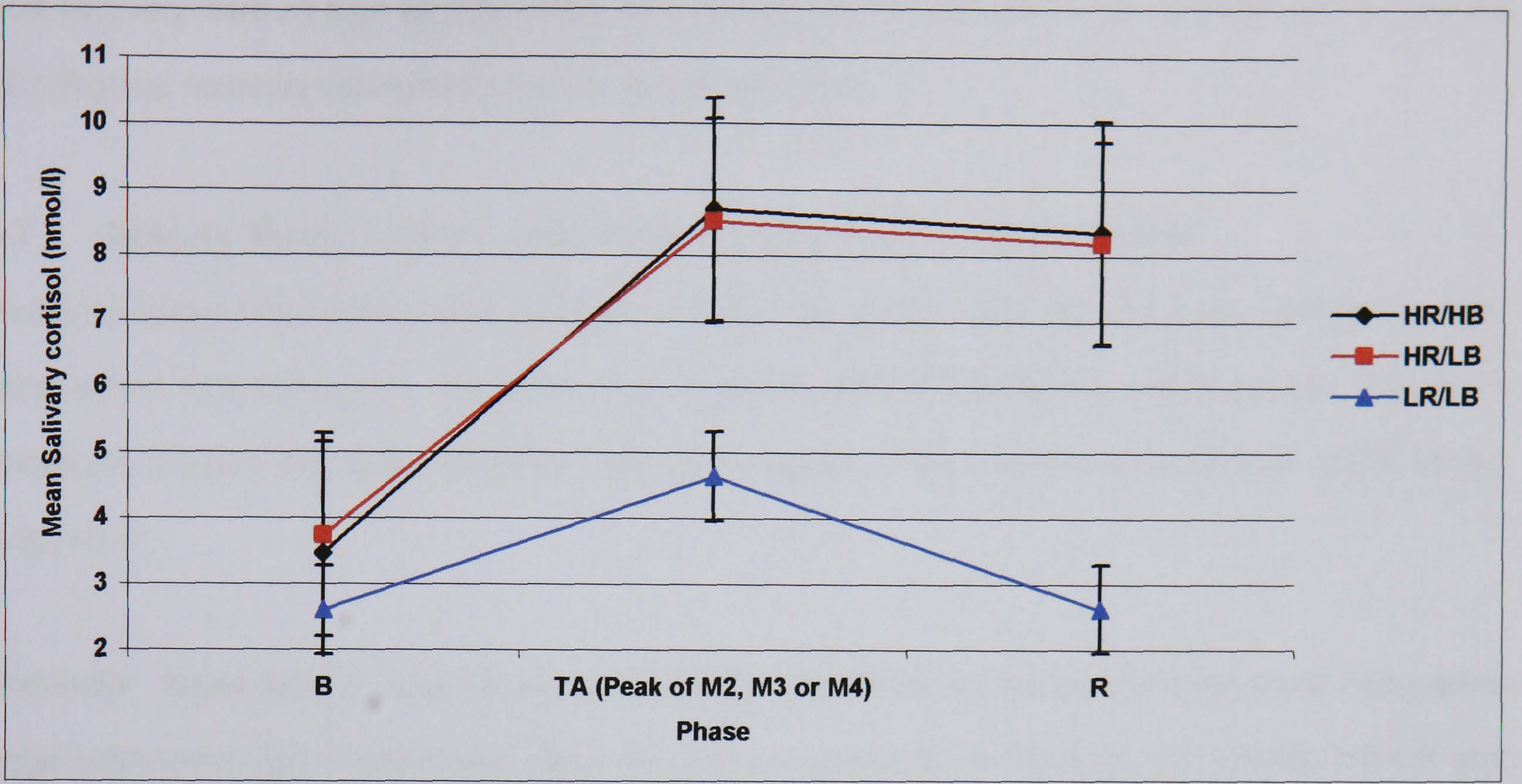



**Table 82. Follow up tests summary table: Salivary cortisol values (nmol/l)**

| | Mean difference | *P* |
|---|---|---|
| **Group** | | |
| **TA (Peak of M2, M3 or M4)** | | |
| HR/HB vs HR/LB | .54 | NS |
| HR/HB vs LR/LB | 3.96 | <0.001 |
| HR/LB vs LR/LB | 3.42 | <0.001 |
| **R** | | |
| HR/HB vs HR/LB | .10 | NS |
| HR/HB vs LR/LB | 5.68 | <0.001 |
| HR/LB vs LR/LB | 5.58 | <0.001 |
| **Phase** | | |
| **HR/HB** | | |
| B vs TA (Peak of M2, M3 or M4) | -5.24 | <0.001 |
| B vs R | -4.71 | <0.001 |
| TA (Peak of M2, M3 or M4) vs R | -1.89 | NS |
| **HR/LB** | | |
| B vs TA (Peak of M2, M3 or M4) | -3.89 | <0.001 |
| B vs R | -3.54 | <0.001 |
| TA (Peak of M2, M3 or M4) vs R | .35 | NS |
| **LB/LB** | | |
| B vs TA (Peak of M2, M3 or M4) | -2.38 | <0.005 |
| B vs R | -.02 | NS |
| TA (Peak of M2, M3 or M4) vs R | 2.36 | <0.005 |

In summary, cortisol reactivity for both the HR/HB and HR/LB group was significantly greater than that of the LR/LB group following both the task and recovery phase. For all three groups, there was a significant rise in cortisol reactivity from baseline to task. For the HR/HB and HR/LB group, cortisol values obtained post recovery were *as* high as task values, and still significantly elevated over baseline values. For the LR/LB group recovery values had returned to baseline level.

## 9.7 Memory Recall: Auditory presentation: Stroop threat vs neutral words

Table 83 shows Mean (SD) words recalled from the four Stroop word categories (ego-self-threat, ego-other-threat, ego-self-control, ego-other control) by the HR/HB, HR/LB and LR/LB groups. Figure 39 shows the two-way interaction between category and group on the measure of threat and neutral Stroop word recall.

**Table 83. Mean (SD) number of words correctly recalled from the four Stroop word categories (ego-self-threat, ego-other-threat, ego-self-control, ego-other-control) by the HR/HB, HR/LB and LR/LB groups.**

| | | Ego-self-threat | Ego-other-threat | Ego-self-control | Ego-other control | Mean total |
|---|---|---|---|---|---|---|
| **HR/HB** | **Mean** | **6.25** | **4.75** | **3.44** | **3.69** | **4.53** |
| | SD | 1.24 | 1.81 | 1.26 | 1.25 | 1.39 |
| **HR/LB** | **Mean** | **5.00** | **4.33** | **2.92** | **3.58** | **3.96** |
| | *SD* | *1.28* | *1.44* | *2.02* | *1.01* | *1.44* |
| **LR/LB** | **Mean** | **3.67** | **3.58** | **2.67** | **3.50** | **3.36** |
| | *SD* | *1.24* | *2.21* | *1.86* | *1.59* | *1.73* |
| **Column** | **Mean** | **4.77** | **4.12** | **2.96** | **3.58** | |
| | *SD* | *1.66* | *1.97* | *1.74* | *1.35* | |

A 4 (Stroop category: ego-self-threat, ego-other-threat, ego-self-control, ego-other-control) x 3 Group: HR/HB, HR/LB, LR/LB) mixed factorial ANOVA with Stroop category as the within subjects factor and group as the between subjects factor revealed a significant main effect of Stroop category, $F(3,147) = 14.38$, $p<0.001$, $Eta^2 = .227$, and group, $F(2,49) = 8.75$, $p<0.001$, $Eta^2 = .263$. There was also a significant category x group interaction effect, $F(6,147) = 2.17$, $p<0.05$, $Eta^2 = .081$. Figure 38 shows the two-way interaction between category and group on the measure of threat and neutral Stroop word recall. Table 84 shows follow-up tests for the measure of number of words correctly recalled.

**Figure 38. Mean word recall from the four Stroop word categories (ego-self-threat, ego-self-control, ego-other-threat, ego-other-control) by the HR/HB, HR/LB and LR/LB groups.**

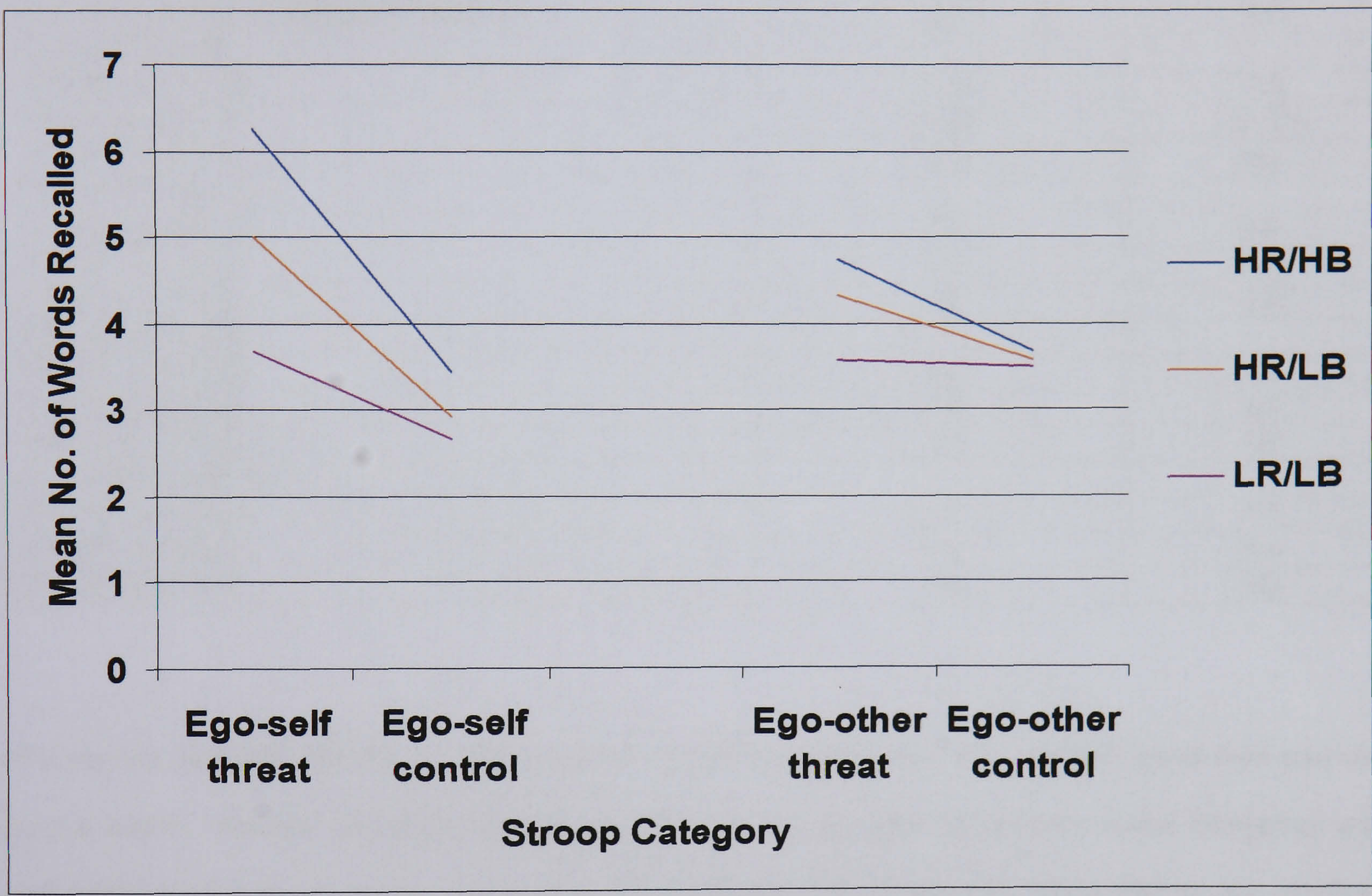


**Table 84. Follow up tests summary table: Stroop threat and neutral word recall**

| Group | Mean difference | *p* |
|---|---|---|
| **HR/HB** | | |
| Ego-self threat vs ego-self control | 2.81 | <0.001 |
| Ego-other-threat vs ego-other control | 1.06 | NS |
| **HR/LB** | | |
| Ego-self threat vs ego-self control | 2.08 | <0.005 |
| Ego-other-threat vs ego-other control | .75 | NS |
| **HR/LB** | | |
| Ego-self threat vs ego-self control | 1.00 | NS |
| Ego-other-threat vs ego-other control | .08 | NS |
| **Ego-self threat** | | |
| HR/HB vs HR/LB | 1.25 | NS |
| HR/HB vs LR/LB | 2.58 | <0.001 |
| HR/LB vs LR/LR | 1.33 | NS |
| **Ego-self control** | | |
| HR/HB vs HR/LB | .52 | NS |
| HR/HB vs LR/LB | .77 | NS |
| HR/LB vs LR/LR | .25 | NS |
| **Ego-other threat** | | |
| HR/HB vs HR/LB | .42 | NS |
| HR/HB vs LR/LB | 1.17 | NS |
| HR/LB vs LR/LR | .75 | NS |
| **Ego-other control** | | |
| HR/HB vs HR/LB | .11 | NS |
| HR/HB vs LR/LB | .19 | NS |
| HR/LB vs LR/LR | .08 | NS |

In summary, both the HR/HB and HR/LB group recalled significantly more ego-self threat than ego-self neutral words. Number of words correctly recalled for the ego-other threat and neutral categories was non significant for these groups, and number of words correctly recalled for threat and neutral words in both Stroop categories was non significant for the LR/LB group. For the ego-self threat category, HR/HB females recalled significantly more words than LR/LB females. There was no significant difference between recall of words between HR/HB and HR/LB, and HR/LB and LR/LB females. There was also no significant group difference for each of the remaining categories (ego-self control, ego-other threat and control).

## 9.8 Discussion

This study compared the effects of a mental arithmetic test (MAT), under three different conditions, that varied in terms of both cognitive demand (amount of cognitive effort required to undertake the task), and emotional content. Participants were first required to complete the MAT with no audio distraction tape (condition 1). Thereafter, participants undertook condition 2 and condition 3 in randomised order. Conditions 2 and 3 were increased over condition 1 in terms of cognitive demand with the addition of an audio distraction tape. The audio distraction tape employed in condition 2 contained ego-threat words found to be of emotional salience to females with bulimic symptoms and restrained eaters in experiment 1 and 2 of this thesis. Therefore, condition 2 contained both an increase in cognitive demand plus emotional content over condition 1. The audio distraction tape employed in condition 3 contained non-emotive neutral words that were matched to the ego-threat words (all words taken from Waller et al., 1996). Therefore, condition 3 was increased over condition 1 in terms of cognitive demand only. Condition 2 and 3 was followed by a cued free recall task (involving recall of threat and neutral words contained within the audio distraction tape). Therefore, participants were required to *strategically* process the information contained within the audio tapes.

Preliminary analyses revealed no significant group difference in terms of use of oral contraceptives (a factor that could potentially affect cortisol reactivity), age, perceived control over the task undertaken, and BMI. All three groups were within the normal weight category (BMI = 20-25). In support of the continuum model, the three groups differed significantly in terms of scores on dietary restraint and bulimia scales (RS_R, DEBQ, and BULIT-R), as a function of symptom severity (HR/HB females scored significantly higher than HR/LB females, who in turn scored significantly higher than LR/LB females).

In terms of perceived control over each of the three experimental tasks (conditions) undertaken, results revealed no significant group difference. Overall, a moderate amount of control was reported for each task (see Table 66). As a manipulation check, average performance for the three experimental matrices contained within the high (condition 2 and 3) and low (condition 1) cognitive load MAT conditions was assessed. As predicted, performance in both high cognitive load conditions was significantly decreased when compared to the low cognitive load condition. However, results also revealed that performance during condition 2 (MAT: ego tape), consisting of both high cognitive load and emotional loading, was further significantly decreased over condition 3 (MAT: neutral tape) containing high cognitive load alone. These results existed irrespective of restraint classification. Inspection of the performance means (Table 58) revealed that overall performance on the MAT task (both with and without the addition of audio tape) was poor for all participants. Inspection of the raw data revealed that many individuals ended their performance on a matrix with an incorrect total, and therefore received a score of zero for that matrix. Thus, for example, an individual with a performance pattern of a score of 0 for Matrix 2, a score of 3 for Matrix 3, and a score of 0 for Matrix 4 would achieve an overall mean of .67 for her performance on the experimental condition. Inspection of the raw data also revealed that *no* participant scored zero for all three matrices in any of the three experimental conditions. Performance on the MAT was assessed at the end of the experiment, and participants did not receive feedback with regard to whether their final total for each of the three matrices contained within the three experimental conditions was correct or incorrect.

It was predicted that conditions high in cognitive demand would create a significantly greater anxiety response (in terms of self-report, physiological and biological reactivity), significantly lower perceptions of self-esteem, and significantly greater intake of snack food than the low cognitive demand condition, particularly when combined with emotional content (ego-threat words), and that any group differences observed would exist as a function of symptom severity. In terms of self-reported negative affect, self-esteem, physiological and biological dependent measures, there were no significant group differences in baseline values.

***Self-reported anxiety ratings (STAI) following stress and food ingestion***

In respect of self-reported anxiety (STAI), the following pattern of results was revealed. For each of the three MAT conditions there was a significant increase in anxiety ratings from baseline to task, suggesting that all three tasks were efficient in provoking a significant *cognitive* stress response. However, anxiety ratings following completion of condition 2 (MAT: ego tape) were significantly higher than those of both condition 1 (MAT: no tape) and condition 3 (MAT: neutral tape). In line with predictions, this suggests that a combination of both cognitive demand and emotional loading (in the form of ego-threat words) may be the most 'potent' for initiating a stress response. However, contrary to predictions, there was no significant difference between condition 3 and condition 1, and this effect existed for all participants, irrespective of restraint status. For each of the three experimental conditions, there was a significant decrease in self-reported anxiety ratings from post-task to post-recovery. Although post-recovery values remained higher than baseline values, these comparisons failed to achieve significance according to the adjusted alpha level.

For both the HR/LB and LR/LB group, post-recovery ratings had returned to baseline values. However, post-recovery anxiety ratings for the HR/HB group were still significantly elevated over baseline values, and were significantly higher than those of both the HR/LB and LR/LB group. This pattern of results may suggest that, regardless of experimental condition undertaken, females with bulimic symptoms demonstrate either a sustained anxiety response following exposure to stress (compared to HR/LB and LR/LB females), or alternatively that these results may reflect anxious emotions provoked by the act of food ingestion.

***Self-reported self-esteem (SSES) following stress and food ingestion***

In terms of self-esteem ratings, contrary to both study 1 and 2 reported within this thesis, groups in the present study did not differ significantly in terms of pre-test self-esteem ratings. Post-experimental results showed, contrary to predictions, that irrespective of experimental condition undertaken, for all three groups there was a significant lowering of self-esteem ratings from baseline to task. For both the HR/LB and LR/LB females, post-recovery ratings had returned to a level similar to baseline values. However, for the HR/HB group, post-recovery ratings were non-significantly different to post-task ratings, and remained significantly lower than baseline ratings. Again, this may be a sustained effect of stress exposure, or a consequence of emotions experienced during food ingestion.

In line with the continuum model, group differences in self-esteem ratings at the task phase exist as a function of symptom severity (i.e. ratings for the HR/HB group were significantly lower than those of the HR/LB group, and in turn ratings for the HR/LB group were significantly lower than those of the LR/LB group). A similar pattern emerged in respect of post-recovery ratings. However, the comparison between HR/LB and LR/LB females failed to reach significance.

***Physiological reactivity (HR, SBP, DBP) following stress and food ingestion***

In terms of cardiovascular reactivity, for SBP, for all three groups, there was a significant increase from baseline to task, and a significant reduction from task to recovery, with recovery values still significantly elevated over baseline values. This pattern could indicate a sustained response to stress exposure or alternatively could exist as a consequence of food ingestion. Task phase values during M2, M3, and M4 were non-significantly different, indicating a sustained stress response, with no habituation effect. However, SBP values for the duration of the task phase for condition 2 (high cognitive load/emotional content) were significantly greater than those of both condition 3 (high cognitive load), and condition 1 (low cognitive load). This finding is in line with predictions. However, contrary to predictions there was no significant difference between condition 3 and condition 1, and this pattern of response existed irrespective of restraint classification. There was no significant group difference in SBP reactivity during the recovery phase.

For DBP, values were significantly elevated for the entire duration of the task phase (M2, M3, and M4) in comparison to baseline values. Recovery values were significantly reduced in comparison to task values, and non-significantly different from baseline values. This pattern existed with no significant condition or group differences.

For HR reactivity, there was a significant elevation from baseline to task, that was sustained for the entire duration of the task phase. Contrary to predictions, this pattern exists with no significant condition or group differences. However, condition differences did exist at the recovery phase. For both condition 2 and 3, HR values were as high as task values, and significantly elevated over baseline values. For condition 1, recovery HR values were significantly lower than task values, and than HR values for condition 2 and 3, but still significantly elevated over baseline values. This pattern existed for all participants, irrespective of restraint status.

***Biological reactivity (salivary cortisol) following stress and food ingestion***

For salivary cortisol reactivity, there was a significant rise from baseline to (peak) task response for all three experimental conditions. However, in line with predictions, peak task response for condition 2 was significantly elevated over that of both condition 1 and condition 3. Contrary to predictions, there was no significant difference between condition 3 and condition 1. Recovery values for condition 2 were significantly lower than peak task values, but remained significantly elevated over baseline values, and non-significantly different from condition 1 and 3 values. For condition 1 and 3, recovery values were non-significantly different to peak task values, but remained significantly elevated over baseline values.

In terms of group differences in cortisol reactivity, for both the HR/HB and LR/LB group was significantly greater than that of the LR/LB group following both the task and recovery phase. For all three groups, there was a significant rise in cortisol reactivity from baseline to task. For the HR/HB and HR/LB group, cortisol values obtained post recovery were *as* high as task values, and still significantly elevated over baseline values. For the LR/LB group recovery values had returned to baseline level.

In summary, in terms of physiological and biological reactivity, each of the three experimental conditions was efficient in provoking a significant and sustained increase in reactivity, compared to baseline measures. In line with predictions, a condition difference existed for SBP and salivary cortisol reactivity, whereby condition 2 (high cognitive load plus emotional content) provoked a significantly greater response than both condition 3 (high cognitive load only) and condition 1 (low cognitive load). Contrary to predictions, there was no significant difference between condition 1 and 3 in terms of SBP and cortisol reactivity, and no significant condition difference in term of DBP and HR reactivity. In addition, no significant group differences were found for physiological reactivity (SBP, DBP, and HR). However, for salivary cortisol reactivity the two high restraint groups, with and without bulimic symptoms displayed significantly higher peak reactivity responses following task exposure than did unrestrained eaters. This result existed irrespective of condition type.

In terms of physiological and biological reactivity during the recovery phase (involving snack food ingestion), whereas DBP values had returned to baseline values, SBP, HR, and cortisol reactivity was still significantly elevated over baseline. Again, it is difficult to determine whether this arose as a consequence of a sustained response to stress, or in response to actual food ingestion.

***Food and water intake in response to stress***

In terms of snack food intake, pre-test measures revealed a significant preference for chocolate (sweet) and crisps (salty) over peanuts (salty) and plain crackers (bland). There was no significant difference in food preference ratings between chocolate and crisps, and between peanuts and crackers. These preferences existed irrespective of restraint category.

In respect of group and condition differences in snack food intake, the pattern of results was complex. Therefore, a summary of group comparisons for total amount of snack food intake, intake by category (sweet, salty and bland), macronutrient intake (energy, protein, carbohydrate and fat), and intake of chilled water is provided. Table 85 indicates when intake was significantly higher for restrained eaters with bulimic symptoms when compared to restrained eaters without bulimic symptoms following exposure to the three experimental conditions. Table 86 indicates when intake was significantly higher for restrained eaters with bulimic symptoms when compared to unrestrained eaters following exposure to the three experimental conditions. Table 87 indicates when intake was significantly higher for restrained eaters without bulimic symptoms than unrestrained eaters following exposure to the three experimental conditions.

**Table 85. Comparison between the HR/HB and HR/LB group on the measure of intake following exposure to the three experimental conditions.**

| Intake | MAT: Condition 1 (no tape) | MAT: Condition 2 (ego tape) | MAT: Condition 3 (neutral tape) |
|---|---|---|---|
| Total | ✓ | ✓ | ✓ |
| Sweet | | ✓ | |
| Salty * | | | |
| Bland | | | ✓ |
| Energy | ✓ | ✓ | ✓ |
| Protein | ✓ | | ✓ |
| Carbohydrate | | ✓ | ✓ |
| Fat | ✓ | | ✓ |
| Water* | | | |

✓ = significantly greater intake by the HR/HB than HR/LB group.

**Table 86. Comparison between the HR/HB and LR/LB group on the measure of intake following exposure to the three experimental conditions.**

| Intake | MAT: Condition 1 (no tape) | MAT: Condition 2 (ego tape) | MAT: Condition 3 (neutral tape) |
|---|---|---|---|
| Total | ✓ | ✓ | ✓ |
| Sweet | ✓ | ✓ | ✓ |
| Salty * | | | |
| Bland | | | ✓ |
| Energy | ✓ | ✓ | ✓ |
| Protein | ✓ | ✓ | ✓ |
| Carbohydrate | ✓ | ✓ | ✓ |
| Fat | ✓ | ✓ | ✓ |
| Water* | | | |

✓ = significantly greater intake by the HR/HB than LR/LB group.

**Table 87. Comparison between the HR/LB and LR/LB group on the measure of intake following exposure to the three experimental conditions.**

| Intake | MAT: Condition 1 (no tape) | MAT: Condition 2 (ego tape) | MAT: Condition 3 (neutral tape) |
|---|---|---|---|
| Total | ✓ | ✓ | ✓ |
| Sweet | ✓ | | |
| Salty * | | | |
| Bland | | | |
| Energy | ✓ | | ✓ |
| Protein | ✓ | ✓ | ✓ |
| Carbohydrate | ✓ | | ✓ |
| Fat | ✓ | ✓ | ✓ |
| Water* | | | |

✓ = significantly greater intake by the HR/LB than LR/LB group.

* Results revealed that intake of salty food items and chilled water existed as a function of symptom severity (i.e. the HR/HB group consumed significantly more than the HR/LB group, who in turn consumed significantly more than the LR/LB group). This pattern of results existed for each of the three experimental conditions.

To summarise, inspection of group and condition means in respect of total food intake, intake by taste class (sweet, salty, and bland) and intake by macronutrient content for *each* of the three experimental manipulations were ordered in terms of symptom severity, whereby mean consumption for females with bulimic symptoms was higher than that of restrained eaters, which in turn was higher than that of the control population. However, not all group comparisons achieved significance, and this pattern existed irrespective of experimental condition (e.g., level of cognitive or emotional loading, and irrespective of whether participants were requested to strategically process the stimuli contained within the tasks or not). In terms of total food intake, a *significant* group difference was observed between the three groups, and this finding did exist as a function of symptom severity. Following exposure to each of the experimental conditions, females with bulimic symptoms consumed significantly more than did restrained eaters, who in turn consumed significantly more than did unrestrained eaters.

In relation to predictions, the limited cognitive capacity theory would suggest that 'disinhibition' of dietary restraint should occur with high cognitive load, irrespective of anxiety level. Therefore food intake for restrained eaters following both condition 2 and 3 should be significantly higher than intake following condition 1. The 'escape' theory would suggest that perceived ego threat, or explicit ego-threat (presentation of ego-threat stimuli) will create anxiety and a lowering of self-esteem, leading to a narrowing of attention to immediate environmental cues (palatable food), and overeating. Therefore, although all three experimental conditions could be perceived as ego threatening, condition 2 is not only made more difficult with an increased cognitive loading (and therefore potentially more anxiety provoking), but this task also contains ego-threatening stimuli that are specifically emotionally salient to the target populations (females with bulimic symptoms and restrained eaters). Previous research has shown that a combination of both high cognitive load and explicit ego-threat is more potent in terms of inducing disinhibition in restrained eaters (Lattimore & Maxwell, 2004). Results of Lattimore & Maxwell's (2004) study showed that restrained eaters (classified using the RS and its subscales, concern for dieting (CD) and weight fluctuation (WF): Herman & Polivy, 1980) consumed significantly more snack food (crisps, chocolate and dried fruit) following the high cognitive load task when it was ego threatening than when it involved processing and memorization of colour nouns, and significantly more than unrestrained eaters in a high cognitive load ego-threat condition. Similarly, Wallis & Hetherington (2004) found evidence for the potency of explicit ego-threat. In this study, participants were classified as restrained and emotional eaters (DEBQ: van Strien et al., 1986). Participants undertook either an ego-threat Stroop task, an incongruent colour Stroop task, or a 'control' Stroop task made up of neutral words. Results showed that both stress task were efficient in provoking a significant intake in chocolate, relative to the control task. However, emotional eating was associated with greater intake after only the ego Stroop task, relative to the control task.

Therefore, food intake following exposure to condition 2 within the present study should have been greater than that of both condition 1 and condition 3. Although self-reported negative affect and cortisol reactivity were significantly greater for condition 2 than condition 1 and 3, total food consumption for the two high restraint groups was similar following exposure to all three experimental conditions, and existed as a function of symptom severity. Specifically, females with bulimic symptoms consumed significantly more than restrained eaters, who consumed significantly more than controls. However, it could be that target populations perceived each of the 3 tasks to be ego-threatening. Many researchers have demonstrated disinhibition in the laboratory using tasks that are *intended* to be ego-threatening, but that do not *explicitly* include ego-threat stimuli (see Table 1).

Support for the 'escape' theory does however come from analysis of the number of threat and neutral words correctly recalled, (contained within the audio tapes) using a *cued* free recall task, both target populations (females with bulimic tendencies and restrained eaters, without bulimic tendencies) recalled significantly more ego-self threat than matched neutral words. In addition, the HR/HB group recalled significantly more ego-self threat words than did the LR/LB group. For the LR/LB group, there was no significant difference between number of ego-self threat and neutral words correctly recalled. Similarly, there was no significant group difference in number of words correctly recalled for ego-other threat and neutral words.

In summary, using methodology refined in consideration from results obtained in study 2 of this thesis, this study further examined the predictions made by two opposing theories, developed to explain the 'disinhibition' effect - the limited cognitive capacity theory (Boon et al., 2002; Ward & Mann, 2000) and the 'escape' from self awareness theory (Heatherton & Baumeister, 1991). Taken together, results suggest no support for the cognitive demand theory. Results of this study are more (but not entirely) consistent with the suggestion put forward by the 'escape' theory that an ego-threat involvement is necessary in order to induce overeating in response to stress. Further, results of investigations of attentional and memory bias from experiment 1, 2 and 3 suggest that a specific ego-threat may be most relevant – self-directed ego threat.

***Activation of the HPA axis, food intake and food selection***

It has been suggested that activation of the HPA axis may not only exert a stimulatory effect on energy intake (Dallman et al., 2004), but it may also influence food selection and the intake of specific nutrients, such as fat, which can lead to a positive energy balance. Within the present study, females with high dietary restraint scores and bulimic symptoms were found to exhibit exaggerated cortisol responding to stress, when compared to a control population. This suggests that within the two target populations, the experience of stress served to activate the HPA axis. Following exposure to stress, a *significant* group difference was observed between the three groups in terms of the total amount of snack food consumed, and this finding existed as a function of symptom severity.

In terms of intake in respect of taste class, and macronutrients, following exposure to each of the experimental conditions, females with bulimic symptoms consumed significantly more than did restrained eaters, who in turn consumed significantly more than did unrestrained eaters. Following exposure to condition 1 and condition 2, ingestion for females with bulimic symptoms was significantly greater in respect of sweet and salty food items, and in terms of the macronutrients, energy, protein, carbohydrates and fats, when compared to the control population. This pattern was repeated in respect of condition 3, with the exception that this group also consumed significantly more bland food items than did the control group.

Taken together, results suggest that, following exposure to stress, the two target populations demonstrated a preference for both sweet and salty food items, but not for bland food items. The control population demonstrated a preference for sweet food items only.

# Chapter 10 General Discussion and Future Research Directions

Using an aggregation of experimental paradigms taken from cardiovascular/stress and dietary restraint literatures, the current research adopted a psychophysiological approach to a) the measurement of the stress response, b) arousal responses to post-stress food consumption and c) information processing, to investigate the effects of self-directed ego threat stimuli on female restrained eaters, with and without bulimic symptoms.

In consideration of methodological issues, data were subjected to both categorical and continuous analyses (see Section 6.13). In consideration of prior research findings (e.g., Blair et al., 1991; Renaud & Blondin, 1997; Silva & Leite, 2000; Tulen et al., 1989; Ruddell et al., 1988), it was anticipated firstly that the tasks employed within the present research would provoke a significant *elevation* in [self-reported anxiety, physiological and biological[15]] responding, and a significant *lowering* of self-reported self-esteem, for all participants, when compared to baseline measurements. The following results were found:

Study 1 of this thesis revealed only minimal responding (*change* from baseline) in terms of self-reported anxiety in a control population of unrestrained eaters, in relation to both the ego and colour Stroop tasks undertaken. In addition, the target population (females with bulimic symptoms) who took part in the colour Stroop condition were also only minimally affected by this task. This finding conflicts with prior research findings, where a significant elevation [over baseline] in self-reported anxiety responses to both an ego-threat and an incongruent colour Stroop task has been reported (e.g., Lattimore & Maxwell, 2004). Similarly, Wallis & Hetherington (2004) reported that retrospective self-reported anxiety ratings were significantly higher for an incongruent colour Stroop task, when compared to a control condition. Therefore, the prediction made in respect of self-reported negative affect values for study 1 was not fully supported. In addition, results of analyses of DBP values obtained in study 2 also showed no elevation in responding from baseline to task by each of the three populations [HR/HB, HR/LB, LR/LB]. This result existed irrespective of task type. Thus, for study 2, results obtained in relation to the expected [significant] elevation in physiological responding did not fully conform to the prediction made.

[15] Physiological and biological measures were employed in study 2 and 3 only

All other tasks, and task combinations (i.e., ego Stroop, with and without the addition of pre-test instructions for later word recall; MAT with and without the addition of an audio distraction tape), employed were found to provoke significant elevations in self-reported ratings of mood (anxiety and self-esteem) (all studies) and physiological and biological reactivity (study 2 and 3 only) when compared to baseline values, in all participants. Therefore, predictions in respect of these tasks were supported. Taken together, with the exception of the colour Stroop task [study 1], these results demonstrate the effectiveness of *each* of the experimental manipulations used within this research to induce a significant arousal response in all populations. These results are in line with those of other researchers who have reported a significant rise in measures of cognitive and SNS arousal in response to tasks similar to the ones employed within the present research (e.g., Blair et al., 1991; Renaud & Blondin, 1997; Silva & Leite, 2000; Tulen et al., 1989; Ruddell et al., 1988).

Taken together, this pattern of responding is largely in line with what one might expect in response to tasks that require an *active behavioural response* from the participant. Active coping tasks are associated with an increase in systolic blood pressure, heart rate, cardiac output, and stroke volume; shortened pre-ejection periods and decreases in total peripheral resistance (Obrist, 1979; Sherwood et al., 1990; Buhler et al., 1983). These results therefore provide evidence for the existence of *task specific responding* (see Section 4.5.3).

The significant rise (over baseline) obtained in respect of salivary cortisol values [study 2 and 3] indicates activation of the HPA axis (see Section 4.4.2). For study 2, although a significant phase x condition interaction was obtained, there was no significant difference between the two conditions at the task phase. Therefore, in terms of cortisol values, the two tasks [ego and ego-recall Stroop] exerted similar effects. It should be noted, that although a significant elevation from baseline to peak response across B1, B2, and B3 of the task phase, these values were quite low, revealing a mean of 3.53 for the ego Stroop task and a mean of 3.17 for the ego-recall Stroop task. In contrast, mean peak responding in respect of the MAT tasks that were delivered in study 3 were much higher, indicating that a *greater* strength of responding was elicited by these tasks, when compared to the Stroop tasks delivered in study 2. A significant phase x condition interaction effect revealed mean [peak responding] values of 5.58 for

MAT3 (neutral tape), 5.82 for MAT1 (no tape), and 9.14 for MAT2 (ego tape). The difference between MAT2 and MAT1 and MAT 2 and MAT3 was significant, and there was no significant difference between [reactivity] values elicited by MAT1 and MAT3. Taken together, this suggests that the maths task, accompanied by an audio distraction tape containing ego-threatening stimuli, was found to be the most 'potent' task in terms of inducing an arousal response, for all participants. However, when these results are considered in addition to a significant phase x group interaction effect, where mean peak response values for the two target populations were 8.70 (HR/HB) and 8.53 (HR/LB) respectively, and where these values were significantly elevated over those of the control population (LR/LB: Mean = 4.98), this suggests that condition 2 (MAT 2) was especially potent for the two target populations.

It was also anticipated that all tasks employed within the present research would provoke a significant *decrease* in perceptions of self-esteem. Results showed that all tasks, including the conventional Stroop task employed in study 1, were found to significantly reduce self-esteem levels, in comparison to baseline values, for all participants.

**To summarise, aside from the colour Stroop task, all tasks and task combinations were found to induce a significant arousal response, for all groups, when compared to baseline measures. Results obtained in respect of physiological and biological data obtained from study 2 and study 3 suggest that this arousal response was sufficient to trigger the HPA axis, and the subsequent release of cortisol. Inspection of the mean cortisol values suggests that the MAT tasks presented within study 3 were more 'potent' in terms of inducing arousal than were the Stroop tasks presented in study 2. Of the three MAT tasks presented within study 3, MAT2 [with the addition of an audio distraction tape containing ego-threat stimuli] appeared to be particularly powerful for all groups, but for the two target groups in particular. The pattern of [physiological] results obtained from study 2 and 3 suggests also that the tasks employed provoked an 'active behavioural coping response'. Results from the first main aim of the present research will now be summarised.**

**AIM 1: Stress-induced eating**

The first *main* aim of the present research was to test two competing theoretical explanations of stress-[over]eating – the limited capacity versus the 'escape' theory (see Sections 2.9 and 3.5). The following predictions were made:

**Study 1**

**H1.** Condition 1 [unmasked Stroop task containing ego-threat word stimuli: ***high emotional/low cognitive loading***] would provoke greater responding [S-R mood and food intake] than Condition 2 [unmasked Stroop task containing incongruent colour words: ***low emotional/low cognitive loading***] in target populations when compared to a control population.

**Study 2**

**H2.** Condition 2 [unmasked Stroop task containing ego-threat word stimuli, accompanied by pre-test instructions for later word recall: ***high emotional/high cognitive loading***] would provoke greater responding [S-R mood, physiological and biological reactivity, and food intake] than Condition 1 [unmasked Stroop task containing ego-threat word stimuli: ***high emotional/low cognitive loading***] in target populations when compared to a control population.

**Study 3**

**H3.** Condition 2 [serial addition math task [MAT], accompanied by an audio [distraction] tape [containing ego-threat word stimuli], plus pre-test instructions for later word recall: ***high emotional/high cognitive loading***] would provoke greater responding [S-R mood, physiological and biological reactivity, and food intake] than both Condition 1 [MAT: ***low emotional/low cognitive loading***] and Condition 3 [MAT, accompanied by an audio [distraction] tape [containing neutral word-threat stimuli], plus pre-test instructions for later word recall: ***low emotional/high cognitive loading***] in target populations when compared to a control population. Condition 3 would provoke greater responding than Condition 1.

In consideration of the continuum model of BN (Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987) it was also anticipated that the results derived from each of the three studies would exist as a function of symptom severity. In addition, in consideration of the new generation schema-based emotional model of BN (Waller, submitted for publication – see Mountford et al., 2004), it was anticipated that overeating would occur in response to tasks that contained either an *explicit* [study 1: condition 1, study 2: condition 1 and 2, and study 3: condition 2] or *implicit* [all tasks] threat to the ego, and in response to tasks that required the *strategic* processing of ego-threat information (study 2: condition 2; study 3: condition 2). Highlighted also was the fact that overeating in response to 'stress' would add support for Herman & Polivy's (1980) restraint theory (see Section 2.4).

***Stress-eating: Categorical analyses***

Study 1 of this thesis compared the effects of an ego-threat Stroop task with that of a conventional (incongruent colour) Stroop task on females with bulimic symptoms, and a control population of females who possessed *neither* restrained nor bulimic eating attitudes. These tasks were *both* low in terms of cognitive load, and differed in terms of emotional loading, in that the ego Stroop task contained stimuli that have been found to be particularly salient to non-clinical females with bulimic symptoms (e.g.McManus et al., 1995; Waller et al., 1996; Quinton, 1998), and to induce overeating when presented both subliminally (Patton, 1992; Waller & Mijatovich, 1998; Meyer & Waller, 1999), and within a Stroop task (Lattimore, 2001). It was therefore expected that the ego Stroop task would be more potent in terms of inducing arousal and food (ice cream) intake in the target population (females with significant bulimic symptoms) when compared to a control population, and when compared to a colour Stroop task.

Results of this study suggested that, for the target population only, the ego Stroop task provoked a significant elevation in self-reported anxiety responses, lower perceptions of self-esteem, and greater intake of a highly palatable food (ice cream) when compared to a conventional Stroop task and when compared to values obtained from a control population, who also undertook the ego Stroop task. Therefore, predictions in respect of study 1 were supported.

The observation that both groups consumed similar amounts of food following exposure to the colour Stroop task is contrary to prior research where researchers have demonstrated disinhibition of dietary restraint in response to incongruent colour nouns (e.g., Rutledge & Linden, 1998; Wallis & Hetherington, 2004). For example, Rutledge & Linden (1998) reported a significantly greater consumption of chocolate chip cookies and crackers in restrained eaters (classified using to both the RS: Herman & Polivy (1980), and the 20-item disinhibition subscale taken from Stunkard & Messick's (1985) TFEQ), as compared to a control population, following exposure to three active coping tasks (mental arithmetic, incongruent colour Stroop, and word scramble). Wallis & Hetherington (2004) reported that dietary restraint (as assessed by the restraint subscale of the DEBQ; van Strien et al., 1986) was associated with greater intake of chocolate following exposure to an incongruent colour Stroop task, compared to a control condition, consisting of neutral words.

However, *in line* with the present study, Lattimore & Maxwell (2004) reported no significant group difference in snack food intake following exposure to a computer driven Stroop task containing colour nouns, *some* of which were incongruent colour words. Participants in the present study differed from restrained eating populations in the aforementioned studies in that they possessed not only restrained eating attitudes, but also bulimic attitudes. None of the aforementioned studies assessed levels of bulimic symptomatology in their restrained eating populations, making comparison with the present study difficult. However, the population employed in the present study was comparable to those employed by Levine & Marcus (1997) and Lattimore (2001).

Results of the present study are also contradictory to those of Levine & Marcus (1997) who reported, counter to their hypothesis, that non-clinical women with "significant bulimic symptoms" did not differentially increase their total intake of snack food items when exposed to an interpersonal stress task, that had the potential to be ego threatening, in that participants were required to prepare and deliver a three-minute speech about their negative qualities to a video camera that they believed to be filming them. However, in their study, there was a significant increase in carbohydrate intake following stress, but this effect was not mediated by bulimic status.

Findings in relation to total food intake in the present study are, however, similar to those of Cattanach et al. (1988) who reported a greater desire to binge eat following mood manipulation relating to interpersonal conflict and social interaction in non-clinical women with eating disorder symptomatology, compared to a control group. Unfortunately, actual food intake was not measured within Cattanach et al.' s (1988) study. The present results are also in line with those of Lattimore (2001) who found that dieters who self-reported binge-eating tendencies (BULIT-R; Smith & Thelan, 1984) were found to consume significantly more ice cream following exposure to an ego-threat Stroop task that was similar to the task employed within the present research, when compared to a general stressor (a fearful film). These findings are also in line with prior studies that report that *subliminally* presented emotional cues unrelated to eating can induce greater levels of eating in non-clinical women with bulimic attitudes (Patton, 1992; Waller & Mijatovich, 1998; Meyer & Waller, 1999).

Given that both tasks were similar in terms of cognitive loading, but that only the ego Stroop task provoked high self-reported anxiety, a lowering of self-esteem, and a greater intake of food, only for the target population, led to the suggestion that that the explicit presence of ego-threatening information may be important in relation to inducing binge-type behaviour. The results of study 1 were therefore interpreted as providing support for Heatherton & Baumeisters (1991) functional model of bingeing. Taken together, these results were also interpreted as providing support for more recently developed models of eating pathology (Cooper et al., 2004; Waller, submitted for publication – see Mountford et al., 2004).

Study 2 compared the effects of the ego-threat Stroop task (employed also in study 1 of this thesis) in two conditions (high vs low cognitive load) on mood (anxiety and self-esteem), food intake (ice cream) and physiological and biological reactivity in two target populations, females who displayed bulimic symptoms (who were also restrained eaters), and restrained eaters who did not display bulimic symptoms.

The two experimental conditions were comparable in that they both contained a task with high emotional loading (i.e., ego-threat stimuli), and they both demanded an *active* behavioural response. However, participants who completed condition 2 were provided with pre-test instructions for an immediate free recall of words contained within the Stroop task (*cued and immediate free recall*), whereas participants who completed condition 1 were not issued with pre-test instructions, but were also given an immediate free recall task to complete (*incidental and immediate free recall*). Thus, cognitive load (degree of difficulty to perform the task) was increased in condition 2 over condition 1. Recently, several researchers have concluded that a combination of *both* high cognitive load plus ego-threat is important in relation to the construction of a maximally 'efficient' stressor to induce dietary restraint (e.g., Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004). In addition, in condition 2 participants were required to *strategically* process the words within the Stroop task, whereas in condition 1 they were not. In this study, physiological (HR, SBP and DBP) and biological (salivary cortisol) responding was assessed during a baseline period, during task performance, and during the recovery period (during food ingestion).

A review of the eating pathology literature reveals that, although a number of researchers have demonstrated that overeating can occur in non-clinical females with bulimic symptoms when 'threat' information, unrelated to eating, is presented subliminally (Patton, 1992; Waller & Mijatovich, 1998; Meyer & Waller, 1999), and within a Stroop task that is deemed to primarily demand the automatic processing of information (Lattimore, 2004), to date, no studies have assessed the effects of tasks that demand primarily *strategic* processing on non-clinical females with bulimic symptoms, or restrained eaters. This limitation was addressed in study 2.

At the task phase, participants who were instructed to *strategically* process the information contained within the task for meaning, self-reported greater anxiety ratings than those who were instructed to override the meaning of the word, and respond to the colour. However, this [experimental condition] effect existed irrespective of level of eating pathology. Therefore, the prediction made in terms of self-reported anxiety ratings was not supported. Analyses in respect of self-esteem ratings and food intake revealed that the two target populations were found to have significantly *lower* self-esteem ratings, and a significantly *higher* intake of ice cream when compared to control populations following exposure to stress. These results existed irrespective of task type, suggesting that both the ego and ego-recall Stroop task exerted similar effects in terms of affecting self-esteem levels and food intake. Although mean ratings for the SSES and food intake were in line with the continuum model of bulimia (Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987), not all group comparisons achieved significance in accordance with the adjusted alpha level. Therefore predictions made in relation to self-esteem and food intake were not entirely supported. However, the possibility that this finding may exist because of a loss of power [to achieve a significant result] arising from relatively small cell sizes cannot be ruled out (see also Section 6.13). The two tasks also exerted similar [non-significant] effects on the three groups in terms of physiological and biological reactivity. These results do not therefore support the predictions made.

Taken together, the results obtained from study 2 suggest that despite the fact that the two target populations and the control group responded similarly [to both tasks] in terms of self-reported, physiological and biological reactivity, behaviourally they responded differently. In this respect, inspection of the group means suggested that intake existed as a function of symptom severity. These findings are in line with those reported previously by the author of this thesis (Lattimore & Caswell, 2004), where analyses suggested that restrained eaters who exhibited a physiological stress response (increased heart rate reactivity) consumed significantly more food than unrestrained eaters who show similar stress responses ($p<.001$). It was suggested that restrained responders (to the active coping task) seemed capable of overriding a physiological stress response that should (and normally does) suppress appetite/ingestive behaviour.

In relation to testing two competing theories of disinhibition of dietary restraint [the 'escape' theory and the cognitive load theory], it was originally intended that the two tasks differ in terms of cognitive loading, through the addition of conflicting task instructions. However, it was concluded that the two tasks may have been more similar than different in terms of their level of cognitive loading for the following reasons, a) food intake was a response to similar task combinations (i.e., in condition 1, the ego Stroop *plus* an immediate and unexpected word recall task, and in condition 2 the ego Stroop task *plus* word recall), b) results of the word recall task suggest that the two target populations may have strategically processed the information within the Stroop task in condition 1, despite instructions *not* to do so, but to respond only to the colour that the word was written in, whilst ignoring the meaning of the word.

However, the two target populations did overeat, in comparison to a control population, following exposure to tasks that both involved ego-threat. The results of this study also suggest that target populations (females with bulimic symptoms and restrained eaters) overate in response to a task that required the *strategic* processing of ego-threat information. These results therefore add support to the 'escape' model (Heatherton & Baumeister, 1991), and to the newer cognitive models of eating pathology (Cooper et al., 2004; Waller, submitted for publication – see Mountford et al., 2004).

***Ice cream intake by flavour (study 1 and 2)***

In respect of the intake of each of the three flavours of ice cream provided in study 1, for the ego Stroop condition, the HR/HB group consumed significantly more vanilla, chocolate and strawberry ice cream compared to the LR/LB group. There was no significant group difference for any of the three flavours of ice cream following exposure to the conventional Stroop task. In respect of intake of each of the three flavours of ice cream provided within study 2, for the ego Stroop condition, the HR/HB group consumed significantly more vanilla, chocolate and strawberry ice cream compared to the LR/LB group. There was no significant group difference for any of the three flavours of ice cream following exposure to the conventional Stroop task.

One interpretation of the pattern of results obtained was that the target populations preferred the taste of each of the three flavours of ice cream served significantly more than did the control group, causing them to consume more of each of the different flavours of ice cream presented. To investigate this possibility, ice cream 'liking' ratings for each of the three flavours, obtained during the bogus taste tests deployed in study 1 and 2 were analysed. Results from study 1 revealed that, although participants preferred the taste of the vanilla and chocolate ice cream served to them significantly more than the strawberry ice cream, there was no significant group or condition difference in ratings. Similarly, the results obtained from study 2 revealed that, although participants preferred the taste of the vanilla and chocolate ice cream served to them significantly more than the strawberry ice cream, there was no significant group or condition difference in ratings. Thus, it would appear that females who possessed both restrained eating and bulimic tendencies consumed significantly more of an ice cream they did not rate particularly highly when stressed (following exposure to the ego-threat Stroop task).

Study 3 was designed to address the limitation found within study 2 of this thesis, namely that the experimental protocol was not sufficiently constructed so as to allow an adequate test of the limited capacity or cognitive load theory of bingeing. In study 3, participants were required to complete a mental arithmetic task. All participants first completed condition 1, the MAT, with no distraction tape. The order of conditions 2 and 3 was randomised. Both cognitive demand and emotional content were increased in condition 2 (over condition 1) with the addition of an audio distraction tape, containing ego-threat words. Cognitive load alone was increased in condition 3 (over condition 1) with the addition of an audio distraction tape containing neutral stimuli. Words contained within the two audio distraction tapes were taken from Waller et al. (1996), and were employed in the emotional Stroop task used in study 1 and 2 of this thesis. MAT conditions 2 and 3 were followed by a *cued* and *immediate* free word recall task, wherein participants were required to freely recall as many words as they could remember of the threat and neutral words contained within the audio distraction tape. The addition of pre-test instructions for later recall of words in condition 2 and 3 also ensured that words contained within the audio tapes were purposefully attended to and therefore conditions 2 and 3 also involved the *strategic* processing of ego-threat (self-directed and ego-threat from others) and the matched neutral words that relate to each of the threat categories, contained within the audio tapes.

In terms of group differences at the task phase, comparisons undertaken in relation to self-reported negative affect and self-esteem ratings, cortisol reactivity and food intake values were found to be significantly higher for females with significant bulimic symptoms, when compared to the control population. For STAI, SSES, and food intake, values for this target population were also significantly higher than those of the restrained eaters. For restrained eaters, values for the SSES, cortisol and food intake were significantly higher than those obtained from the control population. Therefore, predictions made in relation to self-reported negative affect and food intake were supported, given that the results obtained existed as a function of symptom severity. The pattern of these results also adds support to the continuum model of eating pathology (Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987). The prediction for the STAI was not fully supported, in that values for the HR/HB group were significantly higher than both those of the restrained eaters and the control population. Similarly, the prediction made in relation to cortisol values was not fully supported, in that values for each of the target populations were significantly higher than those of the control population. Finally, the prediction made in relation to physiological reactivity was not supported, because no significant group differences were in existence. In addition, for all dependent measures, there was an effect of experimental condition.

Significant condition effects did exist in respect of self-reported anxiety ratings, SBP and cortisol. These results suggest that MAT2, containing both high cognitive load plus ego-threat was the most efficient stress condition. This finding is in line with those of Lattimore & Maxwell (2004) and Wallis and Hetherington (2004). However, a comparison of the high cognitive load (with neutral information: MAT3) and the low cognitive load task (with no audio tape: MAT1) revealed no significant difference in responding in terms of these variables. In addition, the three tasks exerted similar effects in terms of DBP, HR responding, self-reported self-esteem ratings and food intake, they existed also irrespective of level of eating psychopathology. Taken together, these results provide no support for the limited capacity model of disinhibition, and therefore contradict those of prior researchers, who have reported evidence to support this model (Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004; Ward & Mann, 2000).

Thus, as with study 2, the three populations responded relatively similarly in terms of physiological reactivity (HR, SBP, DBP), to each of the three experimental tasks. However, in terms of self-esteem, cortisol reactivity and food intake, values for the two target populations were significantly increased over those of the control population, irrespective of task type. In relation to theory, although condition 2 (high cognitive load plus emotional loading) appeared to be the most potent in terms of responding, for all participants [but particularly for the two target populations], it could be that the two target populations found all three stressors to be ego-threatening, with this perception triggering disinhibition of dietary restraint. Many studies have induced 'disinhibition' using tasks that contain an *implicit* threat to the ego (see Section 2.3). Such an interpretation of results would also add support to the 'escape' theory (Heatherton & Baumeister, 1991). Similarly, given that females with significant bulimic symptoms responded with significantly higher anxiety and self-esteem ratings, cortisol reactivity, and consumed more snack food than the control population, in relation to tasks that could be described as ego-threatening, these results might be interpreted as providing support for the newer cognitive models of BN (Cooper et al., 2004; Waller, submitted for publication – see Mountford et al., 2004).

Given that females who were classified as possessing high levels of dietary restraint overate in response to all tasks employed within this research, except for the colour Stroop task, employed in study 1, these results also add support to Herman & Polivy's (1980) dietary restraint theory.

***Single vs multiple food items***

In study 1 and 2, females with bulimic symptoms, and restrained eaters (study 2 only) were found to overeat in response to ego-threat stress, when only a single food item was presented. Only two laboratory studies have been conducted that have employed females with bulimic symptoms – one used a single food item and reported disinhibition in response to stress (Lattimore, 2001), the other used multiple food items and found no significant difference in intake between the target and control population (Levine & Marcus, 1997). The results of the present research (studies 1 and 2) are in line with those of Lattimore (2001), in that females with bulimic symptoms consumed significantly more ice cream when compared to a control population. Results of study 3 contradict those of Levine & Marcus (1997) in that this target population also consumed significantly more than a control population when multiple food items were presented. A comparison of study foods reveals that four of the six foods chosen for the study by Levine & Marcus (1997)(M&Ms, cookies, cheese crackers, and potato chips), selected to be food types often preferred by binge eaters (i.e. sweets, salty snacks, cookies, and pastries), were similar to the food items used within the present study. These foods were high in both fat and calories. However, Levine & Marcus (1997) also included pretzels and raisins. These food items were selected to provide an adequate range of food types and macronutrients.

It has been suggested that activation of the HPA axis, and the corresponding release of cortisol, may be related not only a greater consumption of food, but also to the selection of certain types of food, the consumption of which may result in a positive energy balance (e.g., sweet foods, fats, and carbohydrates) (e.g., Dallman et al., 2004). Support for this hypothesis is derived from an evaluation of the results from study 3. Significant cortisol release in response to stress was observed for the two target populations, in comparison to baseline values, and in comparison to a control population. Cortisol values for the control population were significantly elevated over baseline values. Results in relation to intake by taste class suggest that females with bulimic symptoms, and restrained eaters, demonstrate a preference for both sweet and salty foods, and consumed significantly more of these food types than did the control population. Control participants were found to prefer sweet foods only.

**Aim 1: Summary**

**Taken together, the results obtained from data that was processed using *categorical* analyses undertaken in relation to dependent measures relating to arousal and food intake for each of the three studies were interpreted as providing support for Herman & Polivy's (1980) restraint theory and their continuum model of eating pathology (Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987), for Heatherton & Baumeister's (1991) functional model of bingeing, and for the new generation cognitive models of the eating disorders (Cooper et al., 2004; Waller, submitted for publication – see Mountford et al., 2004). Restrained eaters, both with and without bulimic symptoms, were found to overeat in response to laboratory stress manipulations that contained a) 'implicit' ego-threat, or b) 'explicit' ego-threat stimuli, and also where the task demanded primarily the a) automatic [pre-conscious] or b) strategic [conscious] processing of ego-threat information. These tasks appear to trigger the HPA axis, thereby inducing the release of cortisol, which appears to be related to not only the amount of food ingested, but also the type of food ingested. The two target populations overate, with a preference for sweet and salty food items, when compared to a group of control females.**

**However, although the design of the experimental protocol employed within study 2 was deemed to be inadequate in respect of allowing a full test of the limited capacity or cognitive load theory of bingeing (Ward & Mann, 2000), results obtained from study 3, incorporating a more rigorous experimental design, revealed no support for this theory.**

**Aim 2: Arousal responses to [post-stress] food intake**

The second aim of the present research was to assess arousal responses [self-reported anxiety and self-esteem, and physiological and biological[16]] to food intake. Given that prior research results regarding the

[16] Physiological and biological mesures were employed in study 2 and 3 only.

effect of post-stress food ingestion are either conflicting or unavailable, no specific predictions were made in this respect.

Few studies have reported data relating to psychophysiological reactivity in relation to post-stress *food ingestion,* and existing prior research evidence in respect of self-reported assessment of mood in relation to 'bingeing' behaviour shows conflicting findings. For example, both the consumption of chocolate and spontaneous eating have been associated with an increase in the release of beta-endorphin (Dum et al., 1983; Davis et al., 1983), and sweet foods, such as chocolate have been shown to be associated with improved mood (Benton & Donohoe, 1999). Therefore, the consumption of highly palatable foods seems to elicit positive emotional changes, and it has been suggested that *bingeing* serves the function of alleviating feelings of negative emotional affect (Leon & Roth, 1977; Bruch, 1973; Kaplan & Kaplan, 1957; Lacey, 1986; Root & Fallon, 1989; Heatherton & Baumeister, 1991), induced by threats to the individual's emotional stability or self-esteem (i.e., ego-threats) (Heatherton & Baumeister, 1991). However, both positive (Ondercin, 1979) and negative (e.g., Kaye et al., 1986) changes in mood have been reported by clinical women following a binge, and restrained eaters have been reported to indicate that they experienced guilt in relation to the consumption of sweet or salty snacks (King et al., 1987). Therefore, one of the aims of the present research was to assess the [cognitive, physiological and biological] effects displayed by females classified as having high levels of dietary restraint and/or bulimic symptoms in relation to highly palatable foods consumed following exposure to stress.

Results obtained from study 1 suggested that females who self-reported bulimic symptoms, who undertook the ego Stroop task, perceived themselves to be *less* anxious, and self-reported *elevated* feelings of self-esteem following post-experimental food ingestion compared to a control population, and compared to values provided immediately following exposure to the experimental manipulation. This might suggest that the consumption of highly palatable food item [ice cream] may have elicited positive emotional changes, and that *bingeing* may serve the function of alleviating feelings of negative emotional affect (Leon & Roth, 1977; Bruch, 1973; Kaplan & Kaplan, 1957; Lacey, 1986; Root & Fallon, 1989; Heatherton & Baumeister, 1991), induced by threats to the individual's emotional stability or self-esteem (i.e., ego-threats) (Heatherton & Baumeister, 1991). These findings contradict those reported by

Rutledge & Linden (1998). Employing a study protocol similar to the one employed within this thesis [i.e., a distinct baseline, task, and a recovery phase involving food ingestion] these authors reported that post-stress food consumption was associated with *impaired* recovery rates for individuals classified as restrained eaters according to the RS (Herman & Polivy, 1980) and the TFEQ (Stunkard & Messick, 1985). However, the results obtained from study 2 and 3 of this thesis are more [but not entirely] in line with those reported by Rutledge & Linden (1998) in that they intimated that post-stress food consumption was associated with impaired recovery rates, particularly for females who self-reported bulimic symptoms.

For study 2, recovery phase values for self-reported anxiety (STAI) were significantly lower than values associated with the task phase, but remained significantly elevated when compared to baseline values, suggesting impaired recovery. However, these findings existed irrespective of experimental condition, and there were no significant group differences. SBP recovery phase values relating to the ego Stroop task were significantly lower than task values, but remained significantly elevated over baseline values. For the ego-recall Stroop task, SBP values for the recovery phase were similarly significantly lower than were task values, but were non-significantly different to baseline values, suggesting that 'recovery' had occurred. However, again, these results existed irrespective of level of eating psychopathology. For cortisol reactivity, for both of the experimental conditions, post-recovery values were as high as task values, and significantly elevated over baseline values, suggesting impaired recovery for each of the target populations, and the control population.

Significant group differences *did* occur in respect of the recovery phase values for both self-esteem ratings [SSES] and for DBP reactivity. Again, both tasks exerted similar effects, whereby post-recovery change scores for self-esteem ratings were significantly higher than post-recovery task change scores (following food ingestion), indicating more positive feelings of self-esteem. Post-hoc tests revealed that each of the target groups self-reported significantly *lower* self-esteem ratings than the control group. These data might suggest that the act of good ingestion had the effect of *raising* very low levels of self-esteem for the two target populations, induced through exposure to ego-threat, but not sufficiently so as to equate them with their pre-test level of self-esteem.

DBP values obtained for all populations were stable [and normal] across baseline *and* task recordings. However, recordings obtained in respect of the recovery period for the two target populations were significantly *elevated* in comparison to baseline values, task values, and in comparison to the control population. This significant increase in responding by the two target populations appears to be specifically associated with the recovery phase [and therefore with the act of food ingestion], and *not* to the act of undertaking a stressful task. This might indicate a physiological arousal response to the ingestion of ice cream, possibly arising from the perception of this food item as an 'illegal' food (Kaye et al., 1986; King et al, 1987). Conversely, this arousal response may have resulted as a consequence of the chemical properties of the food itself, given that food consumption can itself act as a 'stressor' that can challenge cardiovascular and metabolic homeostasis (Pacak et al., 1998; McCarty, 1989).

Similarly, for study 3, results relating to physiological and biological dependent measures [HR, DBP, and cortisol] revealed that values obtained during food ingestion, for each of the three experimental conditions, were still elevated over baseline values [but significantly lower than task values, except for cortisol values for MAT1 and MAT3], *for all participants*. Recovery phase DBP values were non-significantly different to those obtained during the baseline phase.

However, significant group differences associated with the recovery period were obtained in respect of self-reported mood [anxiety and self-esteem] and cortisol reactivity. For the two self-report measures [STAI and SSES], mean ratings for restrained eaters and controls obtained at the end of the recovery period were non-significantly different to those obtained at the end of the baseline phase. However, for females with bulimic tendencies, although post-recovery mean ratings were significantly lower than post-task ratings, they were still significantly elevated over ratings obtained at the end of the baseline phase, suggesting impaired recovery.

In respect of cortisol reactivity, post-recovery phase values for the two target populations were as high as post-task values, significantly higher than values obtained from the control population, and significantly elevated over baseline values. These data therefore also suggest that post-stress food consumption was associated with *impaired* recovery rates for individuals classified according to the BULIT-R (Smith &

Thelan, 1984), RS-R (Herman & Polivy, 1980), and DEBQ (van Strien et al., 1986) as possessing significantly bulimic symptoms and/or restrained eating attitudes.

**Aim 2: Summary**

**To summarise, taken together the majority of the data obtained from the three studies contained within this thesis in order to asses arousal responses to post-stress food ingestion suggest that such ingestion was associated with *impaired* recovery rates for all individuals, but more so for restrained eaters, and for females who self-report bulimic symptoms in particular. However, it should be acknowledged that any group differences detected during or at the end of the recovery phase (including food ingestion) *could* potentially have resulted from a sustained response to the stressor undertaken, rather than a specific cognitive (emotional) reaction to food ingestion. However, the findings in relation to DBP obtained from study 2 do suggest that this 'reaction' by the two target populations was specifically related to the recovery phase, and not the task phase. Therefore, an alternative explanation might be that the responses that occurred could potentially have resulted because of the [chemical] properties of the food itself (Pacak et al., 1998; McCarty, 1989), or as a consequence of the cognitive appraisal of the food items consumed as 'illegal' foods (Kaye et al., 1986; King et al, 1987). A remedy for this [in relation to future studies] may be to modify the experimental protocol to incorporate a pre-[taste-test] adaptation period in order to separate out reactivity associated with the stress phase, from reactivity associated with the recovery phase. It would also be beneficial to include an extended post-taste-test recovery period, in order to better assess 'time-to-recovery' or return to baseline for the different populations.**

***Stress-eating: Continuous analyses***

It was anticipated that there would be a positive and significant association between level of eating pathology and arousal responses, and a negative association between level of eating pathology and self-esteem ratings, obtained in respect of exposure to laboratory manipulations [unmasked emotional Stroop tasks] containing ego-threatening stimuli [study 1: condition 1, study 2: condition 1 and 2]. Results derived from the ego Stroop task, undertaken in study 1, revealed a positive and significant association between *each* of the three classification scales [RS-R, DEBQ, and BULIT-R] and self-reported negative affect. A negative and significant association was also found between *each* of the three classification scales and self-esteem ratings. Therefore the prediction was supported. These results suggest that ratings of perceptions of anxiety and self-esteem, reported following exposure to the ego-threat Stroop task, existed as a function of level of eating psychopathology. Therefore, these results provide support for the continuum model of BN ((Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987).

In relation to the ego Stroop task undertaken in study 2, the hypothesis was only partially supported in that although each of the three classification scales were positively and significantly related to STAI values, and negatively and significantly related to SSES values, no significant associations were obtained in relation to physiological and biological responding. For the ego-recall Stroop task a positive and significant association was obtained between each of the three classification scales and STAI values, and a negative and significant association was obtained in respect of the relationship between each of the dietary restraint scales [RS-R and DEBQ], but not the bulimia scale. The only [positive] and significant association obtained in relation to physiological and biological reactivity was one between values for the bulimia scale [BULIT-R] and SBP. Taken together, results suggest that restrained eating and bulimic attitudes are more closely related to self-reported measures of negative affect [anxiety and self-esteem] than physiological and biological arousal measures following exposure to tasks that contain self-directed ego threatening stimuli. This appears to be the case whether this information is processed more automatically or more strategically.

It was further suggested that there would be a positive and significant association between the time taken to colour-name self-directed ego threat words and total amount of food ingested. This prediction also received partial support, in that no significant association was obtained between *interference* scores for self-directed ego threat response times and food intake for study 1[17]. However, for study 2, although *raw* [median] values for ego-self threat stimuli were positively and significantly related to the total amount of food ingested for both the ego and the ego-recall Stroop tasks, no similar associations were observed in respect of interference values. When values were entered into multiple regression analyses, ego-self

[17] An assessment of raw [median] response times was not undertaken in study 1

raw [median] values were found to significantly predict food intake in relation to the ego Stroop task in study 2 [but not in relation to the ego-recall Stroop task].

**In summary, taken together, the results obtained from data that was processed using *continuous* analyses undertaken in relation to dependent measures relating to arousal and food intake for each of the three studies were interpreted as providing support for Herman & Polivy's (1980) restraint theory and their continuum model of eating pathology (Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987), for Heatherton & Baumeister's (1991) functional model of bingeing, and for the new generation cognitive models of the eating disorders (Cooper et al., 2004; Waller, submitted for publication – see Mountford et al., 2004). Further evidence for the importance of *self-directed* ego-threatening stimuli was obtained from both *categorical* and *continuous* analyses undertaken in respect of an assessment of the existence of information processing and memory biases for ego-threat stimuli. This evidence also provides support for the above mentioned theoretical perspectives, and will now be summarised.**

**Aim 3: Information processing and memory bias**

The third main aim of the current research was to ascertain the existence of information processing and memory biases for schema-relevant cues *unrelated* to eating (self-directed ego-threat) in non-clinical females who self-reported bulimic symptoms, and in restrained eaters, who self-reported no such symptoms. In consideration of the 'escape' theory of bingeing (Heatherton & Baumeister, 1991), the new generation schema-based emotional model of BN (Waller, submitted for publication – see Mountford et al., 2004), and the continuum model of BN (Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987) (see Chapter 3) the following predictions were made:

**Information processing bias**

**H4.** Target populations would demonstrate a significant *slowing* in the time taken to colour-name self-directed ego-threat stimuli when the task employed involved [primarily] the *automatic* processing of information [Study 1, condition 1; Study 2, condition 1], when compared to a control population, and when compared to the time taken to colour name matched neutral word stimuli.

**Memory bias**

**H5.** Target populations would demonstrate a greater recall of self-directed ego threat words when compared to a control population, and when compared to the number of matched neutral word stimuli correctly recalled.

It was also anticipated that the predicted [information processing and memory bias] results would exist as a function of symptom severity.

***Information processing: Categorical analyses***

It was predicted that when the ego Stroop task involved primarily the *automatic* processing of information [ego Stroop task – study 1 and study 2] group differences would exist between females with relatively bulimic attitudes, restrained eaters without bulimic attitudes, and controls in terms of the time taken to colour-name self-directed ego-threat stimuli [but not ego-threat from others]. It was expected that this effect might exist according to level of eating psychopathology. Specifically, females with relatively bulimic attitudes would show a significantly greater degree of 'escape from awareness' from self-directed ego threat, demonstrated through greater *interference* and *delay in time taken* to respond to colour-name self-directed ego threat information (but not ego-threat from others) than controls. Restrained eaters without bulimic attitudes would occupy an intermediate position between females with relatively bulimic attitudes and controls.

In respect of study 1, in line with the hypothesis, significant group differences occurred in respect of both raw [median] and interference times for ego-self threat stimuli, with values for the target population [females with significant bulimic symptoms] being significantly higher [indicating a *slowing* of responding] than those of the control population. Further, for the target population both raw and interference scores for ego-self threat information were significantly higher than those obtained in respect of matched neutral information.

In respect of the ego Stroop task employed within study 2, the prediction was not fully supported. Only two significant comparisons were obtained when raw (median) values relating to ego-self threat stimuli were analysed; restrained eaters were significantly slower to respond to self-directed ego-threat than neutral stimuli, and females with bulimic symptoms were significantly slower to respond to self-directed ego-threat stimuli than controls. When interference scores for the ego-self category were analysed significant group differences occurred wherein interference scores for restrained eaters were significantly higher (indicating a *slowing* in responding) than those of females with bulimic tendencies and controls. Interference scores for females with bulimic symptoms were significantly higher than those of controls. However, a problem that complicates the interpretation of results based on interference scores is the fact that interference scores for restrained eaters in relation to the ego-self category were obtained as a consequence of very fast responses to ego-self neutral word stimuli, rather than a greater slowing of response in relation to ego-self threat stimuli. Therefore, results obtained in relation to interference scores should be interpreted with some caution. Furthermore, contrary to expectations, interference scores in relation to the ego-other category contained within the ego Stroop task also revealed a greater *slowing* of responding by restrained eaters, compared to females with bulimic symptoms and controls.

It was further anticipated that when the task involves *strategic* processing with pre-test instructions for later free recall of Stroop word (ego-recall Stroop task), no significant group (females with bulimic symptoms, restrained eaters without bulimic symptoms, and controls) or category (ego-threat from self, ego threat from others, and their matched neutral words) differences would exist in terms of both response times or interference scores. This prediction was supported.

Utilizing raw latency scores, results revealed no significant group differences in times taken to colour-name stimuli contained within the four Stroop categories, within the three Stroop blocks, making up the Stroop task. In line with predictions, this suggests that the addition of a secondary task (cued and immediate free word recall) served to extinguish the information processing bias in relation to ego-self threat stimuli found for the ego Stroop task within this study and in study 1 of this thesis. For the ego-other category, interference times for restrained eaters were significantly greater than those of females with bulimic symptoms and the control group, with no significant difference between the latter two groups.

Finally, also in line with predictions, analysis of raw response times for ego-self threat stimuli revealed that times for the ego recall Stroop task were significantly *slower* than those of the ego Stroop task.

**Information processing: *continuous analyses***

It was further predicted that, when the task demanded the primarily automatic processing of information [ego Stroop task – study 1 and 2], there would be a positive and significant association between scores for self-directed ego threat words (but not ego-threat from others) and level of eating pathology. Specifically, women with a higher level of eating pathology would have higher response times and interference scores (indicating *slower* responding) for ego-threat self-stimuli (but not ego-threat from others). Conversely, it was anticipated that when the task demanded primarily *strategic* processing *with* pre-test instructions for later free recall of Stroop words, (ego-recall Stroop task), there would be no significant association between response times (or interference scores) and level of eating pathology for either of the two threat categories (self-directed ego threat, ego-threat from others).

In relation to study 1, only interference scores were reported. Results from these analyses were in line with the prediction. Interference scores for the ego-self threat category were positively and significantly related to each of the three classification scales. No significant correlations were obtained in respect of values obtained in respect of the ego-other category. In respect of study 2, the prediction was not fully supported. A positive and significant association was revealed between ego-self raw [median] values for each of the three classification scales. A similar association was found in relation to interference values for the ego-self category and the two dietary restraint scales [RS-R and DEBQ], but not for the bulimia scale [BULIT-R]. This prediction was also *not* fully supported. Both raw and interference values for ego-self threat *were* found to be positively and significantly associated with each of the dietary restraint scales, but not the bulimia scale.

**Memory bias: categorical analyses**

***Do target populations demonstrate an 'explicit' memory bias for ego-threat stimuli?***

For study 1, although mean values, associated with difference analyses, intimated the possibility of an explicit memory bias for ego-threat words (but not ego-threats from others) in females with bulimic symptoms, compared to controls, all comparisons (group and Stroop word category) failed to achieve significance according to the adjusted alpha level. In line with study 1, the results of study 2 also showed no evidence of an explicit memory bias for ego-threat in the two target populations, when data were analysed categorically. However, in study 3, the results of the immediate word recall task showed very clearly that the two target populations recalled significantly more ego-self threat than neutral words. Moreover, females with bulimic symptoms recalled significantly more words than the control population. Although recall for restrained eaters occupied an intermediate position, group comparisons involving this group did not achieve significance. One interpretation for the pattern of word recall results across the three studies is that, when information is presented visually, target populations are able to engage in cognitive avoidance of the information. However, when the information is presented via audiotape, they are less well able to deploy this strategy. Further investigation is now needed in order to clarify these findings. For example, a limitation of the present research is that continuous analyses were not undertaken or reported in respect of data relating to number of words correctly recalled in Study1 and Study 2 of this thesis.

***Aim 4: Habituation effects/Temporal responding: The problem of 'automaticity'***

The fourth aim of the present research was to assess whether temporal (see Section 4.7.1) and habituation (see Section 4.7.4) effects occur in terms of the information processing of ego-threat stimuli, when information is processed over several trials. Given that prior research results are conflicting or unavailable, no specific predictions were made in this respect.

One of the issues that exists within the information-processing literature is the extent to which the emotional Stroop task demands the automatic processing of information contained within it. A significant *slowing* of responding by eating disordered individuals to tasks such as the unmasked Stroop task, that are deemed to primarily demand the *automatic* processing of information, has been interpreted as attentional bias *towards* threat stimuli. Similar [slowing] responses to tasks that primarily demand the *strategic* processing of information are interpreted as a cognitive avoidance away from threat that is perceived to be personally relevant. The problem of 'automaticity' of responding was addressed within the present research in two ways. Firstly, by including a word recall task within the experimental protocols, that were undertaken with either incidental or cued pre-test instructions for later word recall, with immediate or delayed word recall. Secondly, by including physiological dependent measures in an attempt to detect whether a 'shift' from preconscious to conscious processing occurs over the course of the completion of a stress manipulation for target populations [females who self-report bulimic and/or restrained eating attitudes and behaviours], when the manipulation contains stimuli that are particularly salient to these target populations, when the task is presented over several blocks or matrices.

According the Beck & Clark's (1997) model of anxiety, conscious recognition of 'threat' that is perceived to be personally relevant should be accompanied by ANS activity [increases in HR and BP]. Therefore, no reactivity should be in evidence early on in the task, if the stimuli contained within the task are being processed pre-consciously. If these stimuli subsequently enter conscious awareness, this 'shift' in processing should be accompanied by an increase in autonomic arousal, particularly for individuals who perceive the stimuli to be personally threatening.

Study 1 employed an unmasked ego Stroop task, with delayed word recall (>30 minutes). Results showed that participants were able to recall some words that were contained within the Stroop task, suggesting that stimuli contained within the Stroop task were processed at a conscious level (strategically processed), thereby enabling recall from LTM. This might suggest that the slowing of responding associated with the emotional Stroop task represents cognitive avoidance away from [rather than towards] salient information – in this case, 'threat' stimuli that are unrelated to eating pathology. Another consideration might be that of the existence of 'temporal effects', whereby stimuli are processed more automatically at the start of the task, and then more strategically later in the task, as personally relevant information begins to enter conscious awareness. This suggestion is in line with that of Meyer & Waller (1997), who suggest that the two processing types are interconnected. Drawing on Beck & Clark's (1997) model of information processing in anxiety, Meyer & Waller (1997) hypothesize a *temporal* pattern of cognitive responding, whereby an initial hyper-vigilance and orientation towards 'threat' information [that is deemed to be personally relevant] occurs in the first instance, followed by cognitive avoidance of threat once the threat information enters full conscious awareness. According to Beck & Clark (1997), the process of processing information as threatening involves three stages, as follows:

The first stage involves the initial registration of the stimulus. This recognition is said to be very rapid, automatic, involuntary, generally outside of conscious awareness, and involves no strategic or elaborative processing at all. The detection of negative and personally relevant stimulus leads to activation of the next stage of threat processing – *immediate preparation*. The *primal mode* (a cluster of interrelated schemas embodying more primitive and immediate cognitive, affective, behavioural, and physiological patterns) is activated. One characteristic of primal responding includes activation of the ANS in preparation for enacting defensive behaviours such as fight or flight. Thus, progression to stage 2 would involve a significant increase in heart rate and blood pressure reactivity, together with the release of cortisol, if the 'stressor' is potent enough to trigger the HPA axis. Ultimately, primal processing is said to involve a mixture of both automatic and more elaborative or strategic processing. It is automatic because it is rapid, involuntary, inflexible and primarily stimulus-driven, but also consists of more elaborative, controlled processing – the beginning of primary threat appraisal or the (higher level) semantic analysis of the threat stimulus. The final stage in the cognitive model of anxiety involves activation of elaborative, semantic information processing that is slow, effortful and schema driven, where the individual engages in a deeper analysis of the threatening situation or stimuli. One possible outcome that can occur at this stage is that feelings of anxiety may subside because the individual has engaged in some defensive behaviour such as escape or avoidance (see also Section 3.4.2).

Support for the assertion that an initial attentional bias towards threat maybe followed by a later avoidance process comes from a study undertaken by Meyer et al. (2000), employing a non-clinical sample. This study allowed for temporal factors to be considered. Fifty female students completed a computer-driven threat processing task, that assessed the speed of processing of self-directed ego threat words following different inter-stimulus intervals of 500, 1,000, 1,500 and 2,000 ms. Results showed that the women were significantly slower to process ego-self threat cues following the 2,000-ms interval than following the other intervals. Those women with increased levels of bulimic attitudes (assessed using the EDI) were slower to process threats following the 1,500-ms interval, but not after the longer or shorter intervals. These results suggest a pattern of cognitive avoidance that increases over time, when individuals have a greater length of time to process the information.

Within the present research, the temporal effects of exposure to 'threat' were assessed via the presentation of both the [Stroop and MAT] tasks employed over several blocks/matrices. Self-report ratings of mood [anxiety and self-esteem], physiological (SBP, DBP) and biological (salivary cortisol) reactivity measures were obtained at the end of each block/matrix. A finer detailed assessment obtained in the form of continuous HR monitoring. However, results obtained from each of the three experiments contained within this thesis revealed an increased and sustained response across the task phase of the experimental protocol for all tasks [aside from the colour Stroop task, employed in study 1], and with no change [increase or decrease in responding] throughout the duration of the task phase. Therefore, the results obtained from the studies within this thesis add no support for the suggestion that a *temporal* pattern of cognitive responding, whereby an initial hyper-vigilance and orientation towards 'threat' information [that is deemed to be personally relevant] occurs in the first instance, followed by cognitive avoidance of threat once the threat information enters full conscious awareness (Beck & Clark, 1997; Meyer et al., 2000; Meyer & Waller, 1997). However, each block/matrix was 5 minutes in length, and it could be that this suggested 'shift' from pre-conscious to conscious processing occurs very rapidly, or early on within the first block/matrix presented. In this event, difference comparisons in respect of blocks/matrices averages might reveal no significant effects, simply because the assessment is not sufficiently fine detailed. Therefore, it would be interesting to investigate this further by conducting further analyses in respect of HR reactivity, whereby group differences in mean minute-by-minute responding is assessed, or where data are analyzed in relation to 30 second epochs. Further research limitations will now be discussed.

**Research limitations**

As mentioned earlier in this Chapter, no continuous analyses were undertaken or reported in relation data relating to word recall [all studies]. Neither were continuous analyses undertaken for *all* other dependent measures employed within experiment 3. Given that target populations were found to exhibit significantly higher cortisol responding to stress [compared to controls], it is possible that positive and significant associations may have been highlighted between eating psychopathology [RS-R, DEBQ, and BULIT-R], total amount of food ingested, intake of specific classes of foods [sweet, salty, and bland], or of specific macronutrients [fats, proteins, carbohydrates], and physiological [HR, SBP, and DBP] and biological [salivary cortisol] responding. Further, no continuous analyses were undertaken in respect of dependent measures obtained during baseline and recovery phases. Results from such analyses, particularly the testing of interaction effects using multiple regression analyses, may have added clarity to the present findings.

***Full randomisation of experimental conditions***

A further limitation associated with study 3 of this thesis revolves around the issue of full randomisation in terms of the presentation of different conditions in a within subjects design. In study 3 all participants first undertook MAT1 (the no tape condition), and thereafter the order of presentation of MAT2 and MAT3 was randomised. In order to establish whether this lack of full randomisation impacted on the results obtained, further difference analyses would be required that involved entry of the values obtained from each of the dependent measures obtained in relation to MAT 1 as covariates.

***Use of the Median split***

Highlighted within Section 6.13 of this thesis were several potential problems that have been associated with the act of the splitting of groups at the median prior to analyses. One such problem is a reduction in power to achieve a significant result. Therefore, the possibility of the existence of a Type II error should not be ruled out in relation to some of the 'difference' analyses undertaken within the present research that failed to attain statistical significance, but where mean values were in the predicted direction. For example, the examination of group and Stroop word category differences in the recall of the Stroop task stimuli.

Another problem associated with the creation of groups through dichotomization is that it can make comparison of findings across studies difficult. For each of the three studies contained within this thesis, individuals were classified according to cut-off of 80 on the BULIT-R, but according to different median values in respect of the dietary restraint classification scales (RS-R: Study 1 and 3 = 14, Study 2 =15, and DEBQ: Study 1 = 2.9, Study 2 = 2.8, and Study 3 = 2.7). In hindsight, it may have been more advantageous to classify individuals according to the same median value for each scale, for all studies, in order to allow a better comparison across the three studies contained within this thesis.

***Psychophysiological measurement***

Very few studies of stress-induced eating have included physiological and biological dependent measures in conjunction with food intake. No studies have assessed physiological and biological reactivity responses to emotionally salient 'threat' information that is unrelated to eating in non-clinical women who self-report restrained eating and bulimic attitudes and behaviours. Given the available evidence (see Section 6.11) it was considered important that physiological and biological reactivity be assessed at baseline, during exposure to stress or emotionally salient stimuli, and also during the act of food consumption, occurring as a consequence of such exposure.

In terms of the assessment of *basal* levels of cortisol, clinically eating disordered women with AN, BN, BED, and the night eating syndrome have been found to exhibit higher levels (Putignano et al., 2001; Pirke et al., 1992; Gluck et al., 2004a; Birkentvedt et al., 1999), in comparison to controls. In non-clinical women, both salivary and urinary cortisol have been shown to be either increased in individuals high in dietary restraint (Anderson et al., 2002; McLean et al, 2001), or not significantly different between restrained and unrestrained individuals (Beiseigel & Nickols-Richardson, 2004). In the present studies [2 and 3], there was no significant difference between populations of non-clinical females with bulimic symptoms (who were also restrained eaters), restrained eaters, without bulimic symptoms and controls in terms of baseline salivary cortisol values.

It was suggested that a consideration of specificity of physiological and biological responding might explain the commonly observed individual differences in both the amount of food ingested [hyper- vs hypophagia], and the types of foods selected in response to stress.

No significant correlations between physiological and biological reactivity and food/water intake were observed for either the ego or the ego-recall Stroop task. However, a limitation of the present research is that no analyses were undertaken separately for the three populations, and no correlation analyses at all were conducted in respect of values obtained in study 3. Other researchers have undertaken population specific analyses in order to add clarity to initial results obtained. For example, Rutledge and Linden (1998) did undertake separate analyses for restrained and unrestrained eaters. Their study showed that when correlations between physiology and food consumption were undertaken separately for restrained and unrestrained eaters, the relationship for unrestrained eaters was negative and significant. In a normal population, this would be expected, since studies show that increased autonomic reactivity leads to the release of appetite inhibiting catecholamines and to a variety of gastric changes believed similarly to suppress eating (Blair et. al., 1991). However, for restrained eaters the correlation was non-significant. This suggests the possibility that restrained eaters may be less sensitive to physiological signs of stress than unrestrained eaters, or even that they have acquired a sort of conditioned appetite response, for which (certain types of) stress has become an eliciting stimulus.

Similarly, a study undertaken by the present author (Lattimore & Caswell, 2004), employing an active coping task (see Section 4.4.9) also revealed that the data on physiological reactivity was, by itself, inconclusive, as both stress tasks did not produce credible increases in autonomic nervous system (ANS) activity when one examined baseline versus task averages. However, when data were broken down, by examining change scores for heart rate reactivity (task minus baseline values), and subsequently identifying responders and non-responders, overall differences in amount of food consumed by the two groups were observed following exposure to the active coping task. These small differences were further moderated when restraint status was considered. Later analyses suggested that restrained eaters who exhibit a physiological stress response (increased heart rate reactivity) consume significantly more food than unrestrained eaters who show similar stress responses ($p<.001$). These results suggest that restrained responders (to the active coping task) seem capable of overriding a physiological stress response that should (and normally does) suppress appetite/ingestive behaviour. Therefore, clarity may be added to the present findings through the addition of further analyses.

**Implications for theory**

Implications of the present results for the theoretical models discussed within this thesis are presented with due consideration/acknowledgement of the research limitations discussed above. In particular the need for clarification of these results via the addition of further analyses and further research studies (see below: Recommendations for Future Research). Taken together, the results of the three experiments reported within this thesis, obtained from both categorical and continuous analyses, revealed only very limited support for the cognitive load/limited capacity model (Ward & Mann, 2000). Support was obtained for the 'escape' theory. Results were also supportive of other theoretical models of dietary restraint (restraint theory: Herman & Polivy, 1980), and of clinical eating psychopathology [the continuum model of BN: Herman & Polivy, 1988; Hsu, 1990; Polivy & Herman, 1985, 1987, and the new generation [emotional] cognitive models of BN: Cooper et al., 2004; Waller, submitted for publication – see Mountford et al., 2004].

Restraint theory posits that restrained eaters are characterised by an anomalous eating pattern that consists of frequent bouts of dieting, interspersed with periodic overindulgence – the 'disinhibition' hypothesis (Herman & Polivy, 1980). According to this theory, one of the main disinhibitors of dietary restraint is said to be exposure to psychological stress.

This 'escape' theory (Heatherton & Baumeister, 1991) suggests bingeing *indirectly* moderates the negative affective state via the process of 'cognitive narrowing' (a purposeful shift to low levels of awareness) to reduce awareness of emotional states. *'Escape from self-awareness'* occurs through the blocking of cognitions (in this instance negative emotions derived from ego-threat) and a narrowing of attention to the immediate stimulus environment. The individual's lower level of self-awareness enables avoidance of meaningful thought. The narrowing of attention disengages the normal inhibitions against eating and also allows an uncritical acceptance of irrational beliefs and thoughts. This leads to disinhibition. This lowering of awareness and blocking of cognitions is similar to the concept of *dissociation.*

The new generation emotional models of the eating disorders attempt to address deficiencies apparent in earlier models (e.g., Fairburn, 1981; 1997; Fairburn & Cooper, 1989; Fairburn et al., 1986; Garner & Bemis's, 1982; Vitousek, 1996; Vitousek & Hollon, 1990). In contrast to earlier cognitive models of eating pathology, these newer models advocate a role for the experience of negative emotional affect, and the individual's ability to cope with this experience, in the aetiology and maintenance of eating psychopathology. In particular, emphasis is placed on the way that the individual processes 'threat' information (e.g., ego threat) that is unrelated to eating, in the maintenance of pathology. These results also suggest that overeating may represent a coping mechanism, deployed in order to deal with negative emotions, once activated (Waller – submitted for publication – in Mountford et al., 2004).

***Real world implications***

Individuals who exist within a University environment are persistently exposed to ego-threat (e.g., giving presentations, undertaking oral and written examinations). Given the results obtained, it would appear that female students who demonstrate restrained eating tendencies are particularly at risk of becoming overweight and obese, or may more easily progress to a clinical status. Non-clinical females who also demonstrate bulimic symptoms may be at even higher risk. This research would suggest the need for support groups and interventions to prevent such occurrences. Further, the results obtained from the present research suggest the need for researchers to include an assessment of bulimic symptoms when designing studies assessing stress-eating.

***Therapeutic implications***

Therapeutically, these findings indicate that addressing cognitive avoidance is likely to be valuable in working with individuals who display behaviours that serve the function of avoiding the processing of ego threats. Meyer et al. (2005) have suggested that effective therapy may require an element of exposure to the avoided cognitions, so that there is an opportunity for the learned value of avoidance to be extinguished.

Given the responding demonstrated by *each* of the target populations included within this research, it may be that the emotional Stroop task, incorporating ego-threat words, may *not* be a useful tool for measuring *responding* to threat in clinical populations, or as a measure of therapeutic change.

***Recommendations for Future Research***

a) Further studies are now needed in an attempt to add clarity to the findings obtained from the studies reported within this thesis. The question of whether an *explicit* memory bias for ego-self threat information requires clarification. Results obtained from the studies contained within this thesis suggest that an explicit memory bias for self-directed ego threat stimuli exists for females who self-report bulimic symptoms [when compared to a control population], and for restrained eaters [when compared to neutral stimuli] when stimuli are presented via audio tape, and accompanied by the cued and immediate free word recall. Conversely, an explicit memory bias was not in evidence when stimuli were presented visually, with either incidental and delayed, or cued and immediate free word recall, according to statistical tests of [means] difference comparisons, although the patterns obtained in respect of mean values [target populations vs controls; recall of threat vs neutral stimuli] did intimate the possibility of the existence of an explicit memory bias, particularly for females who self-reported bulimic symptoms. Therefore, clarification is needed via further experimentation.

In this respect, it would be beneficial to repeat study 3, using a between [rather than within] subjects design, with *incidental* and *delayed* free word recall. In addition, tasks that involve the *visual* and *explicit* processing of ego-self threat stimuli (e.g., the anagram task) might also be employed with conditions that demand the immediate or delayed free recall of stimuli, with non-clinical females who self-report restrained and bulimic attitudes and behaviours in order to assess information processing of 'threat' that is unrelated to eating.

b) Also in terms of the current research, although attributional information was gathered from participants following the conclusion of experiment 3 using the EASQ-R (see Section 6.3.6), this information is not reported, given that it was not central to the main themes. Results arising from this scale suggest that restrained eaters, both with and without bulimic symptoms, who are disinhibited by stress in the laboratory possess an external attribution style for indulgent food consumption. These findings are in line with other researchers who report that restrained eaters who are disinhibited by a high calorie pre-load, and individuals with EDI symptoms also possess an external attribution style (i.e. stable, global, and external causes) (Rotenberg & Flood, 1999; Rotenberg et al., 2002).

c) Experiment 3 revealed a significant group difference in cortisol reactivity, with both females with bulimic symptoms and restrained eaters having a significantly a higher reaction than unrestrained eaters. Given that one of the effects of cortisol release is to increase gastric secretion, and bulimic patients sometimes have delayed gastric emptying, future studies should include measurement of the electrogastrogram (EGG) to assess whether group differences in *gastrointestinal* reactivity in response to different types of stress exist, that might be related to subsequent eating behaviour. The EGG allows a non-invasive assessment of gastric pacemaker activity and when visually inspected reveals normal (3 cycles per minute) gastric functioning (in humans) or gastric dysrhythmias. The present author is currently engaged in such studies with non-clinical females and males who demonstrate disordered eating behaviour (females with bulimic and restrained eating attitudes and behaviours, and males and females who demonstrate symptoms of muscle dysmorphia).

d) Within the current research, ratings of perceptions of hunger and thirst were obtained as a manipulation check prior to experimentation, but were not employed subsequently. The measure employed was also very crude. Hunger has various attributes (e.g. irritability, stomach emptiness, upper abdominal discomfort, etc.) but these attributes have rarely been systematically explored. Future studies might include the development of a questionnaire that contains a range of descriptors designed to determine the dimensions of hunger at various stages of the experimental protocol.

e) The majority of studies investigating the stress-eating relationship, including the present research, have employed female samples. In addition, in terms of studies examining cognitive interference effects, only 3 have included male participants, and none, to my knowledge, have assessed an attentional bias towards ego-threat stimuli in males who demonstrate disordered eating behaviour – such as those with muscle dysmorphia. Future studies might remedy this.

f) Given the problem of assessing the extent to which the unmasked Stroop task involves the *automatic* [rather than strategic] processing of information, future studies might include a 'masked' Stroop task within a laboratory protocol similar to the one used within this research in order to assess information processing and memory bias for ego-self threat stimuli.

# APPENDICES

**APPENDIX 1**

## CONFIDENTIALITY AND CONSENT FORM

Participant No. ____

**Study Title:** ***The relationship between performance on laboratory tasks, emotions and taste perception.***

We are requesting that you participate in a study looking at the effects of laboratory tasks commonly used in psychology research, on various psychological, physiological and behavioural variables. The tasks include some or all of the following:

a) Performing a computer reaction-time task
b) Relaxing
c) Tasting and rating food items
d) Completing questionnaires
e) Providing saliva samples

**Eligibility to participate in this study will be subject to your responses to the following questions:**

**1) Do you have ANY medical problems, including coronary heart disease, hypertension, dyslexia or epilepsy?**

YES

NO

**IF YES, PLEASE PROVIDE DETAILS BELOW:**

..........................................................................................................................................
..........................................................................................................................................
..........................................................................................................................................
..........................................................................................

**2) Do any of your family members suffer from coronary heart disease, hypertension or epilepsy**

YES

NO

**IF YES, PLEASE PROVIDE DETAILS BELOW:**

..........................................................................................................................................
..........................................................................................................................................
..........................................................................................................................................
..........................................................................................

**3) Are you pregnant?**

YES

NO

**4) Do you have ANY food allergies?**

YES

NO

**5) Do you smoke cigarettes?**

YES

NO

**6) Do you use ANY medications?**

YES

NO

**IF YES, PLEASE PROVIDE FULL DETAILS BELOW:**

................................................................................................................................................
................................................................................................................................................
.........................................................................................................

**7) Is ENGLISH your first language?**

YES

NO

**8) Do you normally wear glasses to aid your vision?**

YES

NO

---

ALL INFORMATION THAT YOU GIVE, WHETHER WRITTEN OR VARBAL, DURING THIS STUDY WILL BE STRICTLY CONFIDENTIAL. ALTHOUGH YOU WILL BE ASKED FOR YOUR NAME AT THE BEGINNING, THIS WILL ONLY BE USED TO KEEP TRACK OF INFORMATION YOU PROVIDE ON RATING SHEETS THAT WILL HAVE AN ASSIGNED CODE NUMBER. LISTS OF NAMES LINKED TO CODE NUMBERS WILL BE DESTROYED AT THE END OF THE EXPERIMENT AND WILL AT ALL TIMES BE AVAILABLE ONLY TO THE EXPERIMENTER.

YOU ARE FREE TO WITHDRAW FROM THE STUDY AT ANY POINT UP UNTIL YOU COMPLETE THE EXPERIMENT IF YOU FEEL THAT YOU NO LONGER WISH TO TAKE PART FOR WHATEVER REASON.

A FULL DESCRIPTION AND DEBRIEFING WILL BE PROVIDED AT THE END OF THE EXPERIMENT. I WOULD BE GRATEFUL IF YOU DO NOT DISCLOSE ANY INFORMATION ABOUT THE STUDY TO OTHER INDIVIDUALS AS THIS MIGHT CONFOUND EXPERIMENTAL RESULTS.

---

I understand what is involved in this experiment and the procedure has been explained to me in as much detail as possible. I accept the confidentiality guarantee that has been provided. I am willing to take part on the understanding that there is no perceptible risk to my health and safety and that a full explanation of the purpose of the study will be provided when the experiment is complete. I am also willing to avoid telling other individuals about the study once I have been debriefed.

Participant's Signature: ______________________ Date: ______________________

Experimenter's Signature ______________________

Thank you for your co-operation. A copy of this consent form can be made available on request

APPENDIX 2

## Revised Restraint Scale: RS-R

1. How often are you dieting? (Circle one)

   **Never Rarely Sometimes Usually Always**

2. What is the maximum amount of weight (in pounds) you have ever lost within one month? )(Circle one)

   **0-4 5-9 10-14 15-19 20+**

3. What is your maximum weight gain (in pounds) within a week (Circle one)

   **0-1 1-2 2-3 3-5 5+**

4. In a typical week, how much does your weight (in pounds) fluctuate? (Circle one)

   **0-1 1-2 2-3 3-5 5+**

5. Would a weight fluctuation of 5lbs. affect the way you live your life (Circle one)

   **Not at all Slightly Moderately Very Much**

6. Do you eat sensibly in front of others and splurge alone? (Circle one)

   **Never Rarely Often Always**

7. Do you give too much time and thought to food? (Circle one)

   **Never Rarely Often Always**

8. Do you have feelings of guilt after overeating? (Circle one)

   **Never Rarely Often Always**

9. How conscious are you of what you`re eating? (Circle one)

   **Not at all Slightly Moderately Extremely**

10. How many pounds over your desired weight were you at your maximum weight (Circle one)

   **0-1 1-5 6-10 11-20 21+**

## The Bulimia Test: BULIT-R

**Answer each question by circling the appropriate answer. Please respond to each item as honestly as possible. Remember all of the information you provide will be kept strictly confidential.**

**1. I am satisfied with my eating patterns.**

1. agree
2. neutral
3. disagree a little
4. disagree
5. disagree strongly

**2. Would you presently call yourself a "binge eater"?**

1. yes, absolutely
2. yes
3. yes, probably
4. yes, possibly
5. no, probably not

**3. Do you feel you have control over the amount of food you consume?**

1. most or all of the time
2. a lot of the time
3. occasionally
4. rarely
5. never

**4. I am satisfied with the shape and size of my body.**

1. frequently or always
2. sometimes
3. occasionally
4. rarely
5. seldom or never

**5. When I feel that my eating behaviour is out of control, I try to take rather extreme measures to get back on course (strict dieting, fasting, laxatives, diuretics, self-induced vomiting, or vigorous exercise)**

1. always
2. almost always
3. frequently
4. sometimes
5. never or my eating behaviour is never out of control

**6. I use laxatives or suppositories to help control my weight.**

1. one a day or more
2. 3-6 times a week
3. once or twice a week
4. 2-3 times a month

5) once a month or less (or never)

**7. I am obsessed about the size and shape of my body.**

1. always
2. almost always
3. frequently
4. sometimes
5. seldom or never

**8. There are times when I rapidly eat a very large amount of food**

1. more than twice a week
2. twice a week
3. once a week
4. 2-3 times a month
5. once a month or less (or never)

**9. How long have you been binge eating (eating uncontrollably to the point of stuffing yourself)?**

1. not applicable; I don`t binge eat
2. less than 3 months
3. 3 months-1 year
4. 1-3 years
5. 3 or more years

**10. Most people I know would be amazed if they knew how much food I can consume in one sitting.**

1. without a doubt
2. very probably
3. probably
4. possibly
5. no

**11. I exercise in order to burn calories.**

1. more than 2 hours per day
2. about 2 hours per day
3. more than 1 but less than two hours per day
4. one hour or less per day
5. I exercise but not to burn calories or I don`t exercise

**12. Compared with women your age, how preoccupied are you about your weight and body shape?**

1. a great deal more than average
2. much more than average
3. more than average
4. a little more than average
5. average or less than average

**13. I am afraid to eat anything for fear that I won`t be able to stop.**

1. always
2. almost always
3. frequently
4. sometimes
5. seldom or never

**14. I feel tormented by the idea that I am fat or might gain weight.**

1. always
2. almost always
3. frequently
4. sometimes
5. seldom or never

**15. How often do you intentionally vomit after eating?**

1. 2 or more times a week
2. once a week
3. 2-3 times a month
4. once a month
5. less than once a month or never

**16. I eat a lot of food when I`m not even hungry.**

1. very frequently
2. frequently
3. occasionally
4. sometimes
5. seldom or never

**17. My eating patterns are different from the eating patterns of most people.**

1. always
2. almost always
3. frequently
4. sometimes
5. seldom or never

**18. After I binge eat I turn to one of several strict methods to try to keep from gaining weight (vigorous exercise, strict dieting, fasting, self-induced vomiting, laxatives, or diuretics).**

1. never or I don`t binge eat
2. rarely
3. occasionally
4. a lot of the time
5. most or all of the time

**19. I have tried to lose weight by fasting or going on strict diets.**

1. not in the past year
2. once in the past year
3. 2-3 times in the past year
4. 4-5 times in the past year
5. more than 5 times in the past year

**20. I exercise vigorously and for long periods of time in order to burn calories.**

1. average or less than average
2. a little more than average
3. more than average
4. much more than average
5. a great deal more than average

**21. When engaged in an eating binge, I tend to eat foods that are high in carbohydrates (sweets and starches).**

1. always
2. almost always
3. frequently
4. sometimes
5. seldom, or I don`t binge

**22. Compared to most people, my ability to control my eating behaviour seems to be:**

1. greater than others` ability
2. about the same
3. less
4. much less
5. I have absolutely no control

**23. I would presently label myself a "compulsive eater" (one who engages in episodes of uncontrolled eating).**

1. absolutely
2. yes
3. yes, probably
4. yes, possibly
5. no, probably not

**24. I hate the way my body looks after I eat too much.**

1. seldom or never
2. sometimes
3. frequently
4. almost always
5. always

**25. When I am trying to keep from gaining weight, I feel that I have to resort to vigorous exercise, strict dieting, fasting, self-induced vomiting, laxatives, or diuretics.**

1. never
2. rarely
3. occasionally
4. a lot of the time
5. most or all of the time

**26. Do you believe that it is easier for you to vomit than it is for most people?**

1. yes, it`s no problem at all for me
2. yes, it`s easier
3. yes, it`s a little easier
4. about the same
5. no, it`s less easy

**27. I use diuretics (water pills) to help control my weight.**

1. never
2. seldom
3. sometimes
4. frequently
5. very frequently

**28. I feel that food controls my life.**

1. always
2. almost always
3. frequently
4. sometimes
5. seldom or never

**29. I try to control my weight by eating little or no food for a day or longer.**

1. never
2. seldom
3. sometimes
4. frequently
5. very frequently

**30. When consuming a large quantity of food, at what rate of speed do you usually eat?**

1. more rapidly than most people have ever eaten in their lives
2. a lot more rapidly than most people
3. a little more rapidly than most people
4. about the same rate as most people
5. more slowly than most people (or not applicable)

**31. I use laxatives or suppositories to help control my weight.**

1. never
2. seldom
3. sometimes
4. frequently
5. very frequently

**32. Right after I binge eat I feel:**

1. so fat and bloated I can`t stand it
2. extremely fat
3. fat
4. a little fat
5. OK about how my body looks or I never binge eat

**33. Compared to other people of my sex, my ability to always feel in control of how much I eat is:**

1. about the same or greater
2. a little less
3. less
4. much less
5. a great deal less

**34. In the last 3 months, on average how often did you binge eat (eat uncontrollably to the point of stuffing yourself)?**

1. once a month or less (or never)
2. 2-3 times a month
3. once a week
4. twice a week
5. more than twice a week

**35. Most people I know would be surprised at how fat I look after I eat a lot of food.**

1. yes, definitely
2. yes
3. yes, probably
4. yes, possibly
5. no, probably not or I never eat a lot of food

**36. I use diuretics (water pills) to help control my weight.**

1. 3 times a week or more
2. once or twice a week
3. 2-3 times a month
4. once a month
5. never

APPENDIX 4

The Dutch Eating Behaviour Questionnaire: DEBQ

## Please Tick the box that applies best to each of the numbered statements

| | Never | Seldom | Sometimes | Often | Very Often |
|---|---|---|---|---|---|
| 1. When you put on weight do you eat less than you usually do? | | | | | |
| 2. Do you try to eat less at mealtimes than you would like to eat? | | | | | |
| 3. How often do you refuse food or drink offered to you because you are concerned about your weight? | | | | | |
| 4. Do you watch exactly what you eat? | | | | | |
| 5. Do you deliberately eat foods that are slimming? | | | | | |
| 6. When you have eaten too much, do you eat less than usual the following day? | | | | | |
| 7. Do you deliberately eat less in order not to become heavier? | | | | | |
| 8. How often do you try not to eat between meals because you are watching your weight? | | | | | |
| 9. How often in the evenings do you try not to eat because you are watching your weight? | | | | | |
| 10. Do you take your weight into account with what you eat? | | | | | |

**APPENDIX 5**

**The State-Trait Anxiety Inventory (STAI: Form Y1)**

# SELF-EVALUATION QUESTIONNAIRE

STAI Form Y-1

**Please provide the following information:**

Name______________________________ Date______________ S_____

Age______________ Gender (*Circle*) **M** **F** T_____

DIRECTIONS:

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate value to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

| | NOT AT ALL | SOMEWHAT | MODERATELY SO | VERY MUCH SO |
|---|---|---|---|---|
| 1. I feel calm | 1 | 2 | 3 | 4 |
| 2. I feel secure | 1 | 2 | 3 | 4 |
| 3. I am tense | 1 | 2 | 3 | 4 |
| 4. I feel strained | 1 | 2 | 3 | 4 |
| 5. I feel at ease | 1 | 2 | 3 | 4 |
| 6. I feel upset | 1 | 2 | 3 | 4 |
| 7. I am presently worrying over possible misfortunes | 1 | 2 | 3 | 4 |
| 8. I feel satisfied | 1 | 2 | 3 | 4 |
| 9. I feel frightened | 1 | 2 | 3 | 4 |
| 10. I feel comfortable | 1 | 2 | 3 | 4 |
| 11. I feel self-confident | 1 | 2 | 3 | 4 |
| 12. I feel nervous | 1 | 2 | 3 | 4 |
| 13. I am jittery | 1 | 2 | 3 | 4 |
| 14. I feel indecisive | 1 | 2 | 3 | 4 |
| 15. I am relaxed | 1 | 2 | 3 | 4 |
| 16. I feel content | 1 | 2 | 3 | 4 |
| 17. I am worried | 1 | 2 | 3 | 4 |
| 18. I feel confused | 1 | 2 | 3 | 4 |
| 19. I feel steady | 1 | 2 | 3 | 4 |
| 20. I feel pleasant | 1 | 2 | 3 | 4 |

© Copyright 1968,1977 by Charles D. Spielberger. All rights reserved.

APPENDIX 6

## The State Self-Esteem Scale: SSES

**This is a questionnaire designed to measure what you are thinking at this moment. There is, of course, no right answer for any statement. The best answer is what you feel is true of yourself at this moment. Be sure to answer all of the items, even if you are not certain of the best answer. Again, answer these questions as they are true for you RIGHT NOW.**

**1. I feel confident about my abilities.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**2. I am worried about whether I am regarded as a success or failure.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**3. I feel satisfied with the way my body looks right now.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**4. I feel frustrated or rattled about my performance.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**5. I feel that I am having trouble understanding things that I read.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**6. I feel that others respect and admire me.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**7. I am dissatisfied with my weight.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**8. I feel self-conscious.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**9. I feel as smart as others.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**10. I feel displeased with myself.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**11. I feel good about myself.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**12. I am pleased with my appearance right now.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**13. I am worried about what other people think of me.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**14. I feel confident that I understand things.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**15. I feel inferior to others at this moment.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**16. I feel unattractive.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**17. I feel concerned about the impression I am making.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**18.** **I feel that I have less scholastic ability right now than others.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**19.** **I feel like I`m not doing well.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

**20.** **I am worried about looking foolish.**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| *not at all* | *a little bit* | *somewhat* | *very much* | *extremely* |

## The Eating Attributional Style Questionnaire (Revised): EASQ-R

For this questionnaire, please try to imagine yourself in the situations that follow. If such a situation happened to you, what would you feel would have caused it? While events may have many causes, we want you to pick only one – the **major** cause if this event happened to you. Please write this cause in the blank space provided after each event.

Next we want you to answer some questions about the cause. Decide which choice best describes your answer and circle a number. Keep in mind there are **no** right or wrong answers.

**Once you have answered a question, go to the corresponding question number on the answer sheet and mark your answer in the number or space adjacent to it.**

<u>Scenario 1</u>

You are at home, alone, watching a movie on TV. You eat a big bag of crisps with dip and drink a couple of cans of cola.

Write down the **one** major cause of this event:

____________________________________________________________
____________________________________________________________
______________________________________________

**1.** Is the cause of you eating a bag of crisps and drinking cola due to something about you or something about other people or circumstances?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Totally due to other people or circumstances | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Totally due to me |

**2.** To what degree do you have control over what caused you to eat crisps and drink cola in front of the TV?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**3.** In the future when eating a bag of crisps and drinking cola in front of the TV, will this cause again be present?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Will never again be present | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Will always be present |

**4.** To what degree do you feel you have control over eating a bag of crisps and drinking cola in front of the TV?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**5.** To what extent is this cause responsible for events that are similar to the one above in which you ate a bag of crisps and drank cola?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A cause only of this particular event | 1 | 2 | 3 | 4 | 5 | 6 | 7 | A cause of many other similar events |

**6.** To what degree could you change what caused you to eat crisps and drink cola in front of the TV?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all change | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Completely change |

**7.** How important would this situation be if it happened to you?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all Important | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely important |

<u>Scenario 2</u>

You receive a box of your favourite chocolates at Christmas. You eat two and share the rest with friends and family.

Write down the **one** major cause:

______________________________________________________________
______________________________________________________________
______________________________________________________________

**8.** Is the cause of you eating only two chocolates due to something about you or something about other people or circumstances?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Totally due to other people or circumstances | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Totally due to me |

**9.** To what degree do you have control over what caused you to eat only two chocolates and share others.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**10.** In the future when you receive a box of chocolates and eat only a few, will this cause again be present?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Will never again be present | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Will always be present |

**11.** To what degree do you feel you have control over eating a few chocolates and sharing the rest?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**12.** To what extent is this cause responsible for events that are similar to the one above in which you received a box of chocolates and ate only a few?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A cause only of this particular event | 1 | 2 | 3 | 4 | 5 | 6 | 7 | A cause of many other similar events |

**13.** To what degree could you change what caused you to eat only two chocolates?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all change | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Completely change |

**14.** How important would this situation be if it happened to you?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all important | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely important |

Scenario 3

You are at a friend's birthday party where there is a table full of your favourite foods, including chocolate cheesecake. You eat a salad and for dessert a slice of melon and a few strawberries.

Write down the **one** major cause:

______________________________________________

______________________________________________

______________________________________________

**15.** Is the cause of you eating a salad and fruit due to something about you or something about other people or circumstances?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Totally due to other people or circumstances | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Totally due to me |

**16.** To what degree do you have control over what caused you to eat only a salad and fruit.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**17.** In the future when you attend a celebration of some sort and you eat a salad and fruit, will this cause again be present?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Will never again be present | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Will always be present |

**18.** To what degree do you feel you have control over eating a salad and fruit at a gathering?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**19.** To what extent is this cause responsible for events that are similar to the one above in which you ate salad and fruit at a gathering?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A cause only of this particular events | 1 | 2 | 3 | 4 | 5 | 6 | 7 | A cause of many other similar events |

**20.** To what degree could you change what caused you to eat only a salad and fruit?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all change | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Completely change |

**21.** How important would this situation be if it happened to you?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all important | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely important |

<u>Scenario 4</u>

It's Easter and you go shopping for chocolate eggs for an Easter egg hunt. You decide to buy your favourites because if there is any left over you would hate to see them go to waste. You arrive home and eat all the chocolate eggs you bought before anyone else arrives.

Write down the **one** major cause:

____________________________________________________________
____________________________________________________________
____________________________________________________________

**22.** Is the cause of you eating all the chocolate eggs due to something about you or something about other people or circumstances?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Totally due to other people or circumstances | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Totally due to me |

**23.** To what degree do you have control over what caused you to eat all of the chocolate eggs.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**24.** In the future when you eat a large amount of chocolate, will this cause again be present?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Will never again be present | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Will always be present |

**25.** To what degree do you feel you have control over eating a large amount of chocolate?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**26.** To what extent is this cause responsible for events that are similar to the one above in which you ate a large amount of chocolate?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A cause only of this particular event | 1 | 2 | 3 | 4 | 5 | 6 | 7 | A cause of many other similar events |

**27.** To what degree could you change what caused you to eat all of the chocolate eggs?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all change | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Completely change |

**28.** How important would this situation be if it happened to you?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all important | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely important |

Scenario 5

You and your friends go to the cinema. Your friends decide to buy their favourite ice cream, popcorn, sweets and cola. You have a cup of coffee only.

Write down the **one** major cause:

______________________________________________

______________________________________________

______________________________________________

**29.** Is the cause of you having just a coffee due to something about you or something about other people or circumstances?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Totally due to other people or circumstances | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Totally due to me |

**30.** To what degree do you have control over what caused you to have only a cup of coffee?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**31.** In the future when you just have a coffee at the cinema, will this cause again be present?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Will never again be present | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Will always be present |

**32.** To what degree do you feel you have control over having a coffee when you go to the cinema?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**33.** To what extent is this cause responsible for events that are similar to the one above in which you had coffee when you went to the cinema?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A cause only of this particular event | 1 | 2 | 3 | 4 | 5 | 6 | 7 | A cause of many other similar events |

**34.** To what degree could you change what caused you to have only a cup of coffee?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all change | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Completely change |

**35.** How important would this situation be if it happened to you?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all important | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely important |

<u>Scenario 6</u>

You go to a relative's house for a big Christmas dinner with all the trimmings. You have two helpings of everything and a slice of chocolate cake with ice cream for dessert.

Write down the **one** major cause:

________________________________________

________________________________________

________________________________________

**36.** Is the cause of you eating two helpings of dinner and dessert due to something about you or something about other people or circumstances?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Totally due to other people or circumstances | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Totally due to me |

**37.** To what degree do you have control over what caused you to have two helpings of dinner and a dessert ?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**38.** In the future when you eat two helpings of dinner and have dessert, will this cause again be present?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Will never again be present | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Will always be present |

**39.** To what degree do you feel you have control over eating two helpings of dinner and a dessert?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Complete Control |

**40.** To what extent is this cause responsible for events that are similar to the one above in which you ate two helpings of dinner and dessert?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A cause only of this particular event | 1 | 2 | 3 | 4 | 5 | 6 | 7 | A cause of many other similar events |

**41.** To what degree could you change what caused you to have two helpings of dinner and a dessert?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all change | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Completely change |

**42.** How important would this situation be if it happened to you?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Not at all important | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely important |

**APPENDIX 8**

## Food Preference Questionnaire

1. How much do you like **salted peanuts** (*please circle*)

| *Really dislike* | *dislike* | *indifferent* | *like* | *really like* |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

2. How much do you like **apples**

| *Really dislike* | *dislike* | *indifferent* | *like* | *really like* |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

3. How much do you like **sponge cake**

| *Really dislike* | *dislike* | *indifferent* | *like* | *really like* |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

4. How much do you like **pizza**

| *Really dislike* | *dislike* | *indifferent* | *like* | *really like* |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

5. How much do you like **ice-cream**

| *Really dislike* | *dislike* | *indifferent* | *like* | *really like* |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

6. How much do you like **crisps**

| *Really dislike* | *dislike* | *indifferent* | *like* | *really like* |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

7. How much do you like **plain crackers**

| *Really dislike* | *dislike* | *indifferent* | *like* | *really like* |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

8. How much do you like **chocolate**

| *Really dislike* | *dislike* | *indifferent* | *like* | *really like* |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

9. How much do you like **oranges**

| *Really dislike* | *dislike* | *indifferent* | *like* | *really like* |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |

## Mental Arithmetic Task (MAT): Task and Instructions

### The Serial Mental Arithmetic Challenge

Are

You

Ready!

### Instructions

1. During the challenge you will see 4 mental arithmetic matrices projected on the screen.
2. Each will be displayed for 5 minutes.
3. Your challenge is to add up as many of the numbers in the matrix as you can in five minutes.

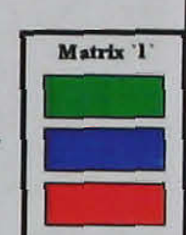
### Presentation of the Matrix Slides

1. Start at the beginning of line one and add all the numbers in the **row.**
2. Carry your total from the end of each row to the next line, as you try to add up all the numbers on the slide.
3. Keep working until you reach the end of the slide or the presentation of the matrix ends and you are instructed to stop.
4. The slide will then be displayed again and you will be asked for:
   1. Your total
   2. The row you reached
   3. The last number you added to your total

### Your Performance……

1. How well you do on the challenge depends upon two factors:
   1. How far you got through the slide.
   2. How accurate was your total.
2. You should try to work quickly but accurately.
3. If you make a mistake or lose your place you should start again.

**Each arithmetic problem matrix is colour banded→**




**In the past we have found that:**

1. 85% of people taking the maths challenge easily add up all the numbers in the first 5 rows, completing the Green Zone.
2. 25% of people add up all the numbers in the first 10 rows, completing both Green and Blue Zones.
3. Only 2 people have ever added up all the numbers, completing Green, Blue, and Red Zones correctly.

CAN YOU SEE

5+ 11 + 19 + 36 + 33 + 38 + 32 + 41 + 5 + 8 + 7 + 14
+ 8 + 15 + 35 + 15 + 7 + 20 + 17 + 26 + 16 + 38 + 34
+ 46 + 27 + 36 + 20 + 3 + 7 + 18 + 25 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 26 + 36 + 24 + 33 + 44 + 16 + 4
+ 6 + 41 + 49 + 2 + 31 + 9 + 7 + 5 + 3 + 12 + 22 + 19

7 + 17 + 21 + 39 + 13 + 22 + 22 + 41 + 9 + 8 + 1 + 44
+ 9 + 25 + 35 + 45 + 6 + 27 + 27 + 13 + 46 + 18 + 24
+ 46 + 17 + 37 + 20 + 3 + 9 + 18 + 35 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 36 + 26 + 24 + 33 + 34 + 16 + 4
+ 6 + 21 + 49 + 2 + 31 + 9 + 7 + 4 + 3 + 12 + 42 + 19

7 + 17 + 21 + 39 + 13 + 22 + 22 + 41 + 9 + 8 + 1 + 44
+ 9 + 25 + 35 + 45 + 6 + 27 + 27 + 13 + 46 + 18 + 24
+ 46 + 17 + 37 + 20 + 3 + 9 + 18 + 35 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 36 + 26 + 24 + 33 + 34 + 16 + 4
+ 6 + 21 + 49 + 2 + 31 + 9 + 7 + 4 + 3 + 12 + 42 + 19

THE NUMBERS CLEARLY?

### Do You Have Any Questions?

•Are

•You

•Ready For

MATRIX 1

?

## Matrix 1

4 + 17 + 11 + 36 + 33 + 32 + 22 + 41 + 2 + 8 + 1 + 14
+ 9 + 15 + 35 + 45 + 7 + 20 + 27 + 16 + 46 + 38 + 24
+ 46 + 27 + 36 + 20 + 3 + 7 + 18 + 25 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 26 + 36 + 24 + 33 + 44 + 16 + 4
+ 6 + 41 + 49 + 2 + 31 + 9 + 7 + 5 + 3 + 12 + 22 + 19

7 + 17 + 21 + 39 + 13 + 22 + 22 + 41 + 9 + 8 + 1 + 44
+ 9 + 25 + 35 + 45 + 6 + 27 + 27 + 13 + 46 + 18 + 24
+ 46 + 17 + 37 + 20 + 3 + 9 + 18 + 35 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 36 + 26 + 24 + 33 + 34 + 16 + 4
+ 6 + 21 + 49 + 2 + 31 + 9 + 7 + 4 + 3 + 12 + 42 + 19

2 + 17 + 21 + 29 + 13 + 22 + 22 + 41 + 9 + 8 + 1 + 44
+ 5 + 25 + 35 + 41 + 6 + 27 + 17 + 13 + 26 + 18 + 24
+ 36 + 17 + 27 + 20 + 3 + 5 + 18 + 35 + 27 + 48 + 44
+ 4 + 22 + 33 + 24 + 36 + 26 + 34 + 13 + 34 + 16 + 4
+ 6 + 31 + 49 + 2 + 11 + 9 + 7 + 4 + 3 + 42 + 42 + 19

## Matrix 1

The Experimenter requires the following information:

1. What is Your Total?

2. What is Your Row?

3. What Was The Last Number You Added?

## Where did you finish Matrix 1

4 + 17 + 11 + 36 + 33 + 32 + 22 + 41 + 2 + 8 + 1 + 14
+ 9 + 15 + 35 + 45 + 7 + 20 + 27 + 16 + 46 + 38 + 24
+ 46 + 27 + 36 + 20 + 3 + 7 + 18 + 25 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 26 + 36 + 24 + 33 + 44 + 16 + 4
+ 6 + 41 + 49 + 2 + 31 + 9 + 7 + 5 + 3 + 12 + 22 + 19

7 + 17 + 21 + 39 + 13 + 22 + 22 + 41 + 9 + 8 + 1 + 44
+ 9 + 25 + 35 + 45 + 6 + 27 + 27 + 13 + 46 + 18 + 24
+ 46 + 17 + 37 + 20 + 3 + 9 + 18 + 35 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 36 + 26 + 24 + 33 + 34 + 16 + 4
+ 6 + 21 + 49 + 2 + 31 + 9 + 7 + 4 + 3 + 12 + 42 + 19

2 + 17 + 21 + 29 + 13 + 22 + 22 + 41 + 9 + 8 + 1 + 44
+ 5 + 25 + 35 + 41 + 6 + 27 + 17 + 13 + 26 + 18 + 24
+ 36 + 17 + 27 + 20 + 3 + 5 + 18 + 35 + 27 + 48 + 44
+ 4 + 22 + 33 + 24 + 36 + 26 + 34 + 13 + 34 + 16 + 4
+ 6 + 31 + 49 + 2 + 11 + 9 + 7 + 4 + 3 + 42 + 42 + 19

• Are
• You
• Ready For
MATRIX 2
?

## Where did you finish Matrix 2?

4 + 47 + 17 + 36 + 39 + 32 + 32 + 41 + 9 + 8 + 1 + 16
+ 8 + 45 + 35 + 25 + 7 + 20 + 27 + 46 + 16 + 38 + 24
+ 46 + 27 + 16 + 20 + 3 + 7 + 28 + 25 + 37 + 38 + 44
+ 9 + 25 + 43 + 25 + 26 + 36 + 26 + 33 + 44 + 16 + 6
+ 3 + 43 + 49 + 2 + 31 + 9 + 7 + 1 + 3 + 12 + 27 + 19

6 + 47 + 21 + 39 + 13 + 29 + 22 + 41 + 9 + 8 + 1 + 34
+ 9 + 45 + 35 + 15 + 6 + 27 + 47 + 13 + 46 + 28 + 24
+ 46 + 27 + 37 + 20 + 3 + 9 + 38 + 35 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 36 + 46 + 24 + 33 + 34 + 16 + 4
+ 6 + 31 + 49 + 9 + 31 + 9 + 7 + 4 + 3 + 12 + 32 + 12

6 + 37 + 21 + 29 + 13 + 22 + 42 + 41 + 9 + 8 + 1 + 14
+ 9 + 15 + 35 + 45 + 6 + 37 + 27 + 13 + 46 + 28 + 24
+ 46 + 17 + 47 + 20 + 3 + 9 + 38 + 35 + 37 + 48 + 44
+ 4 + 12 + 43 + 24 + 36 + 36 + 24 + 33 + 24 + 16 + 4
+ 6 + 11 + 49 + 2 + 31 + 5 + 7 + 4 + 9 + 12 + 42 + 29

## Matrix `2`

The experimenter requires the following information:

1. What is Your Total?

2. What is Your Row?

3. What Was The Last Number You Added?

## Where did you finish Matrix 2?

4 + 47 + 17 + 36 + 39 + 32 + 32 + 41 + 9 + 8 + 1 + 16
+ 8 + 45 + 35 + 25 + 7 + 20 + 27 + 46 + 16 + 38 + 24
+ 46 + 27 + 16 + 20 + 3 + 7 + 28 + 25 + 37 + 38 + 44
+ 9 + 25 + 43 + 25 + 26 + 36 + 26 + 33 + 44 + 16 + 6
+ 3 + 43 + 49 + 2 + 31 + 9 + 7 + 1 + 3 + 12 + 27 + 19

6 + 47 + 21 + 39 + 13 + 29 + 22 + 41 + 9 + 8 + 1 + 34
+ 9 + 45 + 35 + 15 + 6 + 27 + 47 + 13 + 46 + 28 + 24
+ 46 + 27 + 37 + 20 + 3 + 9 + 38 + 35 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 36 + 46 + 24 + 33 + 34 + 16 + 4
+ 6 + 31 + 49 + 9 + 31 + 9 + 7 + 4 + 3 + 12 + 32 + 12

6 + 37 + 21 + 29 + 13 + 22 + 42 + 41 + 9 + 8 + 1 + 14
+ 9 + 15 + 35 + 45 + 6 + 37 + 27 + 13 + 46 + 28 + 24
+ 46 + 17 + 47 + 20 + 3 + 9 + 38 + 35 + 37 + 48 + 44
+ 4 + 12 + 43 + 24 + 36 + 36 + 24 + 33 + 24 + 16 + 4
+ 6 + 11 + 49 + 2 + 31 + 5 + 7 + 4 + 9 + 12 + 42 + 29

• Are
• You
• Ready For
MATRIX 3
?

## Matrix 3

4 + 47 + 17 + 36 + 39 + 32 + 32 + 41 + 9 + 8 + 1 + 16
+ 8 + 45 + 35 + 25 + 7 + 20 + 27 + 46 + 16 + 38 + 24
+ 46 + 27 + 16 + 20 + 3 + 7 + 28 + 25 + 37 + 38 + 44
+ 9 + 25 + 43 + 25 + 26 + 36 + 26 + 33 + 44 + 16 + 6
+ 3 + 43 + 49 + 2 + 31 + 9 + 7 + 1 + 3 + 12 + 27 + 19

6 + 47 + 21 + 39 + 13 + 29 + 22 + 41 + 9 + 8 + 1 + 34
+ 9 + 45 + 35 + 15 + 6 + 27 + 47 + 13 + 46 + 28 + 24
+ 46 + 27 + 37 + 20 + 3 + 9 + 38 + 35 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 36 + 46 + 24 + 33 + 34 + 16 + 4
+ 6 + 31 + 49 + 9 + 31 + 9 + 7 + 4 + 3 + 12 + 32 + 12

6 + 37 + 21 + 29 + 13 + 22 + 42 + 41 + 9 + 8 + 1 + 14
+ 9 + 15 + 35 + 45 + 6 + 37 + 27 + 13 + 46 + 28 + 24
+ 46 + 17 + 47 + 20 + 3 + 9 + 38 + 35 + 37 + 48 + 44
+ 4 + 12 + 43 + 24 + 36 + 36 + 24 + 33 + 24 + 16 + 4
+ 6 + 11 + 49 + 2 + 31 + 5 + 7 + 4 + 9 + 12 + 42 + 29

## Matrix `3`

The experimenter requires the following information:

1. What is Your Total?

2. What is Your Row?

3. What Was The Last Number You Added?

## Where did you finish Matrix 3?

4 + 47 + 17 + 36 + 39 + 32 + 32 + 41 + 9 + 8 + 1 + 16
+ 8 + 45 + 35 + 25 + 7 + 20 + 27 + 46 + 16 + 38 + 24
+ 46 + 27 + 16 + 20 + 3 + 7 + 28 + 25 + 37 + 38 + 44
+ 9 + 25 + 43 + 25 + 26 + 36 + 26 + 33 + 44 + 16 + 6
+ 3 + 43 + 49 + 2 + 31 + 9 + 7 + 1 + 3 + 12 + 27 + 19

6 + 47 + 21 + 39 + 13 + 29 + 22 + 41 + 9 + 8 + 1 + 34
+ 9 + 45 + 35 + 15 + 6 + 27 + 47 + 13 + 46 + 28 + 24
+ 46 + 27 + 37 + 20 + 3 + 9 + 38 + 35 + 37 + 28 + 44
+ 4 + 22 + 43 + 24 + 36 + 46 + 24 + 33 + 34 + 16 + 4
+ 6 + 31 + 49 + 9 + 31 + 9 + 7 + 4 + 3 + 12 + 32 + 12

6 + 37 + 21 + 29 + 13 + 22 + 42 + 41 + 9 + 8 + 1 + 14
+ 9 + 15 + 35 + 45 + 6 + 37 + 27 + 13 + 46 + 28 + 24
+ 46 + 17 + 47 + 20 + 3 + 9 + 38 + 35 + 37 + 48 + 44
+ 4 + 12 + 43 + 24 + 36 + 36 + 24 + 33 + 24 + 16 + 4
+ 6 + 11 + 49 + 2 + 31 + 5 + 7 + 4 + 9 + 12 + 42 + 29

•Are
•You
•Ready For
MATRIX 4
?

## Matrix 4

7 + 17 + 27 + 46 + 39 + 32 + 32 + 11 + 9 + 8 + 1 + 16
+ 8 + 35 + 45 + 25 + 9 + 20 + 29 + 41 + 16 + 28 + 24
+ 16 + 27 + 46 + 20 + 7 + 9 + 28 + 25 + 27 + 38 + 44
+ 4 + 25 + 33 + 25 + 26 + 46 + 26 + 33 + 34 + 16 + 9
+ 2 + 23 + 29 + 2 + 21 + 9 + 6 + 1 + 3 + 22 + 27 + 39

10 + 47 + 21 + 39 + 13 + 29 + 2 + 41 + 9 + 18 + 1 + 4
+ 49 + 5 + 35 + 15 + 6 + 7 + 47 + 13 + 46 + 28 + 22
+ 42 + 27 + 27 + 20 + 3 + 9 + 38 + 25 + 37 + 18 + 44
+ 4 + 32 + 43 + 24 + 26 + 46 + 24 + 23 + 34 + 16 + 4
+ 6 + 31 + 29 + 9 + 31 + 9 + 7 + 4 + 3 + 32 + 32 + 22

9 + 37 + 25 + 29 + 13 + 22 + 48 + 41 + 2 + 8 + 1 + 14
+ 9 + 35 + 35 + 45 + 6 + 47 + 27 + 13 + 48 + 28 + 24
+ 26 + 17 + 37 + 20 + 3 + 9 + 18 + 35 + 37 + 48 + 44
+ 4 + 22 + 43 + 24 + 36 + 26 + 24 + 33 + 14 + 16 + 4
+ 6 + 21 + 49 + 2 + 51 + 5 + 7 + 4 + 9 + 32 + 42 + 29

## Matrix `4`

The experimenter requires the following information:

1. What is Your Total?

2. What is Your Row?

3. What Was The Last Number You Added?

## Where did you finish Matrix 4?

7 + 17 + 27 + 46 + 39 + 32 + 32 + 11 + 9 + 8 + 1 + 16
+ 8 + 35 + 45 + 25 + 9 + 20 + 29 + 41 + 16 + 28 + 24
+ 16 + 27 + 46 + 20 + 7 + 9 + 28 + 25 + 27 + 38 + 44
+ 4 + 25 + 33 + 25 + 26 + 46 + 26 + 33 + 34 + 16 + 9
+ 2 + 23 + 29 + 2 + 21 + 9 + 6 + 1 + 3 + 22 + 27 + 39

10 + 47 + 21 + 39 + 13 + 29 + 2 + 41 + 9 + 18 + 1 + 4
+ 49 + 5 + 35 + 15 + 6 + 7 + 47 + 13 + 46 + 28 + 22
+ 42 + 27 + 27 + 20 + 3 + 9 + 38 + 25 + 37 + 18 + 44
+ 4 + 32 + 43 + 24 + 26 + 46 + 24 + 23 + 34 + 16 + 4
+ 6 + 31 + 29 + 9 + 31 + 9 + 7 + 4 + 3 + 32 + 32 + 22

9 + 37 + 25 + 29 + 13 + 22 + 48 + 41 + 2 + 8 + 1 + 14
+ 9 + 35 + 35 + 45 + 6 + 47 + 27 + 13 + 48 + 28 + 24
+ 26 + 17 + 37 + 20 + 3 + 9 + 18 + 35 + 37 + 48 + 44
+ 4 + 22 + 43 + 24 + 36 + 26 + 24 + 33 + 14 + 16 + 4
+ 6 + 21 + 49 + 2 + 51 + 5 + 7 + 4 + 9 + 32 + 42 + 29

The

End

APPENDIX 10

Free recall task

# Now write down as many words as you can remember from the Stroop task you performed earlier

# (You have 3 minutes to perform this task)

| | |
|---|---|
| 1 | 17 |
| 2 | 18 |
| 3 | 19 |
| 4 | 20 |
| 5 | 21 |
| 6 | 22 |
| 7 | 23 |
| 8 | 24 |
| 9 | 25 |
| 10 | 26 |
| 11 | 27 |
| 12 | 28 |
| 13 | 29 |
| 14 | 30 |
| 15 | 31 |
| 16 | 32 |

## References

Abraham, S.F. & Beumont, P.J.V. (1982). How patients describe bulimia or binge eating. *Psychological Medicine*, *12*, 625-635.

Abramson, E.E. & Wunderlich, R.A. (1972). Anxiety, fear and eating: A test of the psychosomatic concept of obesity. *Journal of Abnormal Psychology*, *79*, 317-321.

Abell, T.L., Malagelada, J.R., Lucas, A.R., Brown, M.L., Camilleri, M., Go, V.L., Azpiroz, F., Callaway, C.W., Kao, P.C., Zinsmeister, A.R. (1987). Gastric electromechanical and neurohormonal function in anorexia nervosa. *Gastroenterology, 93*, 958-65.

Agras, W.S. & Telch, C.F. (1998). The effects of caloric deprivation and negative affect on binge-eating in obese binge-eating disordered women, *Behaviour Therapy, 29*, 491-503

Aiken, L.S. & West, S.G. (1991). *Multiple Regression: Testing and interpreting interactions.* Newbury Park, CA: Sage Publications.

Ainsworth, C. Waller, G. & Kennedy, F. (2002). Threat processing in women with bulimia. *Clinical Psychology Review, 22*, 1155-1178.

al'Absi, M. & Lovallo, W. R. (1992). Effects of a novel experimental setting on cortisol concentrations in borderline hypertensive and normotensive men. *Psychophysiology, 29*, 1226-1235.

Alaria, P., Gamallo, A., Beato, M.J., & Trancho, G. (1987). Body weight gain, food intake and adrenal development in chronic noise stressed rats. *Physiology & Behaviour*, *40*, 29-32.

American Psychiatric Association (1987). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, DC: American Psychiatric Association.

American Psychiatric Association (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: American Psychiatric Association.

Anderson, D.A., Shapiro, J.R., Lundgren, J.D., Spataro, L.E., & Frye, C.A. (2002). Self-reported dietary restraint is associated with elevated levels of salivary cortisol. *Appetite, 38*, 13-17.

Antelman, S.M., & Szechtman, H. (1975). Tail-pinch induces eating in sated rats which appears to depend on nigrostriatal dopamine. *Science, 189*, 731-733.

Aravich, P.F., Stanley, E.Z., & Dorries, L.E. (1995). Exercise in food-restricted rats produces 2DG feeding and metabolic abnormalities similar to anorexia nervosa. *Physiology and Behavior*, *57*, 147-53.

Arnow, B., Kenardy J. & Agras, W.S. (1992). Binge eating among the obese: a descriptive study. *Journal of Behavioural Medicine*, *15*, 155-170.

Atkinson, C., & Polivy, J. (1976). Effects of delay, attack, and retaliation on state depression and hostility. *Journal of Abnormal Psychology*, *85*, 570-576. **[Multiple Affect Scale].**

Bailly, D. (1993). Epidemiologic research, disorders of eating behaviour and addictive behaviour. *Encephale, 19*, 285-92 (article in French).

Baker, J. D., Williamson, D. A., & Sylve, C. (1995). Body image disturbance, memory bias, and body dysmorphia: effects of negative mood induction. *Behavior Therapy*, *26*, 747-759.

Ball, K., & Lee, C. (1999). Relationships between psychological stress, coping and disordered eating: A review. *Psychology and Health*, *14*, 1007-1035.

Ball, K., Lee, C., & Brown, W. (1999). Psychological stress and disordered eating: an exploratory study with young Australian women. *Women Health*, *29*, 1-15.

Bassett, J.R., Marshall, P.M. & Spillane, R. (1987). The physiological measurement of acute stress (public speaking) in bank employees. *International Journal of Psychophysiology, 5*, 265-273.

Baucom, D.H., & Aiken, P.A. (1981). Effect of depressed mood on eating among obese and non-obese dieting and non-dieting persons. *Journal of Personality and Social Psychololgy*, *41*, 5775-5787.

Bauer, B.G., & Anderson, W.P. (1989). Bulimic beliefs: food for thought. *Journal of Counselling and Development*, *67*, 416-419.

Baum, A. (1990). Stress, intrusive imagery, and chronic distress. *Health Psychology, 9*, 653-675

Baum, A., Gatchel, R.J. & Schaeffer, M.A. (1983). Emotional behavioral and physiological effects of chronic stress at Three Mile Island. *Journal of Consulting and Clinical Psychology, 51*, 565-572.

Baum, A., Grunberg, N.E., & Singer, J.E. (1982). The use of psychological and neuroendocrinological measurements in the study of stress. *Health Psychology*, *1*, 123-161.

Baumeister, R.F., Heatherton, T.D., & Tice, D.M. (1994). *Losing control: How and why people fail at self-regulation.* New York: Academic Press.

Beck, A.T. (1983). Cognitive therapy of depression: New perspectives. In P.J. Clayton & J.E. Barrett (Eds.). *Treatment of depression: old controversies and new approaches.* New York: Raven.

Beck, A.T. & Clark, D.A. (1997). An information processing model of anxiety: Automatic and strategic processes. *Behaviour Research and Therapy*, *35*, 49-58.

Beck, A.T. & Freeman, A. (1990). *Cognitive therapy of personality disorders.* New York: Guilford Press.

Beck, A., T., Ward, C.H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry*, *4*, 561-571.

Beck, A.T., Rial, W.Y., & Rickels, K. (1974). Short form of depression inventory: Cross-validation. *Psychological Reports*, *34*, 1184-1186. **[BDI: Beck Depression Inventory – short form].**

Beck, A.T., Rush, A.J., Shaw, B.F. & Emery, G. (1979). *Cognitive therapy of depression.* New York: Guilford.

Bekker, M.H.J., van de Meerendonk, C., & Mollerus, J. (2004). Effects of negative mood induction and impulsivity on self-perceived emotional eating. *The International Journal of Eating Disorders*, *36*, 461-469.

Beebe, D.W. (1994). Bulimia nervosa and depression: a theoretical and clinical appraisal in light of the binge-purge cycle. *British Journal of Clinical Psychology*, *33*, 259-276.

Bellisle, F. & Dalix, A.M. (2001). Cognitive restraint can be offset by distraction, leading to increased meal intake in women. *American Journal of Clinical Nutr*ition, *74*, 197-200.

Bellisle, F., Dalix, A.M., & Slama, G. (2004). Non food-related environmental stimuli induce increased meal intake in healthy women: comparison of television viewing versus listening to a recorded story in laboratory settings. *Appetite*, *43*, 175-180.

Bellisle, F., Louis-Sylvestre, J., Linet, N., Rocaboy, B., Dalle, B., Cheneau, F., L'Hinoret, D., & Guyot, L. (1990). Anxiety and food intake in men. *Psychosomatic Medicine*, *52*, 452-457.

Bennett, D.A. & Cooper, C. L. (1999). Eating disturbance as a manifestation of the stress process: A review of the literature. *Stress Medicine, 15*, 167-182.

Bennett, W., & Gurin J. (1982). The dieter's dilemma: Eating less and weighing more. New York: Basic Books.

Benton, D. (2002). Carbohydrate ingestion, blood glucose and mood. *Neuroscience and Biobehavioral Reviews, 26*, 293-308.

Benton, D. & Donohoe, R.T. (1999). The effects of nutrients on mood. *Public Health Nutrition, 2,* 403-409.

Benton, O., Durand, M., Aguerre, S., Mormede, P., & Chaouloff, F. (1999). Behavioral, neuroendocrine and serotonergic consequences of single social defeat and repeated fluoxetine pre-treatment in the Lewis rat strain. *Neuroscience, 92*, 327-341.

Ben-Tovim, D.I., & Walker, M.K. (1991). Further evidence for the Stroop test as a quantitative measure of psychopathology in eating disorders. *The International Journal of Eating Disorders, 10*, 609-613.

Ben-Tovin, D.I., Walker, M.K., Fok, D., & Yap, E. (1989). An adaptation of the Stroop test for measuring shape and food concerns in eating disorders: A quantitative measure of psychopathology. *The International Journal of Eating Disorders, 8*, 681-687.

Berger, M., Bosert, S., Krieg, J. Dirlich, G., Ettmeir, W., Schereiber, W., & Zerssens, D.V. (1987). Interindividual differences in the susceptibility of the cortisol system: An important factor for the degree of hypercortisolism in stress situations? *Biological Psychiatry*, *22*, 1327-1339.

Birketvedt, G.S., Sundsfjord, J. & Florholmen, J.R. (2002). Hypothalamic-pituitary-adrenal axis in the night eating syndrome. *American Journal of Physiology Endocrinology and Metabolism, 282*, 366-369

Björntorp, P. & Rosmond, R. (2000). Obesity and cortisol, *Nutrition*, *16*, 924-936.

Björntorp, P. (1991a). Metabolic implications of body fat distribution. *Diabetes Care, 14*, 1132-1143.

Björntorp, P. (1991b). Visceral fat accumulation: the missing link between psychosocial factors and cardiovascular disease? *Journal of Internal Medicine, 230*, 195-201.

Björntorp, P. (1995). Endocrine abnormalities of obesity. *Metabolism, 44*, 21-23.

Björntorp, P. (1997). Stress and cardiovascular disease. *Acta Physiologica Scandinavica Supplementum, 640*,144-148.

Björntorp, P. (2001). Do stress reactions cause abdominal obesity and co morbidities? *Obesity Reviews, 2,* 73-86.

Black, A.E., Jebb, S.A., & Bingham, S.A. (1991). Validation of energy and protein intakes assessed by diet history and weighted records against energy expenditure and 24th urinary nitrogen excretion. *Proceedings of the Nutrition Society*, *50*, 108.

Blair, E.H., Wing, R.R., & Wald, A. (1991). The effect of laboratory stressors on glycemic control and gastrointestinal transit time. *Psychosomatic Medicine*, *53*, 133-143.

Bleu, R. (1996). Dietary restraint and anxiety in adolescent girls. *British Journal of Clinical Psychology*, *35*, 573-583.

Boggiano, M.A., Chandler, P.C., Viana, J.B., Oswald, K.D., Maldonado, C.R., Wauford, P.K. (2005). Combined dieting and stress evoke exaggerated responses to opioids in binge-eating rats. *Behavioral Neuroscie*nce, *119*, 1207-1214.

Boon, B., Stroebe, W., Schut, H. & Ijntema, R. (2002). Ironic processes in the eating behaviour of restrained eaters. *British Journal of Health Psychology, 7*, 1-10.

Boon, B., Vogelzang, L. & Jansen, A. (2000). Do restrained eaters show attention toward or away from food, shape, and weight stimuli? *European Eating Disorders Review, 8*, 51-58.

Booth, D. A. (1978). Acquired behavior controlling energy intake and output. *Psychiatric Clinics of North America 15*, 523-535.

Bower, G.H. (1981). Mood and memory. *American Psychologist, 36*, 129-148.

Bradley, P.J. (1985). Conditions recalled to have been associated with weight gain in adulthood. *Appetite*, *6*, 235-241.

Bradley, G.H. & Matthews, A. (1988). Memory bias in recovered clinical depressives. *Cognition and Emotion, 2*, 235-245.

Broadbent, D. & Broadbent, M. (1988). Anxiety and attentional bias: state and trait. *Cognition and Emotion*, *2*, 165-183.

Bruch, H. (1961). Transformation of oral impulses in eating disorders: A conceptual approach. *Psychiatric Quarterly*, *35*, 458-481.

Bruch, H. (1973). *Eating disorders, obesity, anorexia nervosa and the person within*. New York: Basic Books.

Buchwald, A.M., Strack, S. & Coyne, J.C. (1981). Demand characteristics and the Velten Mood Induction Procedure. *Journal of Consulting and Clinical Psychology, 49*, 478-479.

Buffenstein, R., Karklin, A. & Driver, H.S. (2000). Beneficial physiological and performance responses to a month of restricted energy intake in healthy overweight women. *Physiology and Behavior, 68*, 439-444.

Bulik, C.M., Lawson, R.H. & Carter, F.A. (1996). Salivary reactivity in restrained and unrestrained eaters and women with bulimia nervosa. *Appetite, 27*, 15-24.

Calloway, P., Fonagy, P. & Wakeling, A. (1983). Autonomic arousal in eating disorders - further evidence for the clinical subdivision of anorexia nervosa. *British Journal of Psychiatry, 142*, 38-42.

Cannon, W.B. (1914). The interrelations of emotions as suggested by recent physiological researches. *American Journal of Physiology*, *25*, 256-282.

Cannon, W.B. (1915). *Bodily changes in pain, hunger, fear and rage* (2nd ed.). New York: Appleton.

Cannon, W.B. (1929a). Organization for physiological homeostasis. *Physiological Review, 9*, 399-431.

Cannon, W.B. (1939). *The wisdom of the body.* New York: WW Norton.

Carter, F.A., Bulik, C.M., McIntosh, V.V. & Joyce, P.R. (2000). Changes on the Stroop test following treatment: Relation to word type, treatment condition, and treatment outcome among women with bulimia nervosa. *The International Journal of Eating Disorders, 28*, 349-355.

Castonguay, T.W. (1991). Glucocorticoids as modulators in the control of feeding. *Brain Research Bulletin*, *27*, 423-428.

Cattanach, L., Malley, R., & Rodin, J. (1988). Psychologic and physiologic reactivity to stressors in eating disordered individuals. *Psychosomatic Medicine, 50*, 591-599.

Cavallo, D.A. & Pinto, A. (2001). Effects of mood induction on eating behavior and cigarette craving in dietary restrainers. *Eating Behaviors, 2*, 113-127.

Channon, S. & Hayward, A. (1990). The effect of short-term fasting on processing of food cues in normal subjects. *The International Journal of Eating Disorders*, *9*, 447-452.

Channon, S., Hemsley, D., & De Silva, P. (1988). Selective processing of food words in anorexia nervosa. *British Journal of Clinical Psychology, 27*, 259-260.

Checkley, S. (1996). The neuroendocrinology of depression and chronic stress. *British Medical Bulletin, 52*, 597-617.

Christensen, L. (1992). Effects of eating behavior on mood: A review of the literature. *The International Journal of Eating Disorders*, *14*, 171-183.

Chrousos, G.P. & Gold, P.W. (1992). The concepts of stress and stress system disorders: Overview of physical and behavioral homeostasis. *The Journal of the American Medical Association, 267*, 1244-1252.

Chrousos, G.P. (1998). Stressors, stress, and neuroendocrine integration of the adaptive response. *New York Academy of Sciences, 851*, 311-335.

Chua, J.L., Touyz, S., & Hill, A.J. (2004). Negative mood-induced overeating in obese binge eaters: an experimental study. *International Journal of Obesity*, *28*, 606-610.

Cohen, J. (1977). *Statistical power analysis for the behavioral sciences.* New York: Academic Press.

Cohen, J. (1983). The cost of dichotomization. *Applied Psychological Measurement*, 7, 249-253.

Cohen, J., Cohen, P., West, S.G. & Aiken, L.S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd Ed.). Lawrence Erlbaum Ass. Inc.

Cohen, J.D., Dunbar, K. & McClelland, J.L. (1990). On the control of automatic processes: A parallel distributed-processing account of the Stroop effect. *Psychological Review, 97*, 332-361.

Cohen, J.D., Servan-Schreiber, D. & McClelland, J.L. (1992). A parallel distributed approach to automaticity. *American Journal of Psychology, 105*, 239-269.

Cohen, S. & Hamrick, N. (2003). Stable individual differences in physiological response to stressors: implications for stress-elicited changes in immune related health. *Brain, Behavior, and Immunity, 17*, 407-414.

Cohen, S., Kessler, R. & Gordon, L. (1995). (Eds.) *Measuring stress: A guide for health and social scientists* (pp.3-26) New York: Oxford University Press.

Cohen, S., Kammarck, T., Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*, 385-396. **[PSS: Perceived Stress Scale].**

Conner, M., Fitter, M., & Fletcher, W. (1999). Stress and snacking: A diary study of daily hassles and between-meal snacking. *Psychology and Health, 14*, 51-63.

Cools, J., Schotte, D.E., & McNally, R.J. (1992). Emotional arousal and overeating in restrained eaters. *Journal of Abnormal Psychology, 101*, 348-351.

Cooper, M. J. (1997). Cognitive theory in anorexia nervosa and bulimia nervosa: a review. *Behavioural and Cognitive Psychotherapy, 25*, 113-145.

Cooper, M. J. & Fairburn, C.G. (1993). Demographic and clinical correlates of selective information processing in patients with bulimia nervosa. *The International Journal of Eating Disorders, 13*, 109-116.

Cooper, M.J., & Fairburn, C.G. (1992). Thoughts about eating, weight and shape in anorexia nervosa and bulimia nervosa. *Behavior, Research and Therapy, 30*, 501-511.

Cooper, M.J., & Fairburn, C.G. (1992). Selective processing of eating, weight, and shape related words in patients with eating disorders and dieters. *British Journal of Clinical Psychology, 31*, 363-365.

Cooper, M. & Fairburn, C.G. (1994). Changes in selective information processing with three psychological treatments for bulimia nervosa. *British Journal of Clinical Psychology, 33*, 353-356.

Cooper, M. & Todd, G. (1997). Selective processing of three types of stimuli in eating disorders. *British Journal of Clinical Psychology, 36*, 279-281.

Cooper, M.J., Anastasiades, P., & Fairburn, C.G. (1992). Selective processing of eating-, shape- and weight-related words in persons with bulimia nervosa. *Journal of Abnormal Psychology, 101*, 352-355.

Cooper, J.L., Morrison, T.L., Bigman, O.L., Abramowitz, S.L., Levin, S. & Krener, P. (1988). Mood changes and affective disorder in the bulimia binge-purge cycle. *The International Journal of Eating Disorders, 7*, 469-474.

Cooper, M.J., Wells, A. & Todd, G. (2004). A cognitive model of bulimia nervosa. *British Journal of Clinical Psychology, 43*, 1-16.

Cooper, P.J. & Bowskill, R. (1986). Dysphoric mood and overeating. *British Journal of Clinical Psychology, 25*, 155-156.

Cooper, P.J. & Fairburn, C.G. (1983). Binge-eating and self-induced vomiting in the community: A preliminary study. *British Journal of Psychiatry, 142*, 139-144.

Cooper, M.J., Rose, K.S. & Turner, H. (2005). Core beliefs and the presence or absence of eating disorder symptoms and depressive symptoms in adolescent girls. *The International Journal of Eating Disorders, 38*, 60-64.

Cooper, M.J., Rose, K.S. & Turner, H. (2006). The specific content of core beliefs and schema in adolescent girls high and low in eating disorder symptoms. *Eating Behavior, 7*, 27-35.

Corwin, R.L., & Buda-Levin, A. (2004). Behavioral models of binge-type eating. *Physiology and Behavior, 82*, 123-130.

Costanzo, P. R., Reichmann, S. K., Friedman, K. E., & Musante, G. J., (2000). The mediating effect of eating self-efficacy on the relationship between emotional arousal and overeating in the diet-seeking obese. *Obesity Research, 8*, 76-78.

Cox, T. (1978). *Stress*, London, MacMillen Press.

Crowne, D.P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting and Clinical Psychology, 24*, 349-354. **[MCSDS: Marlowe-Crowne Social Desirability Scale].**

Crowther, J.H., Lingswiler, V.M., & Stephens, M.A.P. (1984). The topography of binge eating. *Addictive Behaviors*, *9*, 299-303. **[DFS: Daily Food Schedule].**

Crowther, J.H., Sanftner, J., Bonifazi, D.Z., & Shepherd, K.L. (2001). The role of daily hassles in binge eating. *The International Journal of Eating Disorders*, *29*, 449-454.

Davis, J.M., Lowy, M.T., Yim, G.K., Lamb, D.R., Malven, P.V. (1983). Relationships between plasma concentrations of immunoreactive beta-endorphin and food intake in rats. *Peptides, 4*, 79-83.

Davis, R., Freeman, R.J. & Garner, D.M. (1988). A naturalistic investigation of eating behavior in bulimia nervosa. *Journal of Consulting and Clinical Psychology*, *56*, 273-279.

Davis, R., Freeman, R.J. & Solyom, L. (1985). Mood and food: an analysis of bulimic episodes. *Journal of Psychiatric Research*, *19*, 331-335.

Davidson, E.J. & Wright, P. (2002). Selective processing of shape and weight-related words in bulimia nervosa: Use of a computerised Stroop test. *Eating Behaviors, 3*, 261-273.

de Ruiter, C., & Brosschot, J.F. (1994). The emotional Stroop interference effect in anxiety: attentional bias or cognitive avoidance? *Behavior Research and Therapy, 32*, 315-319.

de Zwaan, M. (1997). Status and utility of new diagnostic category: binge eating disorder. *European Eating Disorders Review*, *5*, 226-240.

Deaver, C.M., Milyenberger, R.G., Smyth, J., Meidinger, A., & Crosby, R. (2003). An evaluation of affect and binge eating. *Behavior Modif*ication, *27*, 578-599.

Deinzer, R., Kirschbaum, C., Gresele, C. & Hellhammer, D.H. (1997). Adrenocortical responses to repeated parachute jumping and subsequent h_CRH challenge in inexperienced healthy subjects. *Physiology and Behavior*, *61*, 507-511.

DeLongis, A., Folkman, S., & Lazarus, R.S. (1988). The impact of daily stress on health and mood: psychological and social resources as mediators. *Journal of Personality and Social Psychology*, *54*, 486-495 **[The Hassles Scale].**

DeLongis, A., & Preece, M. (2000). Coping skills. In: Fink, G, ed. *Encyclopedia of Stress*, Vol. 1. New York: Academic Press, 532-541.

Derogotis, L.R. (1983). *SCL-90-R: Administration, Scoring, and Procedures Manual II.* Baltimore, MD: Clinical Psychometric Research. **[SCL-90-R: the Symptom Checklist].**

Derogotis, L.R., Lipman, R.S., Covi, L. (1973). SCL-90: an outpatient psychiatric rating scale – preliminary report. *Psychopharmacological Bulletin*, *9*, 13-27.

Derry, P.A. & Kuiper, N.A. (1981). Schematic processing and self-reference in clinical depression. *Journal of Abnormal Psychology, 90*, 286-297.

Deurenberg, P. & Hautvast, J.G. (1989). Prevalence of overweight and obesity in the Netherlands in relation to sociodemographic variables, lifestyle and eating behaviour: starting points for the prevention and treatment of obesity. *Nutrition and Dietetics*, 44, 8-21.

Diener, E. (1979). Deindividuation, self-awareness, and disinhibition. *Journal of Personality and Social Psychology*, *37*, 1160-1171.

Dinneen, S., Alzaid, A., Miles, J. & Rizza, R. (1995). Effects of the normal nocturnal rise in cortisol on carbohydrate and fat metabolism in IDDM. *American Journal of Physiological-Endocrinology, 268*, 595-603.

Divertie, G.D., Jensen, M.D. & Miles, J.M. (1991). Stimulation of lipolysis in humans by physiological hypercortisolemia. *Diabetes*, *40*, 1228-1232.

Dobson, K.S., & Dozois, D.J.A. (2004). Attentional biases in eating disorders: A meta-analytic review of Stroop performance. *Clinical Psychology Review*, *23*, 1001-1022.

Drewnowski, A. (1997). Why do we like fat? *Journal of American Diet Asso*ciation, *97*, 58-62.

Dritschel, B., Cooper, P.J., & Charnock, D. (1993). A problematic counter-regulation experiment: implications for the link between dietary restraint and overeating. *International Journal of Eating Disorders*, *13*, 297-304.

Duchek, J.M. & Neely, J.H. (1989). A dissociative word-frequency x levels-of-processing interaction in episodic recognition and lexical decision tasks. *Memory and Cognition*, *17*, 148-162.

Dum, J., Gramsch, C.H. & Herz, A. (1983). Activation of hypothalamic beta-endorphin pools by reward induced by highly palatable food. *Pharmacological Biochemical Behav*ior, *18*, 443-447.

Dyer, F.N. (1973). The Stroop phenomenon and its use in the study of perceptual, cognitive, and response processes. *Memory and Cognition, 1*, 106-120.

Edwards, F.E. & Nagelberg, D.B. (1986). Personality characteristics of restrained/binge eaters versus unrestrained/non-binge eaters. *Addictive Behavior*, *11*, 207-211.

Eldredge, K.L. (1993). An investigation of the influence of dieting and self-esteem on dietary disinhibition. *The International Journal of Eating Disorders*, *13*, 57-67.

Eldredge, K.L. & Agras, W.S. (1996). Weight and shape overconcern and emotional eating in binge eating disorder. *The International Journal of Eating Disorders*, *19*, 73-82.

Eldredge, K.L., Wilson, G.T., & Whaley, A. (1990). Failure, self-evaluation and feeling fat in women. *The International Journal of Eating Disorders*, *9*, 37-50.

Epel, E., Lapidus, R., McEwen, B. & Brownell, K. (2001). Stress may add bite to appetite in women: a laboratory study of stress-induced cortisol and eating behaviour. *Psychoneuroendocrinology, 26*, 37-49.

Epel, E.S., McEwen, B., Seeman, S., Matthews, K., Castellazzo, G., Brownell, K.D., Bell, J., Ickovics, J.R. (2000). Stress and body shape: stress-induced cortisol secretion is consistently greater among women with central fat. *Psychosomatic Medicine, 62*, 623-632.

Erdfelder, E., Faul, F., & Buchner, A. (1996). GPOWER: A general power analysis program. *Behavioral Research and Therapy, 28*, 1-11.

Everill, J. & Waller, G. (1995). Reported sexual abuse and bulimic symptoms: the mediating role of dissociation. *The International Journal of Eating Disorders, 18*, 1-11.

Everill, J., Waller, G., & Macdonald, W. (1995). Dissociation in bulimic and non-eating-disordered women. *The International Journal of Eating Disorders*, *17*, 127-134.

Eysenck, H.J., & Eysenck, S.B.G. (1963). *The Eysenck Personality Inventory.* San Diego, CA: Educational and Industrial Testing Service. **[EPI: Eysenck Personality Inventory].**

Fairburn, C.G. (1981). A cognitive behavioural approach to the treatment of bulimia. *Psychological Medicine*, *11*, 707-711.

Fairburn, C.G. & Beglin, S.J. (1994). Assessment of eating disorders: interview or self-report questionnaire? *The International Journal of Eating Disorders, 16*, 363-370.

Fairburn, C.G. & Cooper, P.J. (1989). Eating Disorders. In K. Hawton, P.M. Salkovskis, J. Kirk, & D.M. Clark (Eds.). *Cognitive behaviour therapy for psychiatric problems: a practical guide*. Oxford: Oxford Medical Publications.

Fairburn, C.G., Cooper, P.J., Cooper, Z., McKenna, F.P. & Anastasiades, M.J. (1991). Selective information processing in bulimia nervosa. *The International Journal of Eating Disorders, 10*, 415-422.

Fairburn, C.G., Cooper, Z., & Cooper, P.J. (1986). The clinical features and maintenance of bulimia nervosa. In: Brownell, K.D. & F.J.P., (Ed.) *Handbook of eating disorders.* New York: Basic Books.

Fairburn, C.G., Jones, R., Peveler, P.C., Hope, R.A., & O'Connor, M. (1993). Psychotherapy and bulimia nervosa. Longer-term effects of interpersonal psychotherapy, behaviour-therapy, and cognitive- behaviour-therapy. *Archives of General Psychiatry*, *50*, 419-428.

Faunce, G.J. (2002). Eating disorders and attentional disorders: A review. *Eating Disorders, 10*, 125-139.

Fenigstein, A., Scheier, M.F., & Buss, A.H. (1975). Public and private self-consciousness: assessment and theory. *Journal of Consulting and Clinical Psychology*, *43*, 522-527. **[S-CQ: Self-consciousness questionnaire].**

Ferraro, F.R., Andres, M. Stromberg, L., & Kristjanson, J. (2003). Processing fat-related information in individuals at risk for developing an eating disorder. *Journal of Psychology*, *137*, 467-475.

Fioravanti, M., Polzonetti, C.M., Nocca, D., Spera, G., Falcone, S., Lazzaei, R., & Colosimo, A. (2004). Emotional activation of obese and normal women due to imagery and food content of verbal stimuli in a memory task. *Eating Behaviors, 5*, 47-54.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: exposure to corrective information. *Psychological Bulletin*, *99*, 20-35.

Folkman, S., & Lazarus, R.S. (1988). *Ways of coping questionnaire, permission set, manual, test booklets, scoring key.* Palo Alto, CA: Consulting Psychologists Press, Inc. **[WCQ: Ways of Coping Questionnaire].**

Folkman, S., Lazarus, R.S., Gruen, R.J., & DeLongis, A. (1986). Appraisal, coping, health-status and psychological symptoms. *Journal of Personality and Social Psychology, 50*, 571-579.

Foreyt, J.P., Brunner, R.L., Goodrick, G.K., Cutter, G., Brownell, K.D., & St. Jeor, S.T. (1995). Psychological correlates of weight fluctuation. *The International Journal of Eating Disorders*, *17*, 263-275.

Fransella, F., & Crisp, A.H. (1979). Comparison of weight concepts in groups of neurotic, normal and anorexic females. *British Journal of Psychiatry*, *134*, 79-81.

Freeman, L.M.Y., & Gil, K.M. (2004). Daily stress, coping, and dietary restraint in binge eating. *The International Journal of Eating Disorders*, *36*, 204-212.

Frost, R.O., Goolkasian, G.A., Ely, R.J., & Blanchard, F.A. (1982). Depression, restraint and eating behavior. *Behaviour Research and Therapy*, *20*, 113-122.

Fryer, S., Waller, G., & Kroese, B. S. (1997). Stress, coping and disturbed eating attitudes in teenage girls. *The International Journal of Eating Disorders*, *22*, 427-436.

Ganley, R.M. (1989). Emotion and eating in obesity: A review of the literature. *The International Journal of Eating Disorders*, *8*, 343-361.

Garfinkel, P.E., & Garner, D.M. (1982). *Anorexia nervosa: a multidimensional perspective.* New York: Brunner Mazel.

Garner, D. (1991). *Eating Disorders Inventory-2: professional manual.* Odessa, FL: Psychological Assessment Resources. **[EDI: Eating Disorders Inventory].**

Garner, D.M. & Bemis, K. (1982). A cognitive-behavioural approach to anorexia nervosa. *Cognitive Therapy and Research*, *6*, 123-150.

Garner, D.M. & Garfinkel, P.E. (1979). The Eating Attitudes Test: an index of the symptoms of anorexia nervosa. *Psychological Medicine*, *9*, 273-279.

Garner, D.M., Olmsted, M. P., Bohr, Y., & Garfinkel, P.E. (1982). The Eating Attitude Test: psychometric features and clinical correlates. *Psychological Medicine*, *12*, 871-878. **[EAT: The Eating Attitudes Test].**

Garner, D.M., Rockert, W., Davis, R., Garner, M.V., & Olmsted, M.P. (1993). Comparison of cognitive-behavioral and supportive-expressive therapy for bulimia nervosa. *American Journal of Psychiatry, 150*, 37-46.

Gerace, T.A., & George, V.A. (1996). Predictors of weight increases over 7 years in fire fighters and paramedics. *Preventive Medicine*, *25*, 593-600.

Ghaderi, A., & Scott, B (2000). Coping in dieting and eating disorders: A population-based study. *Journal of Nervous Mental Disorders*, May, *188*, 273-279.

Gibson, E., Checkley, S., Papadopoulos, A., Poon, L., & Wardle, J. (1999). Increased salivary cortisol reliably induced by a protein-rich midday meal. *Psychosomatic Medicine, 61*, 2142-2124.

Girdler, S.S., Koo-Loeb, J., Pedersen, C.A., Brown, H.J., & Maixner, W. (1998). Blood pressure-related hypoalgesia in bulimia nervosa. *Psychosomatic Medicine*, *60*, 736-743.

Giner-Sorolla, R. (2001). Guilty pleasures and grim necessities: affective attitudes in dilemmas of self-control. *Journal of Personality and Social Psychology*, *80*, 206-221.

Gleaves, D.H., Williamson, D.A., & Barker, S.E. (1993). Additive effects of mood and eating forbidden foods upon the perceptions of overeating and bingeing in bulimia nervosa. *Addictive Behaviors*, *18*, 299-309.

Goldberg, D. (1978). *Manual of the General Health Questionnaire.* Windsor, UK: NFER-Nelson. **[GHQ: General Health Questionnaire]**

Goldstein, D.S. (1995). *Stress, catecholamines, and cardiovascular disease.* New York: Oxford University Press.

Gotlib, I.H. & McCann, C.D. (1984). Construct accessibility and depression: an examination of cognitive and affective factors. *Journal of Personality and Social Psychology, 47*, 427-439.

Graham, D.T., Kabler, J.D. & Graham, K.F. (1962). Physiological response to the suggestion of attitudes specific for hives and hypertension. *Psychosomatic Medicine, 24*, 257-269.

Grave, R.D., Todisco. P., Olkiosi, E. & Marchi, S. (1996). Binge eating disorder and weight cycling in obese women. *Eating Disorders: The Journal of Treatment and Prevention*, *4*, 67-73.

Green, M.W., & McKenna, F.P. (1993). Developmental onset of eating related color-naming interference. *The International Journal of Eating Disorders, 13*, 391-397.

Green, M.W., McKenna, F.P., & de Silva, M.S. (1994). Habituation patterns to colour naming of eating-related stimuli in anorexics and non-clinical controls. *British Journal of Clinical Psychology, 33*, 499-508.

Green, M.W., & Rogers, P.J. (1993). Selective attention to food and body shape words in dieters and restrained non-dieters. *The International Journal of Eating Disorders, 14*, 515-517.

Green, M.W., & Rogers, P.J. (1998). Impairments in working memory associated with spontaneous dieting behaviour. *Psychological Medicine, 28*, 1063-1070.

Green, M.W., Corr, P., & De Silva, L. (1999). Impaired colour-naming of body shape-related words in anorexia nervosa: Affective valence or associative priming? *Cognitive Therapy and Research, 23*, 413-422.

Green, M.W., Elliman, N.A. & Rogers, P.J. (1996). Hunger, caloric preloading and the selective processing of food and body shape words. *British Journal of Clinical Psychology, 35*, 143-151.

Green, M.W., Elliman, N.A. & Rogers, P.J. & Welsh, D.A. (1997). Impaired colour naming of food and body shape words: weight phobia or distinct affective state? *The International Journal of Eating Disorders, 21*, 77-82.

Greenberg, B.R. (1986). Predictors of binge eating in bulimic and non-bulimic women. *The International Journal of Eating Disorders, 5*, 269-284.

Greenberg, B.R. & Harvey, P.D. (1987). Affective lability versus depression as determinants of binge eating. *Addictive Behaviors, 12*, 357-361.

Greeno, C.G., & Wing, R.R. (1994). Stress-induced eating. *Psychological Bulletin, 115*, 444-464.

Griffin, K.W., Friend, R., Eitel, P., & Lobel. M. (1993). Effects of environmental demands, stress and mood on health practices. *Journal of Behavioral Medicine, 16*, 643-661.

Grilo, C.M., Shiffman, S. & Carter-Campbell, J.T. (1994). Binge eating antecedents in normal-weight non-purging females: is there consistency? *The International Journal of Eating Disorders, 16*, 239-249.

Grilo, C.M., Shiffman, S. & Wing, R.R. (1989). Relapse crises and coping among dieters. *Journal of Consulting and Clinical Psychology*, *57*, 488-495.

Grignaschi, G., Mantelli, B., & Samanin, R. (1993). The hypophagic effect of restraint stress in rats can be mediated by 5-HT2 receptors in the paraventricular nucleus of the hypothalamus. *Neuroscience Letters*, *152*, 103-106.

Grissett, N.I., & Norvell, N.K. (1992). Perceived social support, social skills, and quality of relationships in bulimic women. *Journal of Consulting and Clinical Psychology, 60*, 293-299.

Grunberg, N.E. & Singer, J.E. (1990). Biochemical Measurement, p149. In: Cacioppo, J.T. & Tassinary, L.G. *Principles of Psychophysiology*, Cambridge.

Grunberg, N.E., & Straub, R.O. (1992). The role of gender and taste class in the effects of stress on eating. *Health Psychology*, *11*, 97-100.

Guidano. G.V. & Liotti, G. (1983). *Cognitive processes and emotional disorders: a structural approach to psychotherapy.* New York: Guilford.

Guyton, A.C., & Hall, J.E. (1996). *Textbook of Medical Physiology* (9th Edition) Saunders Co.

Hagan, M.M., Chandler, P.C., Wauford, P.K., Pybak, R.J., & Oswald, K.D. (2003). The role of palatable food and hunger as trigger factors in an animal model of stress induced binge eating. *The International Journal of Eating Disorders*, *34*, 183-197.

Hagan, M.M., Wauford, P.K., Chandler, P.C., Jarrett, L.A., Rybak, R.J., & Blackburn, K. (2002). A new animal model of binge eating: key synergistic role of past caloric restriction and stress. *Physiological Behavior, 77*, 45-54

Hainer, V., Stich, V., Kunesova, M., Parizkova, J., Zak, A., Wernischova, V., & Hrabak, P. (1992). Effect of 4-wk treatment of obesity by very-low-calorie diet on anthropometric, metabolic and hormonal indexes. *American Journal of Clinical Nutrition, 56*, 281-282.

Halmi, K.A. (1997). Models to conceptualize risk factors for bulimia nervosa. *Archives of General Psychiatry, 54*, 507-508.

Harrell, F.E., (2001). *Regression modeling strategies. Statistics and Computing.* Springer-Verlag, Berlin.

Hawkins, R.C. & Clement, P.F. (1980). Development and construct-validation of a self-report measure of binge eating tendencies. *Addictive Behaviors*, *5*, 507-508.

Hayes, A. F. (2004, August). *Variable splitting, statistical interaction, and the efficient use of data in communication research.* Paper presented at the annual meeting of the Association for Education in Journalism and Mass Communication, Toronto, Canada.

Haynes, C., Lee, M.D., & Yeomans, M. R. (2003). Interactive effects of stress, dietary restraint, and disinhibition on appetite. *Eating Behaviors*, *4*, 369-383.

Heatherton, T.F., & Baumeister, R.F. (1991). Binge eating as escape from self-awareness. *Psychological Bulletin*, *110*, 86-108.

Heatherton, T.F., Herman, C.P., & Polivy, J. (1991). Effects of physical threat and ego threat on eating behavior. *Journal of Personality and Social Psycholo*gy, *60*, 138-143.

Heatherton, T. F., Herman, C. P., & Polivy, J. (1992). Effects of distress on eating: the importance of ego-involvement. *Journal of Personally and Social Psychology*, *62*, 801-803.

Heatherton, T.F., & Polivy, J. (1991). Development and validation of a scale for measuring state self-esteem. *Journal of Personality and Social Psychology, 60*, 895-910.

Heatherton, T.F., Herman, C.P., & Polivy, J. (1991). Effects of physical threat and ego threat on eating behaviour. *Journal of Personality and Social Psychology*, *60*, 138-143.

Heatherton, T.F., Herman, C.P., Polivy, J., King, G.A., & McGree, S.T. (1988). The (Mis) measurement of restraint: an analysis of conceptual and psychometric issues. *Journal of Abnormal Psychology*, *97*, 19-28.

Heatherton, T.F., Polivy, J., & Herman, C.P. (1991). Restraint, weight loss, and variability of body weight. *Journal of Abnormal Psy*chology, *100*, 78-83.

Heatherton, T.F., Polivy, J., Herman, C.P. & Baumeister, R.F. (1993). Self-awareness, task failure and disinhibition: how attentional focus affects eating. *Journal of Personality*, *61*, 49-61.

Heatherton, T.F., Striepe, M., & Wittenberg, L. (1998). Emotional distress and disinhibited eating: the role of the self. *Personality and Social Psychology Bulletin*, *24*, 301-313.

Hein, C., Ehlert, U. & Hellhammer, D.H. (2000). The potential role of hypocortisolism in the pathophysiology of stress-related bodily disorders. *Psychoneuroendocrinology*, *25*, 1-35.

Heitmann, B.L., & Lissner, L. (1995). Dietary under reporting by obese individuals – is it specific or non-specific? *British Medical Journal, 311*, 986-989.

Hellhammer, D.H., Kirschbaum, C., Belkien, L. (1987). *Measurement of salivary cortisol under psychological stimulation.* In: Hingtgen, J.N., Hellhammer, D.H., Huppmann, G. (Eds.) Advanced Methods in Psychobiology, Hogrefe, Toronto, 281-289.

Helzer, J.E., & Pryzbeck, T.R. (1988). The co-occurrence of alcoholism with other psychiatric disorders in the general population and its impact on treatment. *Journal of Studies on Alcohol, 49*, 219-224.

Henderson, N.J., & Huon, G.F. (2002). Negative affect and binge eating in overweight women. *British Journal of Health Psychology, 7*, 77-87.

Henry, A. (1997). Stress, coping and binge eating: The role of outcome expectancies and cognitive schemas. *Dissertation Abstracts International: Section B: The Sciences & Engineering, 57*, 7226.

Henry, J.P. & Meehon, P. (1981). Psychosocial stimuli, physiological specificity, and cardiovascular disease. In: Weiner, H., Hofer, M.A., Stunkard, A.J. (Eds.). *Behavior and Bodily Diseases,* New York: Raven Press.

Herman, C.P. (1978). Restrained eating. *The Psychiatric Clinics of North America, 1*, 593-607.

Herman, C.P., & Mack, D. (1975). Restrained and unrestrained eating. *Journal of Personality, 43*, 647-660.

Herman, C.P., & Polivy, J. (1975). Anxiety, restraint and eating behaviour. *Journal of Abnormal Psychology, 84*, 666-672. **[RS: Restraint Scale].**

Herman, C.P., & Polivy, J. (1980). *Restrained eating.* In Obesity, Ed. A.J. Stunkard. Philadelphia: Saunders. **[RRS: Revised Restraint Scale].**

Herman, C.P., & Polivy, J. (1984). A boundary model for the regulation of eating. *In Eating and it's disorders*, Ed. A.J. Stunkard. New York: Raven Press.

Herman, C.P., & Polivy, J. (1988). Psychological factors in the control of appetite. *Current Concepts in Nutrition, 16*, 41-51.

Herman, C.P., Polivy, J., & Esses, V.M. (1987). The illusion of counter regulation. *Appetite*, 9,161-169.

Herman, C.P., Polivy, J., & Heatherton, T.F. (1990). *Effects of distress on eating: An analysis of the experimental literature.* Unpublished manuscript, University of Toronto, Ontario, Canada.

Herman, C.P., Polivy, J., Lank, C.N., & Heatherton, T.F. (1987). Anxiety, hunger and eating behaviour. *Journal of Abnormal Psychology, 96*, 264-269.

Hermans, D., Pieters, G., & Eelen, P. (1998). Implicit and explicit memory for shape, body weight, and food-related words in patients with anorexia nervosa and non-dieting controls. *Journal of Abnormal Psychology, 107*, 193-202.

Herzog, D.B., Field, A.E., Keller, M.B., West, J.C., Robins, W.M., Staley, J., Colditz, G.A. (1996). Subtyping eating disorders: is it justified? *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 928-936.

Hetherington, M.M. & MacDiarmid, J.L. (1993). "Chocolate Addiction": a preliminary study of its description and its relationship to problem eating. *Appetite*, *21*, 233-246.

Hibscher, J.A., Herman, C.P. (1977). Obesity, dieting, and the expression of "Obese" characteristics. *Journal of Comparative and Physiological Psychology*, *91*, 374-80.

Hill, A.J., Weaver, C.F.L.., & Blundell, J.E. (1990). Dieting concerns of 10-year-old-girls and their mothers. *British Journal of Clinical Psychology*, *29*, 346-348.

Hill, A.J., Weaver, C.F.L.., & Blundell, J.E. (1991). Food craving, dietary restraint and mood. *Appetite, 17*, 187-197.

Hollon, S. D., & Beck, A. T. (1994). Cognitive and cognitive behavioral therapies. In: A. E. Bergin, & S. L. Garfield (Eds.), *Handbook of psychotherapy and behavioral change*. Chichester: Wiley.

Honma, K.I., Honma, S. & Hiroshige, T. (1984). Feeding-associated corticosterone peak in rats under various feeding cycles. *American Journal of Physiology*, *246*, 721-726.

Hope, D.A., Rapee, R.M. Heimberg, R.G., & Dombeck, M.S. (1990). Representations of the self in social phobia: vulnerability in social threat. *Cognitive Therapy and Research, 14*, 177-189.

Hsu, L. K. G. (1990). *Eating disorders*. New York: Guilford.

Hsu, L. K. G. (1990). Experimental aspects of bulimia nervosa: implications for cognitive behavioral therapy. *Behavior Modification*, *14*, 50-65.

Hubert, W., & de Jong-Meyer, R. (1989). Emotional stress and saliva cortisol response. *Journal of Clinical Chemistry and Clinical Biochemistry*, *27*, 235-237.

Hunt, J. & Cooper, M. (2001). Selective memory bias in women with bulimia nervosa and women with depression. *Behavioural and Cognitive Psychotherapy*, *29*, 93-102.

Huon, G.F. (1995). The Stroop color-naming task in eating disorders: a review of the research. *Eating Disorders: The Journal of Treatment and Prevention, 3*, 124-132.

Huon, G.F. & Brown, L.B. (1996). Task dependency in color-naming latency among dieters. *The International Journal of Eating Disorders*, *19*, 405-410.

Irwin, J.R., & McClelland, G.H. (2003). Negative consequences of dichotomising continuous variables. *Journal of Market Research*, *40*, 366-371.

Israeli, A.L. & Stewart, S.H. (2001). Memory bias for forbidden food cues in restrained eaters. *Cognitive Therapy and Research, 25*, 37-47.

Jansen, A., Merckelbach, H., Oosterlaan, J., Tuiten, A., van den Hout, M. (1988). Cognitions and self-talk during food intake of restrained and unrestrained eaters. *Behavioral Research and Therapy*, *26*, 393-398.

Jansen, A., van den Hout, M., & Griez, E. (1990). Clinical and non-Clinical binges. *Behavioral Research and Therapy, 28*, 439-444.

Johnson, C., & Larson, R. (1982). Bulimia: an analysis of moods and behavior. *Psychosomatic Medicine*, *44*, 341-351.

Johnson, C., Stuckey, M.K., Lewis, C. & Schwartz, D.M. (1982). Bulimia: a descriptive survey of 316 cases. *The International Journal of Eating Disorders*, *2*, 3-16.

Johnson, W.G., Schlundt, D.G., Barclay, D.R., Carr-Nangle, R.E. & Engler, L.B. (1995). A naturalistic functional analysis of binge eating. *Behavior Therapy*, *26*, 101-118.

Johnson-Sabine, E.C., Wood, K.H., & Wakeling, A. (1984). Mood changes in bulimia nervosa. *British Journal of Psychiatry, 145*, 512-516.

Jones, E.E., Kanouse, D.E., Kelley, H.H., Nisbett, R.E., Valins, S., & Weiner, B. (1972). *Attribution: Perceiving the causes of behaviour.* Morristown, NJ: General Learning Press.

Jones-Chesters, M.H., Monsell, S., & Cooper, P.J. (1998). The disorder-salient Stroop effect as a measure of psychopathology in eating disorders. *The International Journal of Eating Disorders, 24*, 65-82.

Jung, F. (1973). Appetitverhalen von Vorschulkinden unter experimenteller Kontrolle. *Praxis der Kinderopsycologie und kinderpsyciatrie, 22*, 167-171.

Jung, F. (1976). Untersuchungen zur Nahrungsaufrahme von Kindem und Neugeborenen unter besonderer Berucksichtigung psychischer Aktivierung. Math.- Nat. Diss. Gottingen.

Kahan, D., Polivy, J., & Herman, C.P. (2003). Conformity and dietary disinhibition: a test of the ego-strength model of self-regulation. *The International Journal of Eating Disorders. 33*, 165-171.

Kaplan, H.I., & Kaplan, H.S. (1957). The psychosomatic concept of obesity. *Journal of Nervous and Medical Disease, 125*, 181-201.

Kaye, W.H., Gendall, K., Kye, C. (1998). The role of the central nervous system in the psychoneuroendocrine disturbances of anorexia and bulimia nervosa. *Psychiatric Clinics of North America, 21*, 381-396.

Kaye, W.H., Gwirtsman, H.E., George, D.T., Weiss, S.R. & Jimerson, D.C. (1986). Relationship of mood alterations to bingeing behavior in bulimia. *British Journal of Psychiatry, 149*, 479-485.

Kearney, M.T., Cowley, A.J., & MacDonald, I.A. (1995). The cardiovascular responses to feeding in man. *Experimental Physiology, 80*, 683-700.

Keele, P.K. & Mitchell, J.E. (1997). Outcome in bulimia nervosa. *American Journal of Psychiatry, 154*, 313-321.

Kenardy, J., Arnow, B. & Agras, W.S. (1996). The aversiveness of specific emotional states associated with binge-eating in obese subjects. *Australian and New Zealand Journal of Psychiatry, 30*, 839-844.

Kendler, K. S., MacLean, C., Neale, M., Kessler, R., Heath, A., & Eaves, L. (1991). The genetic epidemology of bulimia nervosa. *American Journal of Psychiatry, 148*, 345-353.

Kersting, A., Ohrmann, P., & Lolee-Mentzel, J. (2005). Incidental learning of food and emotional words in women with anorexia nervosa. *Psychotherapy and Psychiatric Medicine, 55*, 135-135.

Keys, A., Brozek, J., Henschel, A., Mickelsen, O., & Taylor, H.L. (1950). *The biology of human starvation*. Minneapolis: University of Minnesota Press.

Kiecolt-Glaser, J.K. & Glaser, R (1987). Psychosocial moderators of immune function. *Annals of Behavioural Medicine, 9*, 16-20.

Killen, J.D., Hayward, C., Wilson, D.M., Taylor, C.B., Hammer, L.D., Litt, L., Simmonds, B. & Haydel, F. (1994). Factors associated with eating disorder symptoms in a community sample of 6th and 7th grade girls. *The International Journal of Eating Disorders*, *15*, 357-367.

King, G.A., Herman, C.P., & Polivy, J. (1987). Food perception in dieters and non-dieters. *Appetite*, *8*, 147-158.

King, G.A., Polivy, J. & Herman, C.P. (1991). Cognitive aspects of dietary restraint: Effects on person memory. *The International Journal of Eating Disorders, 10*, 313-321.

King, M.B. (1986). Eating disorders in general practice. *Journal of the Royal Society of Medicine, 83, 229-232.*

Kirk, S. F. L., & Hill, A. J. (1997). Exploring the food beliefs and eating behavior of successful and unsuccessful dieters. *Journal of Human Nutrition, Diet, 10*, 331-341.

Kirschenbaum, D.S., & Dykman, B.M. (1991). Disinhibited eating by resourceful restrained eaters. *Journal of Abnormal Psycholo*gy, May, *100*, 227-230.

Kirschbaum, C. & Hellhammer, D.H. (1994). Salivary cortisol in psychoneuroendocrine research: recent developments and applications. *Psychoneuroendocrinology, 19*, 313-333.

Kirschbaum, C. & Hellhammer, D.H. (1989). Salivary cortisol in psychobiological research: an overview. *Neuropsychobiology, 22*, 150-169.

Kirschbaum, C. (1999). Mental stress follows mental rules. *Journal of Clinical Endocrinology & Metabolism, 84*, 4292-4294.

Kirschbaum, C., Bartusseck, D., & Strasburger, C.J. (1992). Cortisol response to psychological stress and correlations with personality traits. *Personality and Individual Differences, 13*, 1353-1357.

Kirschbaum, C., Pirke, K.M., & Hellhammer, D.H. (1993). The 'Trier Social Stress Test' – A tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology, 28*, 76-81.

Kirschbaum, C., Pirke, K.M. & Hellhammer, D.H. (1995). Preliminary evidence for reduced cortisol responsivity to psychological stress in women using oral contraceptive medication. *Psychoneuroendocrinology, 20*, 509-514.

Kirschbaum, C., Wust, S. & Hellhammer, D. (1992). Heritability of cortisol responses to h-CRH, ergometry, and psychological stress in humans. *Journal of Clinical Endocrinology and Metabolism, 75*, 1526-1530.

Klein, L., Faraday, M. & Grunberg, N. (1996). Gender differences in eating after exposure to a noise stressor. *Annals of Behavioral Medicine, 18*, 103-105.

Koo-Loeb, J.H., Costello, N. Light, K.C., & Girdler, S.S. (2000). Women with eating disorder tendencies display altered cardiovascular, neuroendocrine, and psychosocial profiles. *Psychosomatic Medicine*, *62*, 539-548.

Koo-Loeb, J. H., Pedersen, C. & Girdler, S. S. (1998). Blunted cardiovascular and catecholamine stress reactivity in women with bulimia nervosa. *Psychiatry Research*, *80*, 13-27.

Krahn, D.D., Gosnell, B.A., Grace, M., & Levine, A.S. (1986). CRF antagonist partially reverses CRF- induced and stress-induced effects on feeding. *Brain Research Bull*etin, *17*, 285-289.

Kuehnel, R.H., & Wadden, T.A. (1994). Binge-eating disorder, weight cycling, and psychopathology. *The International Journal of Eating Disorders*, *15*, 321-329.

Kupfermann, I. (1964). Eating behaviour induced by sounds. *Nature*, *18*, 201-324.

Laberg, J.C., Wilson, G.T., Eldredge, K. & Nordby, H. (1991). Effects of mood on heart-rate reactivity in bulimia nervosa. *The International Journal of Eating Disorders, 10*, 169-178.

Lacey, J.H. (1986). Pathogenesis. In L.J. Downey & J.C. Malkin (Eds.). *Current approaches: bulimia nervosa*. Southampton: Duphar Laboratories Limited.

Lacey, J. H., Cocker, S., & Birtchnell, S. A. (1986). Bulimia: Factors associated with its etiology maintainance. *The International Journal of Eating Disorders, 5*, 475-487.

Laessle, R.G., Tuschl, R.J., Kotthaus, B.C., & Pirke, K.M. (1989). A comparison of the validity of three scales for the assessment of dietary restraint. *Journal of Abnormal Psychology, 98*, 504-507.

Lattimore, P.J. (2001). Stress-induced eating: an alternative method for inducing ego-threatening stress. *Appetite*, *36*, 187-188.

Lattimore, P. & Caswell, N. (2004). Differential effects of active and passive stress on food intake in restrained and unrestrained eaters. *Appetite, 42*, 167-173.

Lattimore, P. & Maxwell, L. (2004). Cognitive load, stress, and disinhibited eating. *Eating Behaviors*, *5*, 315-324.

Lazarus, R.S. & Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.

Leon, G.R., Carroll, K., Chernyck, B. & Finn, S. (1985). Binge eating and associated habit patterns within college student and identified bulimic populations. *The International Journal of Eating Disorders, 4*, 43-57.

Leon, G.R. & Chamberlain, K. (1973). Comparison of daily eating habits and emotional states of overweight persons successful or unsuccessful in maintaining a weight loss. *Journal of Consulting and Clinical Psychology*, *41*, 108-115.

Leon, G.R. & Chamberlain, K. (1973). Emotional arousal, eating patterns, and body image as differential factors associated with varying success in maintaining a weight loss. *Journal of Consulting and Clinical Psychology, 40*, 474-480.

Leon, G.R., Fulkerson, J.A. Perry, C.L. & Cudeck, R. (1993). Personality and behavioural vulnerabilities associated with risk status for eating disorders in adolescent girls. *Journal of Abnormal Psychology*, *102*, 438-444.

Leonard, T., Divac, S., Bichindaritz, I, Rouer-Saporta, S., Samuel-Lajeunesse, B. (1997). Selective processing of eating and body words in restricting-type anorexics, binge-eating-type anorexics, bulimics, and control subjects. *Eating and Weight Disorders, 2*, 17-23.

Lee, M. & Shafran, R. (2004). Information processing biases in eating disorders. *Clinical Psychology Review, 24*, 215-238.

Lennings, C.I. (1980). *De vragenlijst met gebeurtenissed die een mens kunnen overkomen.* Internal publication, Department of Human Nutrition, Agricultural University, Wageningen, The Netherlands. **[DLEQ: The Dutch Life Events Questionnaire]**.

Levitsky, D.A. (2002). Putting behavior back into feeding behavior: a tribute to George Collier. *Appetite*, *38*,143-148.

Leon, G.R., Fulkerson, J.A., Perry, C.L., & Early-Zald, M.B. (1995). Prospective analysis of personality and behavioural vulnerabilities and gender influences in the later development of disordered eating. *Journal of Abnormal Psychology*, *104*, 140-149.

Leon, G.R., Keel, P.K., Klump, K.L., & Fulkerson, J.A. (1997). The future of risk factor research in understanding the etiology of eating disorders. *Psychopharmacological Bull*etin, *33*, 405-411.

Leon, G.R & Roth, L. (1977). Obesity: psychological causes, correlations and speculations. *Psychological Bulletin, 84*, 117-139.

Leon, G.R., & Chamberlain, K. (1973). Comparison of daily eating habits and emotional states of overweight persons successful or unsuccessful in maintaining a weight loss. *Journal of Consulting and Clinical Psychology*, *41*, 108-115.

Leung, N., Waller, G., & Thomas, G. (1999). Core beliefs in anorexic and bulimic women. *Journal of Nervous Mental Disorders, 187*, 736-741.

Levine, M.D., & Marcus, M.D. (1997). Eating behavior following stress in women with and without bulimic symptoms. *Annals of Behavioral Med*icine, *19*, 132-138.

Levine, A.S. & Morley, J.E. (1982). Gnawing is the preferred consummatory behaviour initially induced by tail-pinch. *Appetite, 3*, 135-138.

Liberman, H.R., Wurtman, J.J., & Chew, B. (1986). Changes in mood after carbohydrate consumption among obese individuals. *American Journal of Clinical Nutrition, 44*, 772-778.

Linville, P.W. (1985). Self-complexity and affective extremity: Can't put all of your eggs in one cognitive basket. *Social Cognition*, *3*, 94-120. **[Self-Complexity Task].**

Lingswiler, V.M., Crowther, J.H., & Stephens, M.A.P. (1987). Emotional reactivity and eating in binge eating and obesity. *Journal of Behavioral Medicine, 10*, 287-299.

Lingswiler, V.M., Crowther, J.H., & Stephens, M.A.P. (1989). Affective and cognitive antecedents to eating episodes in bulimia and binge eating. *The International Journal of Eating Disorders, 8*, 533-539.

Long, C.G., Hinton, C. & Gillespie, N.K. (1994). Selective processing of food and body-size words: application of the Stroop test with obese restrained eaters, anorexics, and normals. *The International Journal of Eating Disorders*, *15*, 279-283.

Lowe, M. R., & Kleifield, E. I. (1988). Cognitive restraint, weight suppression, and the regulation of eating. *Appetite, 10*, 159-168.

Lowe, M. R., Gleaves, D. H., Di Simone-Weiss, R. T., Furgueson, C., Gayda, C. A., Kolsky, P. A., Neal-Walden, T., Nelsen, L. A., & McKinney, S. (1996). Restraint, dieting, and the continuum model of bulimia nervosa. *Journal of Abnormal Psychology, 105*, 508-517.

Lowe, M.R. (1984). Dietary concern, weight fluctuation and weight status: Further explorations of the Restraint Scale. *Behaviour Research and Therapy*, *22*, 243-248.

Lowe, M.R. (1992). Staying on versus going off a diet: effects on eating in normal weight and overweight individuals. *The International Journal of Eating Disorders*, *12*, 417-24.

Lowe, M.R. (1993). The effects of dieting on eating behaviour: a Three-Factor Model. *Psychological Bulletin*, *114*, 100-121.

Lowe, M.R. (1994). Putting restrained and unrestrained non-dieters on short-term diets: effects on eating. *Addictive Behaviours*, *19*, 349-356.

Lowe, M.R. (1995). Restrained eating and dieting: replication of their divergent effects on eating regulation. *Appetite*, *25*, 115-118.

Lowe, M.R., & Fisher, E.B. (1983). Emotional reactivity, emotional eating and obesity: A naturalistic study. *Journal of Behavioural Medicine*, *6*, 135-148.

Lowe, M.R. & Kral, T.V.E. (2006). Stress-induced eating in restrained eaters may not be caused by stress or restraint. *Appetite*, *46*,16-21.

Lowe, M.R., Whitlow, J.W., & Bellwoar, V. (1991). Eating regulation: the role of restraint, dieting, and weight. *The International Journal of Eating Disorders*, *10*, 461-471.

Lubin, B. (1967). *Manual for the Depression Adjective Check List.* San Diego: Educational and Industrial Testing Service.

Luck, A., Waller, G., Meyer, C., & Lacey, H. (2006). (submitted for publication). The role of schema processes in the eating disorders. *Cognitive Therapy and Research.*

Macht, M, Gerer, J. & Ellgring, H. (2003). Emotions in overweight and normal-weight women immediately after eating foods differing in energy. *Physiology and Behavior, 80*, 367-374.

Macht, M., Haupt, C., & Ellgring, H. (2005). The perceived function of eating is changed during examination stress: a field study. *Eating Behaviors*, *6*, 109-112.

Macht, M., & Simons, G. (2000). Emotions and eating in everyday life. *Appetite*, *35*, 65-71.

Mackey, C.J. (1980). *The measurement of mood and psychophysiological activity using self-report techniques [SACL].* In: Martin, L; Venables, P.H., Eds. Techniques in psychophysiology. New York: Wiley.

MacCallum, R.C., Zhang, S.B., Preacher, K.J., & Rucker, D.D. (2002). On the practice of dichotomization of quantitative variables. *Psychological Methods*, *7*, 19-40.

MacDiarmid, J.I. & Hetherington, M.M. (1995). Mood modulation by food: an exploration of affect and cravings in 'chocolate addicts'. *British Journal of Clinical Psychology*, *34*, 129-138.

MacLeod, C, Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*, 15-20.

MacLeod, C.M. (1991). Half a century of research on the Stroop effect: an integrative review. *Psychological Bulletin, 109*, 163-203.

MacLeod, C. Rutherford, E., Campbell, L., Ebsworthy, G. & Holker, L. (2002). Selective attention and emotional vulnerability: assessing the causal basis of their association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology, 111*, 107-123.

MacLeod, C. & Rutherford, E.M. (1992). Anxiety and the selective processing of emotional information: mediating roles of awareness, trait and state variables, and personal relevance of stimulus material. *Behaviour Research and Therapy, 30*, 479-491.

MacLeod, C.M. (1992). The Stroop task: the "gold standard" of attentional measures. *Journal of Experimental Psychology, General, 121*, 12-14.

Mahamedi, F., & Heatherton, T. F. (1993). Effects of high calorie preloads on selective processing of food and body shape stimuli among dieters and non-dieters. *The International Journal of Eating Disorders, 13*, 305-314.

Mahoudeau, J. & Reznik, Y. (1993). Appetite comes with eating, cortisol too - a new cause of Cushing's syndrome. *La Presse Médicale Journal*, *22*, 407-408.

Malatinsky, J., Vigas, M., Jurcovicova, J., Jezova, D., Garayova, S., & Minarikova, M. (1986). The patterns of endocrine response to surgical stress during different types of anaesthesia and surgery in man. *Anaesthesiologica Belgica, 37*, 23-32.

Marin, P., Darin, N., Amemiya, T., Andersson, B., Jem, S., & Bjomtorp, P. (1992). Cortisol secretion in relation to body fat distribution in obese premenopausal women. *Metabolism, 41*, 882-886.

Mason, J.W. (1968). A review of psychoendocrine research on the pituitary-adrenal cortical system. *Psychosomatic Medicine, 30*, 576-607.

Mason, J.W. (1975). A historical view of the stress field. *Journal of Human Stress, 1*, 22-36.

Mason, R.A. (1968). Techniques for data acquisition and analysis in field investigations of stress. In: R.W.J. Neufeld (Ed.) *Advances in the investigation of psychological stress.* Wiley Interscience, New York, 195-234.

Mason, J.W., Maher, J.T., Hartley, L.N. (1976). *Psychopathology of Human Adaptation*. Plenum, New York.

Matthews, A. (1990). Why worry? The cognitive function of anxiety. *Behaviour Research and Therapy, 28*, 455-468.

Matthews, A. & MacLeod, C. (1986). Discrimination of threat cues without awareness in anxiety states. *Journal of Abnormal Psychology, 95*, 131-138.

Matthews, A. & MacLeod, C. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology, 45*, 25-50.

Matthews, G. & Wells, A. (2000). Attention, automaticity, and affective disorder. *Behavior Modification, 24*, 69-93.

Mayhew, R. & Edelmann, R.J. (1989). Self-esteem, irrational beliefs and coping strategies in relation to eating problems in a non-clinical population. *Personality and Individual Differences*, *10*, 581-584.

Marrazzi, M.A., McQuarters, A., Barnes, C., Lawhom, J., D'Amico-Rasmussen, Q. (1996). Male/female comparison of morphine effect on food intake – relation to anorexia nervosa. *Pharmacological Biochemistry and Behav*ior, *53*, 433-435.

Mavissakalian, M. (1987). The placebo effect in agoraphobia. *Journal of Nervous and Mental Dis*orders, *175*, 95-99.

Maxwell, S. E., & Delaney, H. D. (1993). Bivariate median splits and spurious statistical significance. *Psychological Bulletin*, *113*, 181-190.

McCann, B.S., Warnick, G.R., & Knopp, R.H. (1990). Changes in plasma lipids and dietary intake accompanying shifts in perceived workload and stress. *Psychosomatic Medicine*, *52*, 97-108.

McCarty, D.T. (1989). Stress and the firefighter. *Fire Command, 38*, 55-56.

McCarty, R. (1989). Stress research: principles, problems and prospects. In: van Lood, G.R., Kvenansky, R., McCarty, R., Axelrod J., Eds. *Stress: neurochemical and humoral mechanisms*. New York: Gordon and Breach Science Publishers.

McEwan, B.S. (1998). Protective and damaging effects of stress mediators. *The New England Journal of Me*dicine, *338*, 171-179.

McFarlane, T., Polivy, J., & Herman, C.P. (1998). Effects of false weight feedback on mood, self-evaluation, and food intake in restrained and unrestrained eaters. *Journal of Abnormal Psychology, 107*, 312-318.

McHugh, P.R. & Moran, T.H. (1979). Calories and gastric emptying: a regulatory capacity with implications for feeding. *American Journal of Physiology, 236*, 254-260.

McKenna, R.J. (1972). Some effects of anxiety level and food cues on the eating behaviour of obese and normal weight subjects: a comparison of the Schachterian and psychosomatic conceptions. *Journal of Personality and Social Psychology*, *22*, 311-319.

McLean, J.A., Barr, S.I., & Prior, J.C. (2001). Cognitive dietary restraint is associated with higher urinary cortisol excretion in healthy pre-menopausal women. *American Journal of Clinical Nutrition*, *73*, 7-12.

McManus, F., & Waller, G (1995). A functional analysis of binge-eating. *Clinical Psychology Review*. *15*, 845-863.

McManus, F., Waller, G., & Chadwick, P. (1996). Biases in the processing of different forms of threat in bulimic and comparison women. *Journal of Nervous and Mental Disease*, *184*, 547-554.

McManus, F., Waller, G., & Chadwick, P. (1996). *Cognitive processing in the link between bulimic disorders and depressive symptomatology.* Part of Freda McManus's unpublished Clin. Psy. D. Thesis.

McManus, F., Waller, G., Shuck, V., Watkins, H. & Chadwick, P. (1995). *Bulimia and the processing of threatening information.* Paper presented at the British Psychological Society Annual Conference, Warwick.

McNally, R.J., Kaspi, S.P., Riemann, B.C., & Zaitlin, S.B. (1990). Selective processing of threat cues in posttraumatic stress disorder. *Journal of Abnormal Psychology, 99*, 398-402.

McNally, R.J., Riemann, B.C., & Kim, E. (1990). Selective processing of threat cues in panic disorder. *Behaviour Research and Therapy, 28*, 407-412.

McNair, D., Lorr, M., Droppleman, L. (1971). *The Profile of Mood States*. San Diego, CA: Educational and Industrial Testing Service. **[POMS: The Profile of Mood States].**

Mercer, L.P., Kelley, D.S., Haq, A.U. & Humphries, L.L. (1996). Dietary induced anorexia: a review of involvement of the histaminergic system. *Journal of the American College of Nutrition*, *15*, 223-230.

Mela, D.J. (2001). Determinants of food choice: relationships with obesity and weight control. *Obesity Research*, *9*, 249-255.

Meyer, C., & Waller, G. (1999). The impact of emotion upon eating behaviour: the role of subliminal visual processing of threat cues. *The International Journal of Eating Disorders, 25*, 319-326.

Meyer, C., & Waller, G. (2000). Subliminal activation of abandonment- and eating-related schemata: relationship with eating disordered attitudes in a non-clinical population. *The International Journal of Eating Disorders*, *27*, 328-334.

Meyer, C., Waller, G. & Watson, D. (2000). Cognitive avoidance and bulimic psychopathology: the relevance of temporal factors in a non-clinical population. *The International Journal of Eating Disorders*, *27*, 405-410.

Meyer, J.E., & Pudel, V. (1972). Experimental studies on food-intake in obese and normal weight subjects. *Journal of Psychosomatic Research*, *16*, 305-308.

Meyer, J.E., & Pudel, V. (1977). Experimental feeding in man: a behavioural approach to obesity. *Psychosomatic Medicine*, *39*,153-157.

Meyer, C., Serpell, L., Waller, G., Murphy, F., Treasure, J., & Leung, N. (2005). Cognitive avoidance in the strategic processing of ego threats among eating-disordered patients. *The International Journal of Eating Disorders*, *38*, 30-36.

Michaud, C., Musse, N., Kahn, J.P., Grebert, M., Burlet, C., & Mejean, L. (1990). Nutrition behavior in adolescent students (15-19 years of age) in the Nancy metropolitan area. A comparison with the recommended nutritional intake of the French population. *Review of Epidemiology Sante Publique*, *37*, 149-159.

Mirsky, A.F., & Rosvold, H.E. (1953). The effect of electroconvulsive shock on food intake and hunger drive in the rat. *Journal of Comparative and Physiological Psychology*, *46*, 153-157.

Mitchell, J.E., Davis, L. & Goff, G. (1985). The process of relapse in patients with bulimia. *The International Journal of Eating Disorders*, *4*, 457-463.

Mitchell, J.E., Hatsukami, D., Eckert, E.D., & Pyle, R. (1985). Characteristics of 275 patients with bulimia. *American Journal of Psychiatry*, *142*, 482-485.

Mitchell, S.L., & Epstein, L.H. (1996). Changes in taste and satiety in dietary restrained women following stress. *Physiology and Behavior*, *60*, 495-499.

Mitchell, S.L., & Perkins, K.A. (1998). Interaction of stress, smoking, and dietary restraint in women. *Physiology & Behavior*, *64*, 103-109.

Mizes, J.S. (1985). Bulimia: a review of its symptomatology and treatment. *Advances in Behavior Research Therapy*, *7*, 91-142.

Mizes, J.S. (1988). Personality characteristics of bulimic and non-eating-disordered female controls: a cognitive behavioural perspective. *The International Journal of Eating Disorders*, *7,* 541-550.

Mogg, K., McNamara, J., Powys, M., Rawlinson, H., Seiffer, A., & Bradley, B. P. (2000). Selective attention to threat: a test of two cognitive models of anxiety. *Cognition and Emotion*, *14*, 375-399.

Monjan, A.A. & Collector, M.I. (1977). Stress-induced modulation of the immune response. *Science, 196*, 307-308.

Moos, R.H., Cronkite, R.C., Billings, A.G., & Finney, J.W. (1984). *Health and daily living form manual.* Palo Alto, CA: Social Laboratory, Veterans Administration Hospital. **[HDL: Health and Daily Living Questionnaire].**

Morley, J.E. & Levine, A.S. (1980). Stress-induced eating is mediated through endogenous opiates. *Science, 209*, 1259-1261.

Mountford, V., Waller, G., Watson, D., Scragg, P. (2004). An experimental analysis of the role of schema compensation in anorexia nervosa. *Eating Behaviors*, *5*, 223-230.

Muller, M., Budde, A. & Netter, P. (1990). *The influence of need for achievement and type and controllability of a stressor on responses of saliva cortisol.* 2nd European symposium on hormone and drug assessment in saliva: perspectives for basic research and clinical practice (conference proceedings).

Nagata, T., McConaha, C., Rao, R., Sokol, M.S., & Kaye, W.H. (1997). A comparison of subgroups of inpatients with anorexia nervosa. *The International Journal of Eating Disorders, 22*, 309-314.

Nagel, K.L. & Jones, K.H. (1992). Predisposition factors in anorexia nervosa. *Adolescence*, *27*, 381-386.

Newman, J.P., Wallace, J.F., Strauman, T.J., Skolaski, R.L., Oreland, K.M., Mattek, P.W., Elder, K.A. & McNeely, J. (1993). Effects of motivationally significant stimuli on the regulation of dominant responses. *Journal of Personality and Social Psychology*, *65*, 165-175.

Niaura, R., Herbert, P.N., Saritelli, A.L., Goldstein, M.G., Flynn, M., Follick, M., Gorkin, L., & Ahern, D. K. (1991). Lipid and lipoprotein responses to episodic occupational and academic stress. *Archives of Internal Medicine*, *151*, 2172-2179.

Nisbett, R.E. (1972). Hunger, obesity and the ventromedial hypothalamus. *Psychological Review*, *79*, 433-453.

Nylander, I. (1971). The feeling of being fat and dieting in a school population: epidemiologic interview investigation. *Acta Socio-Medica Scandinavica*, 3, 17-26.

O'Donnell, L., O'Meara, N., Owens, D., Johnson, A., Collins, P., Johnson, A., & Tomkin, G. (1987). Plasma catecholamines and lipoproteins in chronic psychological stress. *Journal of the Royal Society of Medicine, 80*, 339-342.

Obrist, P.A. (1976). The cardiovascular-behavioral interaction as it appears today. *Psychophysiology, 13*, 95-107.

Ogden, J. & Greville, L. (1993). Cognitive changes to preloading in restrained and unrestrained eaters as measured by the Stroop task. *The International Journal of Eating Disorders*, *14*, 185-195.

Oliver, G., & Wardle, J. (1999). Perceived effects of stress on food choice. *Physiology and Behavior, 66*, 511-585.

Oliver, G., Wardle, J., & Gibson, E.L. (2000). Stress and food choice: a laboratory study. *Psychosomatic Medicine*, *62*, 853-865.

Oliver, K.G., Huon, G.F., Zardo, L. & Williams, K.D. (2001). The role of interpersonal stress in overeating among high and low disinhibitors. *Eating Behaviors, 2*, 19-26.

Ondercin, P. A. (1979). Compulsive eating in college women. *Journal of College Student Development, 20*, 153-157.

Orleans, C.T. & Barnett, L.R. (1984). Bulimarexia: guidelines for behavioural assessment and treatment. In R.C. Hawkins, W.J. Fremouw & P.F. Clement (Eds.). *The binge-purge syndrome. Diagnosis, treatment and research*. New York: Springer.

Ouwens, M.A., van Strien, T. & van der Staak, C.P.F. (2003a). Absence of a disinhibition effect of alcohol on food consumption. *Eating Behaviors*, 4, 323-232.

Ouwens, M.A., van Strien, T. & van der Staak, C.P.F. (2003b). Tendency toward overeating and restraint as predictors of food consumption, *Appetite, 40*, 291-298.

Overduin, J., Jansen, A. & Louwerse, E. (1995). Stroop interference and food intake. *The International Journal of Eating Disorders*, *18*, 277-285.

Owen, J.B., Treasure, J., & Collier, D.A. (Eds.) (2001). *Animal models of disorders of eating behaviour and body composition*. Kluwer Academic Publishers.

Paa, H.K., & Larson, L.M. (1998). Predicting level of restrained eating behavior in adult women. *The International Journal of Eating Disorders*, *24*, 91-94.

Pacak, K., Palkovits, M., Yadid, G., Kvetnansky, R., Kopin, I.J., Goldstein, D.S. (1998). Heterogeneous neurochemical responses to different stressors: a test of Selye's doctrine of non-specificity. *American Journal of Physiology, 275*, 1247-1255.

Palmer, R.L. (1979). The dietary chaos syndrome: a useful new term? *British Journal of Medical Psychology*, *52*, 187-190.

Pare, W.P. (1964). The effect of chronic environmental stress on stomach ulceration, adrenal function and consummatory behaviour in the rat. *Journal of Psychology*, *57*, 143-151.

Pare, W.P. (1965). Stress and consummatory behaviour in the albino rat. *Psychological Reports*, *16*, 399-405.

Pasquali, R., Cantobelli, S., Casimirri, F., Capelli, M., Bortoluzzi, L., Flamia, R., Labate, A.M., & Barbara, L. (1993). The hypothalamic-pituitary-adrenal axis in obese women with different patterns of body fat distribution. *Journal of Clinical Endocrinology and Metabolism, 77*, 341-346.

Paterson, R.J. & Neufield, R.W.J. (1987). Clear danger: situational determinants of the appraisal of threat. *Psychological Bulletin, 101*, 406-416.

Patton, C.J. (1992). Fear of abandonment and binge eating: a subliminal psychodynamic activation investigation. *Journal of Nervous and Mental Disease*, *180*, 484-490.

Pederson-Mussell, M., Mitchell, J.E., Fenna, C.J., Crosby, R.D., Miller, J.P., & Hoberman, J.M. (1997). A comparison of onset of binge eating versus dieting in the development of bulimia nervosa. *The International Journal of Eating Disorders*, *21*, 353-360.

Peeke, P.M. & Chrousos, G.P. (1995). Hypercortisolism and obesity. *New York Academy of Science, 29*, 655-676.

Perpina, C., Leonard, T., Treasure, J., Bond, A., & Banos, R. (1998). Selective processing of food and body-related information and autonomic arousal in patients with eating disorders. *Spanish Journal of Psychology, 1*, 3-10.

Perpina, C., Hemsley, D., Treasure, J., & de Silva, P. (1993). Is the selective information processing of food and body words specific to patients with eating disorders? *The International Journal of Eating Disorders, 14*, 359-366.

Peterson, C. (1991). On shortening the expanded attributional style questionnaire. *Journal of Personality Assessment*, *56*, 179-183.

Pine, C.J. (1985). Anxiety and eating behaviour in obese and non-obese American Indians and White Americans. *Journal of Personality and Social Psychology*, *49*, 774-780.

Pirke, K., Kellner, M., Phillipp, E., Laessle, R., Krieg, J., Fitcher, M. (1992). Plasma norepinephrine after a standardized test meal in acute and remitted patients with anorexia nervosa and in healthy controls. *Biological Psychiatry, 31*, 1074-1077.

Pirke, K., Platte, P., Laessle, R., Seidl, M., Fichter, M. (1992). The effect of a mental challenge test of plasma norepinephrine and cortisol in bulimia nervosa and in controls. *Biological Psychiatry, 32*, 202-206.

Pirke, K.M., Tuschl, R.J., Spyra, B., Laessle, R.G., Schweiger, U., Broocks, A., Sambauer, S., & Zitzelsberger, G. 1990). Endocrine findings in restrained eaters. *Physiology and Behavior, 47*, 903-906.

Pliner, P.L., Chaiken, S., & Flett, G.L. (1990). Gender differences in concern with body weight and physical appearance over the life-span. *Personality and Social Psychology Bulletin*, *16*, 263-273. **[Janis-Field Feelings of Social Inadequacy Scale].**

Polivy, J. & Doyle, C. (1980). Laboratory induction of mood states through the reading of self-referent mood statements: affective changes or demand characteristics? *Journal of Abnormal Psychology, 89*, 286-290.

Polivy, J. (1976). Perception of calories and regulation of intake in restrained and unrestrained subjects. *Addictive Behaviors, 1*, 237-243.

Polivy, J. & Herman, C.P. (1976a). The effects of alcohol on eating behavior: disinhibition or sedation? *Addictive Behaviors, 1*, 121-125.

Polivy, J., & Herman, C.P. (1976b). Effects of alcohol on eating behaviour: influence of mood and perceived intoxication. *Journal of Abnormal Psychology, 85*, 601-606.

Polivy, J. & Herman, C.P. (1983). *Breaking the diet habit.* New York: Basic Books.

Polivy, J. & Herman, C.P. (1985). Dieting and bingeing: a causal analysis. *American Psychologist, 40*, 193-201.

Polivy, J. & Herman, C.P. (1987). Diagnosis and treatment of normal eating. *Journal of Consulting and Clinical Psychology*, 55, 635-644.

Polivy, J., & Herman, C. P. (1980). Restrained eating. In A. B. Stunkard (Ed.), *Obesity*, 208-255, Philadelphia: Saunders.

Polivy, J., & Herman, C.P. (1999). Distress and binging: why do dieters overeat? *The International Journal of Eating Disorders, 6*, 153-164.

Polivy, J. & Herman, C.P. (2002). Causes of eating disorders. *Annual Review of Psychology, 53*, 187-213.

Polivy, J., Herman, C.P. & Howard, K. I. (1988). Restraint Scale: Assessment of dieting. In M. Herson & A. S. Bellack (Eds.), *Dictionary of behavioral assessment techniques*. New York: Pergamon. **[RS: Restraint Scale].**

Polivy, J., Herman, C.P., McFarlane, T. (1994). Effects of anxiety on eating: does palatability moderate distress-induced overeating in dieters? *Journal of Abnormal Psychology, 103*, 505-510.

Polivy, J., Herman C.P. & Warsh, S. (1978). Internal and external components of emotionality in restrained and unrestrained eaters. *Journal of Abnormal Psychology*, *87*, 497-504.

Pollard, T.M., Steptoe, A., Canaan, L., Davies, G.J., & Wardle, J. (1995). The effects of academic examination stress on eating behaviour and blood lipid levels. *International Journal of Behavioral Medicine, 2*, 299-320.

Pope, H.G., Hudson, J.I., Yurgelun-Todd, D. & Hudson, M.S. (1984). Prevalence of anorexia nervosa and bulimia in three student populations. *The International Journal of Eating Disorders, 3*, 45-51.

Popper, R., Smits, G., Meiselman, H.L., & Hirsch, E. (1989). Eating in combat: a survey of U.S. Marines. *Military Medicine*, *154*, 619-623.

Poulakis, Z. & Wertheim, E.H. (1993). Relationship among dysfunctional cognitions, depressive symptoms, and bulimic tendencies. *Cognitive Therapy and Research*, *17*, 549-559.

Powell, A.L. & Thelan, M.H. (1996). Emotions and cognitions associated with bingeing and weight control behavior in bulimia. *Journal of Psychosomatic Research*, *40*, 317-328.

Powell, M.R. & Hendricks, B. (1999). Body schema, gender, and other correlates in non-clinical populations. *Genetic, Social, and General Psychology Monographs*, *125,* 333-412.

Pryor, T., Wiederman, M.W., & McGilley, B. (1996). Clinical correlates of anorexia nervosa subtypes. *The International Journal of Eating Disorders,* 19, 371-379.

Pyle, R.L., Mitchell, J.E., & Eckert, E.D. (1981). Bulimia: a report of 34 cases. *Journal of Clinical Psychiatry*, *42*, 60-64.

Quinton, S. (1998). The processing of threat-related information in female dieters and non-dieters. *European Eating Disorders Review*, *6*, 266-276.

Rand, C.S. & Kuldau, J.M. (1991). Dieting and binging: a causal analysis. *American Psychologist, 40*, 193-201.

Rand, C.S. & Kuldau, J.M. (1992). Epidemiology of bulimia and symptoms in a general population: sex, age, race, and socioeconomic status. *The International Journal of Eating Disorders, 11*, 37-44.

Rand, C.S., & Stunkard, A.J. (1978). Obesity and psychoanalysis. *American Journal of Psychiatry,* 135, 547-551.

Rapaport, D. (1942). *Emotions and memory*. New York, International Universities Press.

Raphael, F.J. & Lacey, J.H. (1994). The aetiology of eating disorders: a hypothesis of the interplay between social, cultural and biological factors. *Eating Disorders Review*, 2, 143-154.

Rasbury, W., & Shemburg, K. (1971). The effects of aversive levels of white noise on consummatory behaviour. *Psychosomatic Science*, *22*, 166-167.

Raynor, H.A., & Epstein, L.H. (2001). Dietary variety, energy regulation, and obesity. *Psychological Bulletin*, *127*, 325-341.

Reznick, H. & Balch, P. (1977). The effects of anxiety and response cost manipulations on the eating behavior of obese and normal-weight subjects. *Addictive Behaviors, 2*, 219-225.

Rodin, J. (1981). Current status of the internal-external hypothesis for obesity: what went wrong? *American Psychologist, 36*, 361-372.

Rodin, J., Silberstein, L., & Striegel-Moore, R. (1985). Women and weight: a normative discontent. *Nebraska Symposium on Motivation, 32*, 267-307.

Rodin, J. & Slochower, J. (1976). Externality in the non-obese: the effects of environmental responsiveness on weight. *Journal of Personality and Social Psychology, 33*, 338-344.

Rodin, J., Slochower, J. & Fleming, B. (1977). Effects of degree of obesity, age of onset and weight loss on responsiveness to sensory and external stimuli. *Journal of Comparative and Physiological Psychology, 91*, 586-597.

Roemmich, J.N., Wright, S.M. & Epstein, L.H. (2002). Dietary restraint and stress-induced snacking in youth. *Obesity Research*, *10*, 1120-1126.

Rofey, D.L., Corcoran, K.J. & Tran, G.Q. (2004). Bulimic symptoms and mood predict food relevant Stroop interference in women with troubled eating patterns. *Eating Behaviors, 5,* 35-45.

Rogers, P.J. (1995). Food, mood, and appetite. *Nutrition Research Review, 8*, 243-269.

Rookus, M.A., Burema, J., & Frijters, J.E.R. (1988). Changes in body mass index in young adults in relation to number of life events experienced. *International Journal of Obesity*, *12*, 29-30.

Root, M.P.P. & Fallon, P. (1998). Treating the victimized bulimic: the functions of binge-purge behaviour. *Journal of Interpersonal Violence*, *4*, 90-100.

Rosenberg, M. (1979). *Conceiving the self.* New York: Basic Books. **[RSE: Rosenberg Self-Esteem Scale].**

Rosenfield, S.N., & Stevenson, J.S. (1988). Perception of daily stress and oral coping behaviours in normal, overweight and recovering alcoholic women. *Research in Nursing and Health, 11*, 165-174.

Rosmond, R. & Bjorntorp, P. (1998). Stress-related cortisol secretion in men: relationships with abdominal obesity, endocrine metabolic and hemodynamic abnormalities. *Journal of Clinical Endocrinological Metabolism, 83*, 1853-1859.

Rosmond, R., Dallman, M.F. & Bjorntorp, P. (1998). Stress-related cortisol secretion in men: relationships with abdominal obesity and endocrine, metabolic and hemodynamic abnormalities, *The Journal of Clinical Endocrinology & Metabolism, 83*, 1853-1858.

Rosmond, R., Holm, G. & Bjorntorp, P. (2000). Food-induced cortisol secretion in relation to anthropometric, metabolic and haemodynamic variables in men. *International Journal of Obesity Related Metabolic Disorders, 24*, 416-422.

Rotenberg, K.J., Carte, L., & Speirs, A. (2005). The effects of modeling dietary restraint on food consumption: do restrained models promote restrained eating? *Eating Behaviors*, *6*, 75-84.

Rotenberg, K.J., & Flood, D. (1999). Loneliness, dysphoria, dietary restraint, and eating behavior. *The International Journal of Eating Disorders*, *25*, 55-64.

Rotenberg, K.J., Lancaster, C., Marsden, J., Pryce, S., Williams, J., & Lattimore, P. (2005). Effects of priming thoughts about control on anxiety and food intake as moderated by dietary restraint. *Appetite, 44*, 235-241.

Roth, A. & Fonagy, P. (1996). *What words for whom? A critical review of psychotherapy research.* London: Guilford Press.

Roy, M.P. (2004). Patterns of cortisol reactivity to laboratory stress. *Hormones and Behavior, 46*, 618-627.

Rosenthal, N.E., Genhart, M.J., Caballero, B., Jacobsen, F.M., Skewerer, R.G., Coursey, R.D., Rogers, S., & Spring, B.J. (1989). Psychobiological effects of carbohydrate- and protein-rich meals in patients with seasonal affective disorder and normal controls. *Biological Psychiatry*, *25*, 1029-1040.

Rozin, P. (1996). The socio-cultural context of eating and food choice. In: Meiselman, H.I., MacFie, H.J.H. (Eds.). *Food choice, acceptance and consumption.* London: Blackie Academic & Professional, 83-104.

Ruddel, W., Langewitz, W., Schachinger, H., Schmieder, R., & Schulte, W. (1988). Hemodynamic response patterns to mental stress: diagnostic and therapeutic implications. *American Heart* Journal, *116*, 617-627. **[MAT; Mental Arithmetic Task].**

Ruderman, A.J. (1983). The Restraint Scale: a psychometric investigation. *Behaviour, Research and Therapy*, *21*, 253-258.

Ruderman, A.J. (1985). Dysphoric mood and overeating: a test of restraint theory's disinhibition hypothesis. *Journal of Abnormal Psychology*, *94*, 78-85.

Ruderman, A.J. (1986). Dietary restraint: a theoretical and empirical review. *Psychological Bulletin, 99*, 247-262.

Ruderman, A.J., & Besbeas, M. (1992). Psychological characteristics of dieters and bulimics. *Journal of Abnormal Psychology, 101*, 383-390.

Ruderman, A.J., & Christensen, H. (1983). Restraint theory and its applicability to overweight individuals. *Journal of Abnormal Psychology*, *92*, 210-215.

Russell, D., Peplau, L.A., & Cutrona, C.E. (1980). The revised UCLA loneliness scale: concurrent and discriminant validity evidence. *Journal of Personality and Social Psychology*, *39*, 472-480. **[UCLA Loneliness Scale].**

Rutledge, T. & Linden, W. E. (1998). To eat or not to eat: affective and physiological mechanisms in the stress-eating relationship. *Journal of Behavioral Medicine, 21*, 221-40.

Sackville, T, Schotte, D.E., Touyz, S.W., Griffiths, R., & Beumont, P.J.V. (1998). Conscious and preconscious processing of food, body weight and shape and emotion related words in women with anorexia nervosa. *The International Journal of Eating Disorders*, *23*, 77-82.

Safer, D.L., Telch, C.F., & Agras W.S. (2001). Dialectical behavior therapy adapted for bulimia: a case report. *The International Journal of Eating Disorders*, *30*, 101-106.

Sanftner, J.L., & Crowther, J.H. (1998). Variability in self-esteem, moods, shame and guilt in women who binge. *The International Journal of Eating Disorders*, *23*, 391-397.

Santonastaso, P., Friederici, S., & Favaro, A. (1999). Full and partial syndromes in eating disorders: a 1-year prospective study of risk factors among female students. *Psychopathology, 32*, 50-56.

Sarason, I. G., Sarason, B.R., Shearin, E.N., & Pierce, G. (1987). A brief measure of social support: practical and theoretical implications. *Journal of Social and Personal Relationships, 4,* 497-510. **[SSQ: Social Support Questionnaire]**

Sapolski, R. M. (1994). *Why zebras don't get ulcers*. New York: W. H. Freeman & Co.

Scarano, G.M. & Kalodner-Martin, C.R. (1994). A description of the continuum of eating disorders: implications for intervention and research. *Journal of Counselling and Development, 72*, 356-361.

Scavo, D., Barletta, C., Buzzetti, R. & Vagiri, D. (1988). Effects of caloric restriction and exercise on B-endorphin, ACTH, and cortisol circulating levels in obesity. *Physiology and Behavior, 42*, 65-68.

Schachter, S., Goldman, R., & Gordon, A. (1968). Effects of fear, food deprivation and obesity on eating. *Journal of Personality and Social Psychology, 10,* 91-97.

Schaeffer, M.A. & Baum, A. (1984). Adrenal cortical response to stress at Three Mile Island. *Psychosomatic Medicine, 46*, 227-237.

Schlundt, D.G., Johnson, W.G., & Jarrell, M.P. (1985). A naturalistic functional analysis of eating behavior in bulimia and obesity. *Advances in Behavior Research and Therapy*, *7*, 149-162.

Schlundt, D.G., Taylor, D., Hill, J.O., Sprocco, T., Hope-Cordle, J., Kasser, T., & Arnold, D. (1991). A behavioural taxonomy of obese female participants in a weight-loss program. *American Journal of Clinical Nutrition, 53*, 1151-1158.

Schlundt, D.G., & Zimering, R.T. (1988). The dieter's inventory of eating temptations: a measure of weight control competence. *Addictive Behaviors*, *13*, 151-164.

Schneiderman, N. & McCabe, P.M. (1989). Psychophysiologic strategies in laboratory research. In Schneiderman, N., Weiss, S.M. & Kaufmann, P.G. (Eds.) *Handbook of Research Methods in Cardiovascular Behavioral Medicine,* New York, Plenum Press.

Schneider, W., Dumais, S.T. & Shiffrin, R.M. (1984). Automatic and control processing and attention. In Parasuraman, R., & Davies, D.R. (Eds.). *Varieties of attention.* New York: Academic Press.

Schoeller, D.A. (1990). How accurate is self-reported dietary energy intake? *Nutrition Reviews, 48*, 373-379.

Schotte, D.E. (1992). On the special status of "ego threats". Comment on Heatherton, Herman, & Polivy (1991). *Journal of Personality and Social Psychology*, *62*, 798-800.

Schotte, D.E., Cools, J., & McNally, R.J. (1990). Film-induced negative affect triggers overeating in restrained eaters. *Journal of Abnormal Psychology*, *99*, 317-320.

Schotte, D.E., McNally, R.J., & Turner, M.L. (1990). A dichotic-listening analysis of body weight concern in bulimia nervosa. *The International Journal of Eating Disorders*, *9,* 109-113.

Schulkin, J., McEwan, B.S. & Gold, P.W. (1994). Allostasis, amygdala, and anticipatory angst. *Neuroscience Biobehavioral Review, 18*, 385-396.

Schuman, M. Gitlin, M.J., & Fairbanks, L. (1987). Sweets, chocolate, and atypical depressive traits. *Journal of Nervous and Mental Disease*, *175*, 491-495.

Schwartz, R.C. & Barrett, M.J. (1987). Women and eating disorders. *Journal of Psychotherapy and the Family*, 3, 1131-1144.

Sebastian, S.B., Williamson, D.A. & Blouin, D.C. (1996). Memory bias for fatness stimuli in the eating disorders. *Cognitive Therapy and Research, 20*, 275-286.

Seddon, K. & Waller, G. (2000). Emotional processing and bulimic psychopathology: age as a factor among non-clinical women. *The International Journal of Eating Disorders, 28*, 364-369.

Selye, H. (1956). *The stress of life*. New York: McGraw-Hill

Selye, H. (1936). A syndrome produced by diverse noxious agents. *Nature*, *138*, 32-42.

Selye, H. (1950). *The physiology and pathology of exposure to stress.* Montreal: Acta Inc.

Selye, H. (1974). *Stress without distress.* New York: New York American Library.

Selye, H. (1976). *Stress in health and disease.* Boston: Butterworth.

Serpell, L., Treasure, J., Teasdale, J. & Sullivan, V. (1999). Anorexia: friend or foe? *The International Journal of Eating Disorders, 25*, 177-186.

Shapiro, J.R., & Anderson, D.A. (2005). Counterregulatory eating behavior in multiple test meals. *Eating Behaviors*, *6*, 169-178.

Sharma, S., & McKenna, F.P. (2001). The role of time pressure on the emotional Stroop task. *British Journal of Psychology, 92*, 471-481

Sheppard Sawyer, C.L., McNally, R.J., & Fischer, J.H. (2000). Film-induced sadness as a trigger for disinhibited eating. *The International Journal of Eating Disorders*, 28, 215-220.

Sherwood, A., Dolan, C.A. & Light, K.C. (1990). Hemodynamics of blood pressure responses during active and passive coping. *Psychophysiology*, *27*, 656-668.

Shigeta, H., Shigeta, M., Nakazawa, N., Yoshikawa, T. (2001). Lifestyle, obesity, and insulin resistance. *Diabetes Care*, 24, 608-608.

Shimizu, N., Oomura, Y. & Kai, Y. Stress-induced anorexia in rats mediated by serotonergic mechanisms in the hypothalamus. *Physiology and Behavior*, *46*, 835-841.

Siegel, P.S., & Brantley, J.J. (1951). The relationship of emotionality to the consummatory response of eating. *Journal of Experimental Psychology*, *42*, 304-306.

Silva, F.T., & Leite, J.R. (2000). Physiological modifications and increase in state anxiety in volunteers submitted to the Stroop color-word interference test: a preliminary study. *Physiology and Behavior*, *70*, 113-118.

Simmons, P.S., Miles, J.M., Gerich, J.E. & Haymond, M.W. (1984). Increased proteolysis: an effect of increases in plasma cortisol within the physiological range. *Journal of Clinical Investigation, 73*, 412-420.

Sklar, L.S., Bruto, V., & Anisman, H. (1981). Adaptation to the tumor-enhancing effects of stress. *Psychosomatic Medicine, 43*, 331-342.

Slade, P.D. (1982). Towards a functional analysis of anorexia nervosa and bulimia nervosa. *British Journal of Clinical Psychology*, *21*, 167-179.

Slochower, J. (1976). Emotional labeling and overeating in obese and normal weight individuals. *Psychosomatic Medicine*, *38*, 131-139.

Slochower, J., Kaplan, S.P., & Mann, L. (1981). The effects of life stress and weight on mood and eating. *Appetite*, *2*, 115-125.

Smith, G.P. (1989). Animal-models of human eating disorders. *New York Academy of Science*, *18*, 63-72.

Smith, A.P., Leekam, S., Ralph, A. & McNeill, G. (1988). The influence of meal composition on post-lunch performance efficiency and mood. *Appetite*, *10*, 195-203.

Smith, M.C., & Thelan, M.H. (1984). Development and validation of a test for bulimia. *Journal of Consulting and Clinical Psychology, 52*, 863-872. **[BULIT-R: The Bulimia Test].**

Smith, C.F., Williamson, D.A., Bray, G.A., & Ryan, D.H. (1999). Flexible vs. rigid dieting strategies: relationship with adverse behavioural outcomes. *Appetite*, *32*, 295-305.

Spielberger, C.D., Gorsuch, R.L. & Lushene, R.E. (1970). *State-Trait Anxiety Inventory.* Palo Alto, Ca: Consulting Psychologist Press.

Spielberger, C.D., & Vagg, P.R. (1984). Psychometric properties of the STAI: a reply to Ramanaiah, Franzen, and Schill. *Journal of Personality Assessment*, *48*, 95-97.

Soukup, V.M., Beiler, M.E., & Terrell, F. (1990). Stress, coping style and problem solving ability among eating-disordered inpatients. *Journal of Clinical Psychology*, *46*, 592-599.

Spillman, D. (1990). Survey of food and vitamin intake responses reported by university students experiencing stress. *Psychological Reports*, *66*, 499-502.

Spranger, S.C., Waller, G., Bryant-Waugh, R. (2001). Schema avoidance in bulimic and non-eating-disordered women. *The International Journal of Eating Disorders*, *29*, 302-306.

Spitzer, R.L., Stunkard, A., Yanovski, S., Marcus, M.D, Wadden, T., Wing, R., Mitchell, J., & Hasin, D. (1993). Binge eating disorder should be included in DSM-IV: a reply to Fairburn et al.'s "the classification of recurrent overeating: the binge eating disorder proposal". *The International Journal of Eating Disorders*, *13*, 161-169.

Spitzer, R.L., Stunkard, A., Yanovski, S., Marcus, M.D, Wadden, T., Wing, R., Mitchell, J., & Hasin, D. (1993). Binge eating disorder: Its further validation in a multisite study. *The International Journal of Eating Disorders, 13*, 137-153.

Staiger, P., Dawe, S. & McCarthy, R. (2000). Responsivity to food cues in bulimic women and controls. *Appetite, 35*, 27-33.

Steere, J., & Cooper, P.J. (1993). The effects on eating of dietary restraint, anxiety, and hunger. *The International Journal of Eating Disorders*, *13*, 211-219.

Steiger, H., Gauvin, L., Jabalpurwala, S., Seguin, J.R., & Stotland, S. (1999). Hypersensitivity to social interactions in bulimic syndromes: relationship to binge eating. *Journal of Consulting and Clinical Psychology*, *67*, 765-775.

Stein, M., Keller, S.E. & Schleifer, S.J. (1985). Stress and immunomodulation: the role of depression and neuroendocrine function. *Journal of Immunology, 135*, 827-833.

Stenzel-Poore, M.P., Heinrichs, S.C., Rivest, S., Koob, G.F, Vale, W.W. (1994). Overproduction of corticotropin-releasing factor in transgenic mice: a genetic model of anxiogenic behavior. *Journal of Neuroscience*, *14*, 2579-2584.

Steptoe, A., Lipsey, Z. & Wardle, J. (1998). Stress, hassles and variations in alcohol consumption, food choice and physical exercise: a diary study. *British Journal of Health Psychology, 3*, 51-63.

Steptoe, A., Pollard, T.M. & Wardle, J. (1995). Development of a measure of the motives underlying the selection of food: the food choice questionnaire. *Appetite*, *25*, 267-284. **[FCQ: Food Choice Questionnaire]**

Sterritt, G.M. (1962). Inhibition and facilitation of eating by electric shock. *Journal of Comparative Physiology and Psychology, 55*, 226-229.

Sterritt, G.M. (1965). Inhibition and facilitation of eating by electric shock III: a further study of the role of strain and of shock level. *Psychonomic Science*, *2*, 319-320.

Stewart, S.H., & Samoluk, S.B. (1997). Effects of short-term food-deprivation and chronic dietary restraint on the selective processing of appetitive-related cues. *The International Journal of Eating Disorders, 21*, 129-135.

Stice, E. (2002). Risk and maintenance factors for eating pathology: a meta-analytic review. *Psychological Bulletin*, *128*, 825-848.

Stice, E. & Agras, W.S. (1999). Subtyping bulimic women along dietary restraint and negative affect dimensions. *Journal of Consulting and Clinical Psychology*, *67*, 460-469.

Stice, E., Killen, J.D., Hayward, C., & Taylor, C.B. (1998). Age of onset for binge eating and purging during late adolescence: a 4-year survival analysis. *Journal of Abnormal Psycholo*gy, Nov, 107 (4), 671-675.

Stice, E., Killen, J.D., Hayward, C., & Taylor, C.B. (1998). Support for the continuity hypothesis of bulimic pathology. *Journal of Consulting and Clinical Psychology*, *66*, 784-790.

Stice, E. & Shaw, H.E. (2002). Role of body dissatisfaction in the onset and maintenance of eating pathology: a synthesis of research findings. *Journal of Psychosomatic Research*, *53*, 985-993.

Stice, E., Ozer, S., & Kees, M. (1997). Relation of dietary restraint to bulimic symptomatology: the effects of criterion confounding of the Restraint Scale. *Behavior Research and Therapy*, *35*, 145-152.

Stice, E., Presnell, K., Spangler, D. (2002). Risk factors for binge eating onset in adolescent girls: a 2-year prospective investigation. *Health Psycholo*gy, *21*, 131-138.

Stone, A.A. & Brownell, K.D. (1994). The stress-eating paradox: multiple daily measurements in adult males and females. *Psychology and Health*, *9*, 425-436.

Stone, A.A. & Neale, J.M. (1984). New measure of daily coping: development and preliminary results. *Journal of Personality and Social Psychology*, *46*, 892-906. **[CSS: Coping Strategies Scale].**

Strauss, J., Doyle, A.E., Kreipe, R.E. (1994). The paradoxical effect of diet commercials on reinhibition of dietary restraint. *Journal of Abnormal Psychology*, *103*, 441-444.

Striegel-Moore, R.H., McAvay, G. & Rodin, J. (1986). Psychological and behavioural correlates of feeling fat in women. *The International Journal of Eating Disorders*, *5*, 935-947.

Striegel-Moore, R.H., Silberstein, L.R. & Rodin, J. (1986). Towards an understanding of the risk factors for bulimia. *American Psychologist, 41*, 246-263.

Strong, K.G. & Huon, G.F. (1997). The development and evaluation of a stage-based dieting status measure. *Eating Disorders*, *5*, 97-104.

Strongman, K.T. (1965). The effect of anxiety on food intake in the rat. *Quarterly Journal of Experimental Psychology, 17*, 255-260.

Strongman, K.T., Coles, M.G.H., Remington, R.E., & Wookey, P.E. (1970). The effect of shock duration and intensity on the ingestion of food of varying palatability. *Quarterly Journal of Experimental Psychology*, *22*, 521-525.

Stroop, J.R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*, 643-662.

Stroud, L.R., Tanofsky-Kraff, M., Wilfley, D.E. & Salovey, P. (2000). The Yale Interpersonal Stressor (YIPS): affective, physiological, and behavioural responses to a novel interpersonal rejection paradigm. *Annals of Behavioral Medicine, 22*, 204-213.

Stunkard, A. J. (1981). "Restrained eating": what is it and a new scale to measure it? In L. A. Cioffi (Ed.), *The body weight regularity system: Normal and disturbed mechanisms*. New York: Raven Press.

Stunkard, A.J. & Messick, S. (1985). The Three-Factor Eating Questionnaire to measure dietary restraint and hunger. *Journal of Psychosomatic Research*, *29*, 71-83. **[TFEQ: Three Factor Eating Questionnaire].**

Tanofsky, M.B., Wilfley, D.E. & Heatherton, T.F. (1998). *The impact of interpersonal stressors on restrained eaters.* Paper presented at the 8th New York International Conference on Eating Disorders. April, 1998: New York.

Tanofsky-Kraff, M., Wilfley, D.E., & Spurrell, E. (2000). Impact of interpersonal and ego-related stress on restrained eaters. *The International Journal of Eating Disorders*, *27*, 411-418.

Tarui, H. & Nakamura, A. (1987). Saliva cortisol: a good indicator for acceleration stress. *Aviation Space and Environmental Medicine, 58*, 573-575.

Tataranni, P.A., Larson, D.E., Snitker, S., Young, J.B., Flatt, J.P. & Ravussin, E. (1996). Effects of glucocorticoids on energy metabolism and food intake in humans. *American Journal of Physiological-Endocrinology, 34*, 317-325.

Telch, C.F., & Agras, W.S. (1994). Obesity, binge eating and psychopathology: are they related? *The International Journal of Eating Disorders*, *15,* 53-61.

Telch, C.F., & Agras, W.S. (1996). Do emotional states influence binge eating in the obese? *The International Journal of Eating Disorders*, *20*, 271-279.

Teskey, G.C., Kavaliers, M., & Hirst, M. (1984). Social conflict activates opioid analgesic and ingestive behaviors in male mice. *Life Sciences*, *35*, 303-315.

Thelan, M.H., Farmer, J., Wonderlich, S. & Smith, M. (1991). A revision of the bulimia test: the BULIT-R. *Psychological Assessment: A Journal of Consulting and Clinical Psychology*, *3*, 119-124

Tice, D.M., Bratslavsky, E., & Baumeister, R.F. (2001). Emotional distress regulation takes precedence over impulse control: if you feel bad, do it! *Journal of Personality and Social Psychology*, *80*, 53-67.

Tiffany, S. T., & Drobes, D.J. (1991). The development and initial validation of a questionnaire on smoking urges. *British Journal of Addiction*, *86*, 1467-1476. **[QSU: Questionnaire on smoking urges].**

Tom, G., & Rucker, M. (1975). Fat, full and happy. *Journal of Personality and Social Psychology, 32,* 761-766.

Treasure, J.L., & Owen, J.B. (1997). Intriguing links between animal behavior and anorexia nervosa. *The International Journal of Eating Disorders*, *21*, 307-311.

Troop, N.A., Holbrey, A., Trowler, R. & Treasure, J. (1994). Ways of coping in women with eating disorders. *Journal of Nervous and Mental Disease*, *182*, 535-540.

Tucker, L. A., & Peterson, T. (2000). Variation in energy intake across 7 consecutive days and body fat percentage in 280 middle-aged women. *Obesity Research*, *8*, 86-89.

Tulen, J.H., Moleman, P., van Steenis, H.G., & Boomsma, F. (1989). Characterization of stress reactions to the Stroop color word test. *Pharmacology, Biochemistry and Behavior*, *32*, 9-15.

Turnbull, S., Ward, A., Treasure, J., Jick, H., & Derby, L. (1996). The demand for eating disorder care: an epidemiological study using the general practice research database. *British Journal of Psychiatry, 169*, 705-712.

Tuschen-Caffier, B., & Vogele, C. (1999). Psychological and physiological reactivity to stress: an experimental study on bulimic patients, restrained eaters and controls. *Psychotherapy and Psychosomatics, 68*, 333-340.

Tuschl, R.J., Laessle, R.G., Platte, P., & Pirke, K.M. (1990). Differences in food-choice frequencies between restrained and unrestrained eaters. *Appetite*, *14*, 9-13.

Tyrka, A.R., Waldron, I., Graber, J.A., & Brooks-Gunn (2003). Prospective predictors of the onset of anorexic and bulimic syndromes. *The International Journal of Eating Disorders*, *33*, 108-108.

Ullman, A.D. (1951). The experimental production and analysis of a 'compulsive eating syndrome' in rats. *Journal of Comparative and Physiological Psychology*, *44*, 575-581.

Ullman, A.D. (1952). Three factors involved in producing compulsive eating in rats. *Journal of Comparative and Physiological Psychology, 45*, 490-496.

Urbszat, D., Herman, C.P., & Polivy, J. (2002). Eat, drink, and be merry, for tomorrow we diet: effects of anticipated deprivation on food intake in restrained and unrestrained eaters. *Journal of Abnormal Psychology*, *111*, 396-401.

van Strien, T., Cleven, A. & Schippers, G. (2000). Restraint, tendency toward overeating and ice cream consumption. *The International Journal of Eating Disorders, 28*, 333-338.

van Strien, T., Frijters, J.E.R., Bergers, G.P.A. & Defares, P.B. (1986). The Dutch Eating Behaviour Questionnaire (DEBQ) for assessment of restrained, emotional and external eating behaviour. *The International Journal of Eating Disorders, 5*, 295-315. **[DEBQ: Dutch Eating Behaviour Questionnaire].**

van Strien, T., Rookus, M.A., Bergers, G.P.A., Frijters, J.E., & Defares, P.B. (1986). Life events, emotional eating and changes in body mass index. *International Journal of Obesity*, *10*, 29-35.

Vaswani, K., Tejwani, G.A., & Mousa, S. (1983). Stress-induced differential intake of various diets and water by the rat: the role of the opiate system. *Life Sciences*, *32,* 1983-1996.

Velten, E. Jr. (1968). A laboratory task for induction of mood states. *Behaviour Research and Therapy, 6*, 473-482.

Vigas, M. (1985). *Neuroendokrinna reakci v strese u cloveka*. In: Veda (Ed.), Bratislava.

Vitousek, K.M. (1996). The current status of cognitive-behavioural models of anorexia nervosa and bulimia nervosa. In P.M. Salkovskis (Ed.). *Frontiers of cognitive therapy*. New York: Guilford Press.

Vitousek, K.B. & Ewald, L. (1993). Self-representation in the eating disorders. The cognitive perspective. In Segal, Z. & Blatt, S. (Eds.). *Self-representation in emotional disorders: cognitive and psychodynamic perspectives*. New York: Guilford Press.

Vitousek, K.B. & Hollon, S.D. (1990). The investigation of schematic content and processing in eating disorders. *Cognitive Therapy and Research*, *1*, 191-214.

Vitousek, K.B., & Orimoto, L. (1993). Cognitive-behavioural models of anorexia nervosa, bulimia nervosa, and obesity. In: Dobson, K.S. and Kendall, R.E. (Eds.). *Psychopathology and Cognition*. San Diego: Academic Press.

Vlitos, A.L.P. & Davies, G.J. (1996). Bowel function, food intake and the menstrual cycle. *Nutrition Research Review*, *9*, 111-134.

Waggoner, D., Sardar, S., Levine, A.S., & Morley, J.E. (1985). A model of stress-induced anorexia. *Federation Proceedings*, *44*, 1281-1281.

Walcott-McQuigg, J.A. (1995). The relationship between stress and weight-control behavior in African-American women. *Journal of the National Medical Association*, *87*, 427-432.

Walker, M.K., Ben-Tovin, D.I., Paddick, S. & McNamara, J. (1995). Pictorial adaptation of Stroop measures of body related concerns in eating disorders. *The International Journal of Eating Disorders*, *17*, 309-311.

Waller, G. (2002). The psychology of binge eating. In Fairburn, C. & Brownell, K.D. (Eds.). *Eating disorders and obesity: a comprehensive handbook*. New York: Guilford Press.

Waller, G., Babbs, M., Milligan, R., Meyer, C., Ohanian, V., & Leung, N. (2003). Anger and core beliefs in the eating disorders. *The International Journal of Eating Disorders*, *34*, 118-124.

Waller, G., Dickson, C., & Ohanian, V. (2002). Cognitive content in bulimic disorders: core beliefs and eating attitudes. *Eating Behaviors*, *3*, 171-178.

Waller, G. & Matoba, M. (1998). *Cross-cultural differences in emotional eating among Japanese and British women*. Paper presented at the 8th New York International Conference on Eating Disorders. April, 1998: New York.

Waller, G., & Meyer, C. (1997). Cognitive avoidance of threat cues: association with Eating Disorder Inventory scores among a non-eating-disordered population. *The International Journal of Eating Disorders*, *22*, 299-308.

Waller, G., & Mijatovich, S. (1998). Preconscious processing of threat cues: impact on eating among women with unhealthy eating attitudes. *The International Journal of Eating Disorders*. *24*, 83-89.

Waller, G., Ohanian, V., Meyer, C. & Osman, S. (2000). Cognitive content among women: the role of core beliefs. *The International Journal of Eating Disorders*, *28*, 235-241.

Waller, G. & Osman, S. (1998). Emotional eating and eating psychopathology among non-eating-disordered women. *The International Journal of Eating Disorders*, *23*, 419-424.

Waller, G., Quinton, S., & Watson, D. (1995). Processing of threat-related information by women with bulimic eating attitudes. *The International Journal of Eating Disorders*, *18,* 189-193.

Waller, G., Watkins, H., Shuck, V., & McManus, F. (1996). Bulimic psychopathology and attentional biases to ego threats among non-eating-disordered women. *The International Journal of Eating Disorders, 20*, 169-176.

Waller, N. G., & Meehl, P. E. (1998). *Multivariate taxometric procedures: distinguishing types from continua*. Thousand Oaks, CA: Sage Publications.

Wallis, D.J., & Hetherington, M.M. (2004). Stress and eating: the effects of ego-threat and cognitive demand on food intake in restrained and emotional eaters. *Appetite, 43*, 39-46.

Walsh, B.T., Gladis, M. & Roose, S.P. (1987). Food-intake and mood in anorexia nervosa and bulimia. *New York Academy of Sci*ence, 499, 231-238.

Ward, A., & Mann, T. (2000). Don't mind if I do: disinhibited eating under cognitive load. *Journal of Personality and Social Psychology*, *78*, 753-763.

Wardle, J. (1980). Dietary restraint and binge eating. *Behavior Analysis and Modification, 4*, 201-209.

Wardle, J. (1986). The assessment of restrained eating. *Behavior Research and Ther*apy, *24*, 213-215.

Wardlle, J. (1987). Eating Style: a validation study of the Dutch Eating Behaviour Questionnaire in normal subjects and women with eating disorders. *Journal of Psychosomatic Research, 31*, 161-169.

Wardle, J., & Beales, S. (1987). Restraint and food intake: an experimental study of eating patterns in the laboratory and in normal life. *Behaviour Research and Therapy*, *25*, 179-185.

Wardle, J., & Beales, S. (1988). Control and loss of control over eating: an experimental investigation. *Journal of Abnormal Psychology, 97*, 35-40.

Wardle, J. & Beinart, H. (1981). Binge eating: a theoretical review. *British Journal of Clinical Psychology, 20*, 97-109.

Wardle, J., & Marsland, L. (1990). Adolescent concerns about weight and eating: a social-developmental perspective. *Journal of Psychosomatic Research*, *34*, 377-391.

Wardle, J., Steptoe, A., Oliver, G., & Lipsey, Z. (2000). Stress, dietary restraint and food intake. *Journal of Psychosomatic Research, 48*, 195-202.

Warr, P., & Payne, R. (1982). Experiences of strain and pleasure among British adults. *Social Science and Medicine*, *16*, 1691-1697.

Warren, R. E. (1972). Stimulus encoding and memory. *Journal of Experimental Psychology*, *94*, 90-100.

Waters, A., Hill, A. & Waller, G (2001). Bulimics' responses to food cravings: is binge-eating a product of hunger or emotional state? *Behaviour Research and Therapy, 39*, 877-886.

Watkins, E. Jr., Sullivan, R.D. & Laughlin, E.H. (1962). Technical consideration in long-term arterial catheterisation for the study or therapy of the endocrine system. *Cosmetic Surgery Clinic of North America*, *42*, 595-602.

Watts, F.N., McKenna, F.P., Sharrock, R., & Trezise, L. (1986). Colour naming of phobia-related words. *British Journal of Psychology*, *77,* 79-108.

Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063-1070.

Webber, E.M. (1993). Psychological characteristics of binging and non-binging obese women. *The Journal of Psychology*, *128*, 339-351.

Weidner, G., Kohlmann, C.W., Dotzauer, E., & Burns, L.R. (1996). The effects of academic stress on health behaviours in young adults. *Anxiety, Stress and Coping*, *9*, 123-133.

Weingarten, H.P. & Elston, D. (1990). The phenomenology of food cravings. *Appetite*, *15*, 231-246.

Weinstein, S.E., Shide, D.J., & Rolls, B.J. (1997). Changes in food intake in response to stress in men and women: psychological factors. *Appetite*, *28*, 7-18.

Wells, A. & Matthews, G. (1994). *Attention and emotion: a clinical perspective.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Werrij, M.Q., Mulkens, S., Hospers, H.J., & Jansen, A. (2005). Overweight and obesity: the significance of a depressed mood. *Patient Education Couns*elling, *62*, 126-131.

Westenhoefer, J., Broeckmann, P., Munch, A.K., & Pudel, V. (1994). Cognitive control of eating behaviour and the disinhibition effect. *Appetite*, *23*, 27-41.

Westenhoefer, J., Pudel, V., & Maus, N. (1990). Some restrictions on dietary restraint. *Appetite*, *14,* 137-141.

Whitehouse, A.M., Cooper, P.J., Vize, C.V., Hill, C. & Vogel, L. (1992). Prevalence of eating disorders in three Cambridge general practices: hidden and conspicuous morbidity. *British Journal of General Practice*, *42*, 57-60.

Williams, J.M.G. & Broadbent, K. (1986). Distraction by emotional stimuli: use of a Stroop task with suicide attempters. *British Journal of Clinical Psychology, 25*, 101-110.

Williams, J.M.G. & Nulty, D.D. (1986). Construct accessibility, depression, and the emotional Stroop task: transient mood or stable structure? *Personality and Individual Differences, 7*, 485-491.

Williams, J.M.G., Matthews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin, 120*, 3-24.

Williams, J.M.G., Watts, F.N., MacLeod, C. & Mathews, A. (1997). *Cognitive Psychology and Emotional Disorders*. (2nd Ed.). Chichester: Wiley.

Williamson, D.A., Davis, C.J., Duchmann, G.G., McKenzie, S.J. & Watkins, P.C. (1990). *Assessment of eating disorders: obesity, anorexia and bulimia nervosa.* New York: Pergamon.

Williamson, D.A., Gleaves, D. & Savin, S.S. (1992). Empirical classification of eating disorder not otherwise specified: support for DSM-IV changes. *Journal of Psychopathology and Behavioral Assessment*, *14*, 201-215.

Williamson, D.A., Perrin, L., Blopuin, D.C., Barbin, J.M. (2000). Cognitive bias in eating disorders: interpretation of ambiguous body-related information. *Eating and Weight Disord*ers, *5*, 143-151.

Williamson, D.A., White, M.A., York-Crowe, E., & Stewart, T.M. (2004). Cognitive-behavioural theories of eating disorders. *Behavior Modification*, *28*, 711-738.

Wilson, B. T. (1993). Assessment of binge eating. In C. G. Fairburn & G. T. Wilson (Eds.), *Binge eating nature, assessment and treatment.* New York: Guilford.

Wilson, G.T. (1993). Binge eating and addictive disorders. In C.G. Fairburn, and G.T. Wilson (Eds.). *Binge eating: nature, assessment and treatment.* New York: Guilford.

Wilson, G.T., Nonas, C.A. & Rosenblum, G.D. (1993). Assessment of binge eating in obese patients. *The International Journal of Eating Disorders*, *13*, 25-33.

Wilson, J.F., & Cantor, M.B. (1986). Noise-induced eating in rats facilitated by prior tail-pinch experience. *Physiology and Behaviour*, *37,* 523-526.

Wing, R.R., Shiffman, S., Drapkin, R.G., Grilo, C.M. & McDermott, M. (1995). Moderate versus restrictive diets: implications for relapse. *Behavior Therapy*, *26*, 5-24.

Wirtshafter, D., & Davis, J.D. (1977). Set points, settling points, and the control of body weight. *Physiological Beha*vior, *19*, 75-78.

Wiseman, C.V., Wilfley, D.E., Kenardy, J. & Arnow, B. (1998). *Precursors and consequences of binge eating episodes: a prospective study of binge eating disorder patients using hand-held computers.* Paper presented at the 8th New York International Conference on Eating Disorders. April 1998, New York.

Wolf, E.M. & Crowther, J.H. (1983). Personality and eating habit variables as predictors of severity of binge eating and weight. *Addictive Behaviors*, *8*, 335-344.

Wolff, G.E., Crosby, R.D., Roberts, J.A. & Wittrock, D.A. (2000). Differences in daily stress, mood, coping, and eating behavior in binge eating and non-binge eating college women. *Addictive Behaviors*, *25*, 205-216.

Wolff, G. & Serpell, L. (1998). A cognitive model and treatment strategies for anorexia nervosa. In H.W. Hoek, J.L. Treasure & M.A. Katman (Eds.). *Neurobiology in the treatment of eating disorders*. New York: Wiley.

Wonderlich, S.A. & Mitchell, J.E. (1997). Eating disorders and comorbidity: empirical, conceptual, and clinical implications. *Psychopharmacological Bulletin*, *33*, 381-390.

Woods, W.P. & Heretick, D.M.L. (1983-84). Self-schemata in anorexia and obesity. *Imagination, Cognition and Personality, 3*, 31-48.

Wright, J., & Mischel, W. (1982). Influence of affect on cognitive social learning person variables. *Journal of Personality and Social Psychology*, *43*, 901-914.

Wurtman, J.J., Brzezinzki, A., Wurtman, R.J. & Laferrere, B. (1989). Effect of nutrient intake on premenstrual depression. *American Journal of Obstetrics and Gynecology, 161*, 1228-1234.

Yager, J., Rorty, M., & Rossotto, E. (1995). Coping styles differ between recovered and nonrecovered women with bulimia nervosa, but not between recovered women and non-eating-disordered control subjects. *Journal of Nervous and Mental Diseases*, *183*, 86-94.

Yanovski, S.Z. (1993). Binge eating disorder: current knowledge and future directions. *Obesity Research, 1*, 306-324.

Yeomans, M.R., Hails, N.J. & Nesic, J.S. (1999). Alcohol and the appetizer effect. *Behavioral Pharmacology, 10*, 151-161.

Yeomans, M.R., Tovey, H.M., Tinley, E.M., & Haynes, C.J. (2004). Effects of manipulated palatability on appetite demand on restraint and disinhibition scores from the Three-Factor Eating Questionnaire. *International Journal of Obesity Related Metabolic Disorders*, *28,* 144-151.

York, D.A. (1992). Central regulation of appetite and autonomic activity by CRH, glucocorticoids, and stress. *Progress in Neuroendocrinimmunology*, 5, 153-165.

Young, J.E. (1990). *Cognitive therapy for personality disorders: A schema focussed approach*. Sarasota, FL: Professional Resource Exchange.

Young, J.E. (1999) - see Young, J.E., Klosko, J.S., & Weishaar, M.E. (2000). Schema Therapy: a practitioner's guide. Guilford Publications.

Zotter, D.L. & Crowther, J.H. (1991). The role of cognitions in bulimia nervosa. *Cognitive Therapy and Research*, *15*, 413-426.

Zuckerman, M. & Lubin, B. (1985). *The Multiple Affective Adjective Check List Revised.* San Diego: Educational and Industrial Testing Service. **[MAACL: Multiple Affect Adjective Checklist].**