

The use of Think Aloud Protocol to Investigate Golfers Decision Making Processes

by

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ABSTRACT

Decision making in sport in general and golf in particular has received only limited attention in the sport psychological literature. In addition, research which has been conducted has mainly used retrospective methods of data collection to investigate athlete's thoughts and decisions during performance. Ericsson and Simon (1993) proposed Think Aloud (TA) protocol analysis as a tool for collecting concurrent data of cognitive processes. As a result this thesis aimed to investigate the efficacy of this method for the collection of decision making data in sport using a self-paced sport in particular to investigate the decision making process in differing skill level golfer's. Within this thesis 4 studies were conducted. Study 1 used TA to investigate differences in decision making of 30 skilled and 30 novice golfer's on a putting task, and examine if different verbalization instructions influence performance. Participants performed 30 putts on an indoor green in either a level 2, level 3, or no verbalization condition. Level 3 verbalization produced a higher volume of verbal data than level 2. Skilled golfers verbalized more about gathering information and planning putts than novices, while novices verbalized more technical instruction than skilled golfers. TA verbalizations at either level 2 or level 3 did not impair putting performance compared to no verbalization. It was concluded that TA protocol is an appropriate method for exploring decision making in self-paced motor tasks such as golf.

Study 2 aimed to further investigate the appropriateness and the use of TA by examining the congruence between data collected via think aloud protocol at level 3 and cued retrospective recall of decisions on a golfing task. Six high level male golfers performed six holes of golf whilst engaging in level 3 think aloud, this involved describing one's thoughts and explaining one's decisions during the task. After performance, three semi-structured retrospective interviews were conducted. The first was ten minutes after performance, the second 24 hours after performance, and the third 48 hours after performance. Think aloud verbalizations and interviews were transcribed verbatim and coded. Content analysis was used to identify first and second order themes related to decision making on the golf task. A comparison of the themes identified indicated large discrepancies between the information reported during think aloud and at interview, with only 38-41% similarity in variables

reported to influence decision making on each hole. These findings suggest retrospective recall of decision making is limited since relevant information is lost due to memory decay. Limitations of both methods were discussed. However, future research in sport could record decision making processes in event, employing the think aloud protocol.

Following the studies 1 and 2 which demonstrated that TA is a suitable method of data collection for collecting decision making data in golf Study 3 aimed to extend previous research on decision making in golf and the expert-novice paradigm by comparing the thought processes of six higher skilled (m handicap 4) and six lower skilled (m handicap 20) male golfers. Participants were asked to think aloud while playing six holes of golf. Verbalisations were recorded, transcribed, and grouped into the themes of (a) Gathering information, (b) Club selection (c) Planning (d) Technical instruction, (e) Shot evaluation and (f) Pre-performance routine. Differences were found between skill levels in that higher skill golfers decisions centred more on gathering information and planning whereas less skilled golfers focused more on technical instruction. These results are consistent with theories of skill acquisition in that higher skilled performers are less reliant on step-by-step monitoring of the skilled motor performance as opposed to beginners.

Finally, study 4 aimed to progress the findings of study 3 by investigating whether stress through the introduction of a competition with monetary prizes will influence performance and the thought process in high and intermediate skilled golfers. A total of 16 participants took part in this study, 8 skilled golfers and 8 intermediate level golfers. All golfers completed the Decision Specific Reinvestment Scale (DSRS; Kinrade, Jackson, Ashford and Bishop, 2010b). Following this participants either took part in a practice round or a competition round and this was counterbalanced to eliminate practice effect. All participants prior to the competition round were instructed that prizes were given to the top three performers and these consisted of £100 voucher for golf merchandise for the winner, £70 voucher for second place and £30 voucher for third place. All golfers were asked to think aloud whilst performing both practice and competition. Verbalisation were recorded, transcribed and grouped in to themes of (a) gathering information, (b) Club selection (c) Planning (d) Technical instruction, (e) Shot evaluation and (f) Dwelling on past shot. The introduction of stress did not

influence performance, however under stress it was found that higher skilled golfers were more likely to use technical rules compared to normal practice conditions, especially during putting performance. Furthermore, high level golfers reported more planning compared to intermediate golfers during both practice and competition condition. These findings support Masters (1993) theory of reinvestment.

The findings of the thesis suggest first that the think aloud protocol is a viable methodology to obtain rich and valid data. Secondly, findings suggest that the decision making process is influenced by the skill level of the athlete and stress. Although the decision making process appeared to be more influenced in higher skilled golfers. From a practical perspective findings suggest using think aloud can aid a player or coach to understand their thought process and to identify what may happen to a golfers performance when faced with the pressure of a competition.

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INTRODUCTION AND RATIONAL FOR THESIS

Expert novice differences have been widely studied throughout the world of sports and sport psychology in addition to other domains such as medicine and computer programming. Identifying these differences and bridging the gap between novice and expert is of great interest to many researchers and practitioners from all areas of sport, from the athlete themselves, to the coaches, psychologists, nutritionists, physiologists. From a psychological perspective, it is important to identify how and why elite or more advanced athletes have developed and maintain more superior decision making ability to their novice counterparts. With this kind of information it is possible to help less skilled performers become experts in a more efficient manner.

Much of the literature has found that those with superior decision making abilities have been exposed to many more hours and years of sport specific activity as well as other related activity (Baker, Cote & Abernethy, 2003). As early as 1963 Knapp identified that the ability in team sports is determined by technique and by decision making. Similarly, Iglesias, Moreno, Santos-Rosa, Cervello and Del Villar (2005) divided performance during game play into cognitive components and skill components; cognitive components being the knowledge and decision making while the skill component is the motor execution. In a game situation the quality of decision making is seen to be just as important as the motor skill execution (Thomas & Thomas, 1994).

According to many cognitive psychologists, decision making is performed by a means of knowledge structures stored into memory. It is proposed that expert athletes have a more sophisticated knowledge structure than novice athletes (McPherson, 1999, 2000) in that they not only know what to do in a wide variety of situations in their own domain but they also know how and when to apply this knowledge and they are able to reproduce it in appropriate situations (Singer & Janelle, 1999). Results into the cognitive differences between experts and novices have shown that experts generated more thoughts, tactics and solutions in response to their goals than novices (McPherson and Kernodle, 2007; Germain and Tenenbaum, 2011) and that experts search more quickly and possibly more deeply than players of a lower level (Connors, Burns & Compitelli, 2011; de Groot's, 1946).

Calmeiro and Tenenbaum (2011) found that when mapping the thought sequences in golfers during putting experienced players' cognitive processes centred on gathering information and planning, while beginners focused on technical aspects. Experienced players diagnosed current performance aspects more often than beginners did and were more likely to use this information to plan the next putt. These results are consistent with experienced players' higher domain-specific knowledge and less reliance on step-by-step monitoring of motor performance than beginners.

Prior to the above findings, research into decision making in sport has mainly focused on the outcome behaviour rather than the thought process and mechanisms that are involved during the time between the thought and the action. This research identified findings such as; elite athletes are faster and more accurate in recognising patterns of play (Williams Davids, Barwitz, & Williams, 1994) and that elite athletes can select the most relevant cues from a display (Wickens, 1992), and have a greater repertoire of possible hypothesis and possible actions stored in the long term memory (McPherson & Kernodle, 2003).

Although there has been a reasonable amount of literature about decision making, much more research needs to be conducted in order to gain a reliable picture of the influence of decision making underlying skilled performance in sport. Furthermore, at the present time, little is known about the decisional process under the influence of stress in sport and whether decisional processes change or are influenced by the presence of stress. However, Kinrade, Jackson and Ashford (2010a) found those performers who were more prone to consciously monitoring their performance during performance were rated more likely to choke under pressure from their coach's ratings. Therefore, it will be extremely interesting to investigate the effects of sport relevant stressors such as goal endangerment and social evaluation on golf performance and to determine whether these factors are detrimental or advantageous to a golfer's performance and decision making process.

One of the main criticisms of this type of research is that the majority of research has been carried out in a simple task in a laboratory setting (Abernethy et al, 1993). In addition, there is only a limited number of empirical studies (Calmeiro & Tenenbaum, 2011; McPherson & Kernodle, 2007; Germain

& Tenenbaum, 2011) that examined the actual thought process that occurs within the athlete through the use of qualitative methods. Another criticism within the decision making research is that studies have measured performance on one task using single subject measures, and as a result more effective methodology needs to be used such as recall, verbal reports and think aloud protocols in order to have multi-dependant measures of performance (McPherson, 1994). This is important as skilled performance is dependent on multiple attributes.

The methodology of collecting decision making data has been found to be a restriction. It is well known that retrospective recall of events has a number of limitations. For example, from the stress and coping literature it has been found that information provided is influenced by memory decay (forgetting) (Stone, Neale, Shiffman, Hickcox, et al., 1998). Secondly, retrospective reports are distorted by knowledge about success of efforts to resolve stressful events (Brown & Harris, 1978). On the whole, as time passes participant's reports about previous events becomes less accurate (Ptacek, Smith, Espe, & Rafferty, 1994). Another important concern with retrospective recall is the issue of bias. Bahrick, Hall and Berger (1996) found that recall of student's high school grades was influenced by the attractiveness of the grade received, therefore, results found that the grade A was recalled accurately 89% of the time but the grade D was only recalled 29% of the time.

Finally, Tenenbaum and Elran (2003) studied the congruence between actual and retrospective reports for pre- and post-competition emotional states; these were studied separately and together. The results revealed that retrospective reports were not affected by the pre-post interference after a 72 hour delay; however, athletes underestimated the intensity of post competition unpleasant emotions. Thoughts and feelings that were openly expressed after 72 hours were not fully congruent with thoughts and feelings reported in real time.

Similar issues apply to the domain of decision making. As such, more realistic paradigms need to be developed which reduce time delays between actions and assessment of decision making. In addition, the use of qualitative research methodologies might provide more rich information on decision making processes. In an attempt to respond to this issue, think aloud verbalisation has been credited for

providing information which is difficult to obtain by other means. This type of data provides a sequence of observations over time rather than a single observation at the end of a task, which can be found when using retrospective recall. It has been argued by some researchers that the level of detail provided by protocols, namely, information corresponding to changes in states of working memory, is the most important level at which to study learning processes (Anderson, 1987). TA allows researchers to collect data during performance of a task, which in turn minimises the event-recall period and increases the likelihood of collecting accurate data (Folkman & Moskowitz, 2004).

There is research that has investigated the difference between elite and high level amateur golfers in terms of their technical skill (Robertson, Burnett, Newton & Knight, 2012), however, there is very little research that investigates the difference in the decision making process between the two different level of skilled golfers. Therefore, the proposed research aims to investigate the decision making processes that occur in high and low level golfers, during both non-stressful and stressful situations and to validate the use of think aloud protocol as a valuable method for collecting decision making data during actual performance.

This thesis opens with an initial review of literature that considers expert performance and decision making (chapter 1). This is then followed by a review of the stress and performance literature and the different theoretical explanations of how stress might affect the decision making process (chapter 2). A review of methods of collecting decision making data is presented which considers limitations for collecting this type of data (chapter 3). Chapters 4-7 present the research that has been conducted throughout this thesis and the main findings from each study. Finally chapter 8 provides a general discussion of the whole thesis bringing together all research findings from the four studies conducted in this thesis.

CHAPTER 1

EXPERT PERFORMANCE AND DECISION MAKING

1.1 INTRODUCTION.

An important aim of the present thesis is to examine the influence of skill level on the decision making in sport. The program of study, in this respect, used the self-paced sport of golf as the vehicle to do this. However, it is vital to discuss what contributes to creating a high skilled performer and how this is acquired in order to aid our understanding of how a high skilled performer makes decisions. Therefore, the current chapter presents a critical review of Ericsson and Smith's (1991) Expert Performance approach and further relevant theories and research of how expert performance is measured and acquired.

1.2 EXPERT PERFORMANCE APPROACH

Much of the research around expert performance highlights that expert performers will spend most of their lives devoted to reaching the highest levels of performance in their domain through highly constrained activity (Ericsson & Charness, 1994; Ericsson, Krampe & Tesch-Remer, 1993).

Furthermore, expert performance is thought to be a mixture or combination of training, experience (de Groot, 1946/1998; Chase & Simon, 1973) and innate differences and talents (Galton, 1869/1979) which cannot be modified by training and practice. The following section will address the approaches to expert performance and discuss how expert performance is acquired.

Ericsson and Smith (1991) developed an approach to studying the structure and acquisition of superior ability, which is known as the expert performance approach. Ericsson and Smith (1991) proposed that to investigate superior performance one must be able to capture and analyse the structure and acquisition of superior achievement, which must also be measurable and be able to be

reproduced under controlled conditions. Therefore, Ericsson and Smith (1991) proposed a three stage systematic framework which was termed the expert-performance approach.

First of all, to be able to study expert performance, it is vital that performance in terms of essential skills and competencies that underpin the successful skilled performance are captured. This capturing of essential skills facilitates the second stage by aiding the development of a representative task that allows the skill to be reproduced under more controlled situations. The second step in the framework is to identify the mechanisms that facilitate superior performance. During this stage, certain types of data may be collected about the performance and the performer may be observed by a highly skilled individual whilst performing representative tasks. The underlying mechanisms may include the cognitive processes of an expert, which may be measured through verbal reports. In addition, component elements of the performance might be isolated and measured through representative tasks. The third and final step involves the investigator taking certain information from the performer or family members, coaches or teachers such as age at introduction to the domain, age at first significant achievement, age at commencement or termination of domain instructions in order to trace the acquisition of those skills and mechanisms. Further information is taken such as estimates of the quantity or present domain relevant activity as well as the type of domain relevant activity and any other relevant information that may contribute in the acquisition of the domain specific skill performance. This framework (Ericsson & Smith, 1991) has provided a guide which many researchers have used to study expertise. Throughout this thesis, Ericsson and Smith's (1991) approach is applied as the golfer's handicap is used to measure the ability of the performer. Those with lower handicaps are deemed as more superior to those with higher handicaps, meaning that the use of the handicap provides a guideline of the performer's competencies. Through the use of think aloud verbal protocol the thesis aims to uncover the underlying cognitive mechanisms of these performers, whilst taking part in tasks that mirror golf performance (putting and the whole game of golf). Through the use of think aloud verbal protocol the thesis will analyse the possible strategies or cognitions the performers could use to generate the correct response to the specific task of golf, which according to Ericsson and Charness (1994) is part of the standardised methodology of cognitive psychology.

When studying expert performance in Scrabble Tuffiash, Roring and Ericsson (2007) discussed this in terms of both the individual differences approach and the expert-performance approach. With the individual difference approach, researchers such as Ackerman (1987, 2000) showed that performance on cognitive skill measures is correlated with different types of abilities during the three phases of cognitive skill development (Fitts & Posner 1967). The three phases being, the cognitive phase, where mistakes are made and lots of effort is involved; the associative phase, where mistakes decline and performance becomes smoother. The third phase being the autonomous phase where little effort is spent on attention of the process of the skill or task and the performance becomes automatic. For many tasks, measures of general abilities correlated the highest with skill during the initial phase, whereas measures of more specific abilities relevant to the specific task became stronger correlating with skill during later periods. However, most studies examining decision making have been conducted in laboratory settings and centred on skills that can be acquired with relatively little (50 hours) practice (Ericsson & Williams, 2007). Tuffiash, Roring and Ericsson (2001) argue that as a result of this findings may not be generalizable to expert performance in naturally occurring environments, following hundreds and thousands of hours of domain specific practice and experience.

Based on individual differences approach Tuffiash, Roring and Ericsson (2007) would predict performance relationships between standardised tests of verbal abilities (word fluencies and vocabulary tests) and Scrabble specific task performance. However, Ericsson (2006) proposed that to reach the highest level of achievements in a domain requires thousands of hours of ‘deliberate practice’, which involves practicing and working on specific areas of that performance. Furthermore, due to the individual continuously modifying their strategies and processes throughout their extensive dedication to that training, they are likely to develop maximum domain specific task restrictions (Ericsson & Lehman, 1996), which in turn creates a higher cognitive processing mechanism that is extremely specific to that domain and may be less likely to transfer to other domains (Ericsson & Kintsch, 1995).

Therefore, Tuffiash, Roring and Ericsson (2007) proposed that in accordance with the expert-performance approach, extended deliberate practice in Scrabble would only predict superior

performance in Scrabble related tasks. Interestingly, based on this proposal, players at the higher level of expertise in Scrabble have developed this through memorising of word lists and other activities to strengthen the ability in anagramming and experience to improve tactical strategies specific to the game of Scrabble. As a result, it was suggested that players do not need to know the meaning of the words or how to pronounce them rather than acquiring verbal aptitude or intelligence of a broader sense (Tuffiash, Roring & Ericsson, 2007).

Findings from this research revealed that through using think aloud protocol during Scrabble performance, experts performed better at Scrabble, using more letters on each move and scoring more points. Further analysis revealed that better players accumulated more related word knowledge and were more efficient at locating higher scoring solutions. As discussed previously, Scrabble expertise was significantly related to deliberate practice. Interestingly and contradictory to the individual differences approach, there was no relationship between high verbal ability scores and Scrabble expertise as those who displayed a 'normal' verbal ability test score also achieved superior levels of Scrabble performance.

Williams and Ericsson (2005) highlighted some of the challenges that researchers might face when they are studying expert performance, especially when capturing perceptual-cognitive expertise in sport. Furthermore it was recognised that there may be difficulty in the first stage of the expert-performance approach as behavioural constructs such as anticipation and decision making are difficult to assess in the field setting and also in the laboratory, in comparison to performance outcomes such as when measuring running or cycling events you are provided with an accurate measure of achievement which is the time the event it completed in. Williams and Ericsson (2005) identified different perceptual-cognitive mechanisms that mediate expert performance. A number of research methodologies have been developed to examine these perceptual cognitive mechanisms. For example, studies have used eye movement tracking to measure a performer's point of gaze and fixations that separate eye movements. Film occlusion is another mechanism which involves providing a film (e.g. a tennis serve) from the returner's perspective. The film is then presented to a participant who is required to predict the end result of the oncoming serve. Biomechanical profiling and data reduction

techniques involves the profiling of various movements. For example biomechanical profiling of a soccer penalty kick may indicate more rotation around the hip region when the ball is placed on one side of the goal, which then provides useful information that can be used to predict and anticipate the ball destination. Furthermore, psychophysiological measures of selective attention involve measures that provide an indication of the level of activation of the system, such as galvanic skin responses, heart rate variability, pupil dilation and blood pressure along with other measure. Finally, verbal protocols were also identified and have been considered as a valid method for capturing perceptual-cognitive expertise during decision making and anticipation tasks (Ericsson & Simon, 1993). By asking participants to report the thought process that comes to mind as participants react or deal with a certain task allows researchers to identify the cognitive processes that mediate task performance. For example, Abernethy, Neal and Koning (1994) were able to identify the cognitive processes that mediate shot selection in snooker. Similarly, Ward and Williams (2003) using the think aloud protocol were able to illustrate the mechanisms of perceptual-cognitive expertise in soccer players. Please note, Think Aloud protocols (Ericsson and Simon, 1980, 1993) will be discussed in more detail in the later chapters of this thesis).

1.3 DELIBERATE PRACTICE

It is proposed that most experts attain their highest level of performance after approximately ten years of intense preparation (Chase & Simon 1973). Although Chase and Simon (1973) proposed this theory for chess players, they also suggested similar preparation is needed in other domains. However, Ericsson et al. (1993) highlighted the mere number of years' experience with relevant activities in a domain is typically only weakly related to performance. From this Ericsson et al. (1993) used the term deliberate practice to highlight the need for domain specific training activities to improve specific aspects of that domain specific performance. According to Ericsson et al. (1993), deliberate practice includes activities that have been specifically designed to improve the current level of performance. Furthermore, the goals, costs and rewards of these types of tasks will differ, as well as the frequency

with which the individuals will pursue them. More specifically “the amount of time an individual is engaged in deliberate practice activities will be monotonically related to that individuals acquired performance” (Ericsson, et al., 1993, p368). For an expert to reach their maximal performance, Ericsson et al. (1993) proposed that the specific activities should be designed by coaches and would benefit from feedback as well as the individual performer having to train with full concentration (Ericsson & Lehman, 1996). As a result of the theory of deliberate practice it was therefore argued that it is not necessarily the amount of years of practice and experience that results in expert performance but the amount of deliberate practice that is more closely related to the level of acquired performance.

Ericsson et al. (1993) recruited musicians with different levels of accomplishment and asked them to estimate the amount of deliberate practice they had engaged in per week for each year of their musical careers. Results of this research revealed that the amount of deliberate practice was much higher for the most accomplished groups of musicians than for the less-accomplished musicians. In particular the average time spent for the highest level violinists was more than 10,000 hours, in comparison to the average for the good level violinists who accumulated around 7,800 hours and the least accomplished group who engaged in around 4,600 hours.

Further evidence of deliberate practice has provided support for the important role of deliberate practice. For example Helsen, Hodges, Winckel, and Starkes (2000) found that as players develop they devote more hours of practice each week. Although Helsen et al. (2000) acknowledge that accumulative practice may be an over simplistic approach to assessing a performer’s practice patterns, their findings were consistent with other domains. Further research examining deliberate practice in sport has also suggested that expert athletes seem to accumulate a superior amount of deliberate practice throughout their development (Ward, Hodges, Starkes & Williams, 2007; Cote, Ericsson & Law, 2007).

Based on Ericsson et al. (1993), more recent research has aimed to create domain specific training activities (deliberate practice) which in turn will help speed up the development process of a performance. One example of this is research by Hayman, Polman, Borkoles, and Taylor (2013) used a deliberate practice putting intervention of aspiring elite adolescent golfers over a 13 week period. They found that the intervention had the potential to improve putting performance as all participants experienced some form of improvement in performance and made commitments to pursue the deliberate practice into their future training. According to Ericsson et al. (1993), deliberate practice is a highly structured activity that requires maximal physical and mental effort, it is not intrinsically enjoyable to undertake and generates no immediate rewards and is performed solely for performance improvements. Therefore, Hayman et al. (2013) introduced 90-120 minutes of short game putting (intervention) drills to their participants that fit in with the characteristics of deliberate practice in that it was intended to be challenging, required constant concentration and with the sole purpose of improving performance rather than enjoyment. All participants in Hayman et al. (2013) study achieved improvements in performance or between 15%-61%. The largest performance improvement was achieved by the participant who spent the longest amount of time undertaking deliberate practice. This supports Ericsson et al. (1993) hypothesis that there is a linear relationship between hours of deliberate practice and levels of performance.

Although Ericsson et al. (1993) article has been cited more than 4,200 times, (Macnamara, Hambrick, & Oswald, 2014) growing evidence indicates that deliberate practice is not as important as originally argued. Gobet and Campitelli (2007) found large amounts of variability in the total amounts of deliberate practice among master chess players, from slightly more than 3,000 hours to more than 23,000 hours. It is therefore thought that a large proportion of variance in performance is explained by factors other than deliberate practice. Macnamara, Hambrick, and Oswald (2014) conducted a meta-analysis to investigate how much of the total variance in performance is explained by the accumulated amount of deliberate practice. They examined the predictability of the task environment, more specifically the degree in which the task environment changes while the performer is planning and

executing an action and the range of possible actions. In addition, they also examined the way in which deliberate practice was measured as it was thought that retrospective reports may provide less accurate and valid accounts than the log method of recording deliberate practice on an ongoing basis. Findings of this study found that for all four domains examined deliberate practice explained 26% of the variance in performance for games, 21% for music, 18% for sports, 4% for education and less than 1% for professionals. Based on these findings, it is important to ask the question as to what makes up the remaining unexplained variance in all of the above domains. It is thought that individual differences may have a higher level of importance and it was recommended that further research is needed to investigate further underpinnings of expert performance (Macnamara, Hambrick, & Oswald, 2014).

More recent research within German football by Hornig, Anst and Gullich (2014) found that in German top-level professional football players accumulated around 4264 hours of practice over 16 years before debuting in their first senior national game. However, what was important to note is that Hornig et al. (2014) refer heavily to deliberate play as a vital element to the hours of practice. Deliberate play is expected to amplify variable playing experience and to maximise job and support sustained motivation (Cotes, Baker & Abernethy, 2007). It has been suggested that one of the problems with deliberate practice is that it has an insufficient application to the domain of sport. Abernethy, Farrow and Berry (2003) suggested the need to supplement the theory of deliberate practice with the concept of deliberate play. Furthermore, it is clear that the examinations of senior top performer's participations histories are scarce, but without these it is extremely difficult to investigate the acquisition of the highest level performers and determine what psychological and psychological characteristics make up an 'elite' level performer (Hornig et al., 2014).

1.4. INFORMATION PROCESSING MODEL

To understand how a decision is made and how a human being processes information to arrive at that decision, it is vital to understand information processing models. Originally the main focus of skill research was on perceptual-motor skills where the production of movement is an essential ingredient. Some researchers (Bartlett, 1958; Proctor & Dutta, 1995; Welford, 1976) argued that an expansive definition of skill should also encompass cognitive activities such as thinking and problem solving. For example, a large part of the expert-novice approaches have come from studies in chess (Chase & Simon, 1973) and skill in chess lies in the pattern recognition process and rules rather than the motor-skill of moving those pieces on the chess board (Summers, 2004).

The information processing model is based on the flow of information that is typically traced through three primary stages involving perceptual processes, decision making and response selection and response programming and execution. An attentional system responsible for selecting between sources of information for further processing and memory systems (long-term and short-term or working memory) for the storage of information are also part of the information processing models (Summers, 2004). Paillard (2005) proposes two levels of information processing. The first level being the sensorimotor level which mainly focusses in a reactive way and the second being the cognitive level, which is able to process large variety of mental states that characterise high brain functions (McMorris, Audiffren, & Tomporowski, 2009). The cognitive level anticipates events and functions in a predictive way on the basis of abstract representations of internal and external worlds stored in long-term memory (LTM).

A model which seems particular relevant to the domain of sport was proposed by Welford (1968). He created a model centred on information processing which involves the process of stimulus identification, response identification and response programming. Welford (1968) proposed that we take information in through all senses and store this information temporarily prior to organising them. Following this if the information is seen relevant to the decision it is stored in the short term memory, if not it is discarded. A decision is made by comparing the current information which has been

temporarily stored in the short term memory with previous experiences from LTM. Based on information provided from LTM a decision is carried out and the action and the result is stored in the long term memory for future reference. Our short term memory (STM) has a very limited capacity as it can only hold about six or seven chunks of information for 20 or so seconds (Lord & Maher, 1991). LTM has theoretically an unlimited capacity; however, the content of LTM depends on the information that passes through the STM and how that information is interpreted and the level of importance. The amount of attentional resources is also important. When we encode information, we allocate attentional resources to sensory memory, when we remember information we allocate attentional resources to search the LTM, and when we solve a problem or transform information we allocate attentional resources to the short-term or working memory (Anderson, 1990). STM can be thought of as a work space in which only so many tasks can be performed. Lord and Maher (1991) provide a simplistic way of explaining how a task is performed from an information processing perspective. They propose a view that emphasizes energy and the amount of energy required to perform a task. More specifically the number of tasks that can be performed concurrently is limited by the combined amount of energy that tasks consume (Anderson 1990; Kahneman, 1973). The energy requirements needed to perform a task depends on the amount of practice and how well the task is practiced. Therefore novel tasks require much more energy or attention (controlled processing), while well-rehearsed tasks do not require as much amounts of attention (automatic processing),

It is thought that novel performance requires controlled processing which is typically easily established and modified but is limited in capacity. Following practice automatic processing may take over. Automatic processing is faster and more unchanging than controlled processes, less sensitive to working memory capacity limits, however are thought to be more difficult to alter and inhibit (Schneider & Shiffrin, 1977). Controlled processes place higher demands on attentional resources and STM capacity than automatic processes. Automatic processes allow a person to do two things at the same time. A person can automatically pay attention to a non-verbal behaviour while attending to the content of another's verbal behaviour using controlled processes (Lord & Maher, 1991). For example, a novice sports performer may have to use a lot of 'energy' or attentional demand may be high for a

novel task and therefore they may have to attend to this in a controlled manner. In comparison a high level performer completing the same task which is well rehearsed they can perform the task using automatic processing and engage in multiple tasks at the same time.

Originally, most research around information processing was carried out in laboratory settings. However, to overcome the limitations of the laboratory-based approach to skill learning, cognitive psychologists began to study expert performance in real-life domains. One of the earlier studies investigating expert-novice differences in cognitions was by Chase and Simon (1973) who investigated the expert-novice differences in chess. Chess players of different levels (Master, class A and beginners) were shown a chess board for 5 seconds where the pieces were either set up as if it was in the middle of a real chess game or randomly arranged. Following the 5 second viewing the chess players were asked to re-construct the arrangement of the pieces. Findings revealed that expert chess players were more accurate in recalling the positions of the chess pieces for the real games. However, when asked to recall the randomly allocated pieces they were no different than novices, highlighting the highly specific nature of their expertise. This shows that over time and practice the higher level chess players have been able to store thousands of chunks of chess related information (a chunk was defined as a sequence of pieces with between piece intervals of less than two seconds) in their LTM which they are able to retrieve and as a result are more familiar with and remember more positions after only 5 seconds of viewing the board.

Gobet and Simon (1998) re-examined Chase and Simon's (1973) research on chess players and supported their findings. They developed this research by using higher level Masters Chess player and found that they used substantially larger chunks than the Master chess players in the 1973 study. They also extended the concept of chunking theory to take account of the evidence for large retrieval structures (templates) in LTM. Hence, Gobet and Simon (1998) found that the elite chess player's LTM and ability to retrieve and recall large chunks of information is greater than originally proposed. As a result of their research, Chase and Simon (1973) proposed that the attainment of many other forms of expertise (e.g. football, music) was the result of acquiring, during many years of experience in their domain, vast amounts of knowledge and the ability to perform pattern-based retrieval.

Although, Chase and Simon's research was conducted within chess and in the domain of sport requires a need to process incomplete, intentionally deceptive, fast-paced information under time pressure, similarities have been found between chess and other sports. For example, Hageman et al. (2010) found expert-novice differences in information processing in that top ranked fencers were able to extract more information and use that information to predict their opponent's next move.

1.5. SKILL ACQUISITION

The previous section described models of information processing. Over time, as a performer takes in more and more information (practice) in a specific area, the individual is able to process that information and become more efficient. The next section outlines how an individual will pass through different levels of skill acquisition and expertise which is a result of what type of information they process and how this information about a skill will change as the individual develops in a specific area of expertise. This is vital when studying decision making as it is important to identify which stage of learning the participants may be in when making conclusions about expert-novice discrepancies.

Cognitive theories of skill acquisition suggest that performance improvements proceed through different phases or learning processes. Fitts and Posner (1967) proposed a three stage model of skill acquisition that suggests that during the initial stages of learning, a novice's performance is based on a set of cognitive rules and where performance is controlled in a step-by-step fashion. Furthermore this stage involves the explicit testing of hypotheses, and performance is characterised as slow, effortful and with many errors. This has been labelled the cognitive phase of learning. Following on from the cognitive phase, when the performer starts to have a better understanding of the task, they then enter the associative phase. During this phase, the need to control the task in a conscious manner decreases and task representations are established that directly connect stimulus situations to actions. With continued practice a performer reaches the autonomous phase of learning, where skill execution is based on a fully automatic task representation, where conscious attentional control is no longer required to execute a particular action when confronted by a particular stimulus situation.

Anderson and Lebiere (1998) have developed a model of skill acquisition known as the ACT-R. Skill learning starts in the declarative phase, where performance is based on facts and information about the skill execution; these are held in the working memory during online execution. Hence, performance would be less automatic due to the working memory being in an active state and being used in small amounts to guide the execution in a step-by-step fashion. It is then proposed that as a performer progresses the declarative knowledge is converted or compiled into procedural knowledge that captures the instructions for performing the task at hand in a new form. Procedural knowledge represents knowledge of how we do things and does not require the active maintenance of each step of task execution in the working memory. A performer in the procedural stage will not think consciously about every component involved in their technical execution of a skill, hence, their performance becomes automatic. Therefore, it is proposed that novices in the early stages of learning will base all of their actions on declarative knowledge and as a result, their performance will involve a step-by-step attention to the movement, whereas a performer further down the learning process will base their performance on procedural knowledge which requires less attention and control that was required at the early stages of learning. French and Thomas (1987) propose that individuals must develop a base of declarative knowledge of a sport, before being able to develop good skills in decision making in a suitable way. This occurs because working memory (WM) cannot be used because it is all being used for execution of the skill. By using a 50 item multiple choice test to assess basketball declarative knowledge and observational instruments they found that when comparing child experts and novices in basketball they found that basketball knowledge was related to decision making skills. Furthermore, over time as the basketball knowledge improved so did the cognitive decision making and control components of performance. Performers that show low levels of declarative knowledge of their sport, show a low quality in their decisions in real game situations (French & Thomas, 1987). Therefore, it could be proposed that mistakes observed in a low level or novice performer may be the result of a lack of knowledge about what to do in game situations due to the lack of procedural knowledge (French & Thomas, 1987; Thomas & Thomas, 1994).

1.6 EXPERT NOVICE DIFFERENCES

It is evident from the previous section of skill acquisition that experts and novices possess different types of knowledge bases which result in different levels of automaticity. The following section will present research findings from expert-novice research in sport which has demonstrated the clear differences between these two levels of performers; as well as problems associated with this type of research.

The cognitive psychology expert-novice approach has generated significant research into how sport experts overcome the limitation of time on performance. It has been assumed that sports requiring fast reactions, those who are skilled performers have developed an ability to recognise advanced cues in the environment allowing for anticipation of what will happen next and thereby reducing processing time. In this type of research, expert and novice performers are asked to watch a film or video sequence of a particular activity and then the film is stopped at particular points. This has been conducted in a variety of racket sports such as squash (Abernethy, 1990) and team sports (Furley & Memmert, 2012). For example, this was examined in tennis. A video was stopped after a tennis shot had been hit and the participant was asked to indicate the landing position of the ball (Loffing & Hagemann, 2014). Eye movement recording devices are also used to assess and investigate visual search patterns during ball-tracking tasks and the differences in these search patterns between high and low level performers (Land & McLeod, 2000). Findings have revealed that expert performers do not need to track the entire ball flight, only the initial flight of the ball and then their eye movements move ahead to the final part of the flight. In general, experts pick up earlier advanced cues and exhibit different visual search patterns than novices (Williams, 1999).

However, when investigating the expert novice paradigm further and looking into the information processing of both levels of performers, it is clear that experts differ from novices in declarative and procedural knowledge (Chi, Glaser, & Farr, 1988; McPherson, 1994). Experts are able to give more appropriate and creative solutions to problems in a game (Sternberg & Howarth, 1995). On the flip side, novices respond according to the surface characteristics of that problem (Abernethy, 1993;

Sternberg & Horvath, 1995). This is an important point to consider in terms of athlete development as a performer may be technically competent, but may lack the procedural knowledge and creative solutions to their performance. This is a vital area that coaches need to consider when developing performers.

Recent research by Calmeiro and Tenenbaum (2011) investigated differences in the cognitions of three experienced and three novice golfers when performing a putting task. The experienced golfers spent more time than beginners assessing the conditions and planning a putt. In addition, experienced players verbalised more diagnostic-related thoughts after the putt and followed these thoughts with planning the next putt. In contrast, low skilled golfers focused more on the technical aspect of the putt. Calmeiro and Tenenbaum (2011) explained these findings in that experienced players did not engage in technical instruction which might indicate a higher degree of automaticity of motor control where the performer's skill is controlled by procedural knowledge. In comparison, novices rely on a step-by-step execution. Hence, this is why they reported more technical mechanics in their verbalisations of the golf putt. During this, poorly learned or novel skills are controlled by declarative knowledge that is held in the short term memory and are attended to in a step-by-step fashion.

Germain and Tenenbaum (2011) studied decision making and thought processes among varying levels of poker players. This study involved expert, intermediate and novice poker players during a computer poker simulator task which involved 60 hand of No-Limit Texas Hold 'Em. All players were placed under two time constrictions (15 seconds and no time constraint). Expert and intermediate players out performed novice players in decision making performance and expert players reported processing more thoughts than intermediate players and novice players. It was also found that novices focused more on basic poker considerations and situational-irrelevant cues. In fact, the majority of thought reported by novices related to their cards or thought's not relating to decision making (i.e., luck or curiosity). Experts were found to display greater expected value scores as they perceived larger and more meaningful patterns of information in the environment, which is a finding reported in other domains (Ericsson & Smith, 1991; Gobet and Simon, 1998).

Although these expert-novice differences are being identified in the literature, there is a lack of clarity in terms of what is an ‘expert performer’. It is important to consider differences between good performers and exceptional performers, however until this becomes more transparent in the literature it is difficult to achieve.

1.7 PROBLEMS ASSOCIATED WITH THE EXPERT-NOVICE LITERATURE

Amongst the literature of elite and expert performance there is confusion about the definition of what an elite or expert athlete is. When writing about elite athletes and experiences of coping with stress Polman (2012) identified this confusion and inconsistency among expertise research and the inconsistency in the criteria used to define the term elite and expert. It was further pointed out that many studies have not explicitly provided information on the achievement levels of the athletes included or controlled for this factor in their statistical analysis. Welch and Tschaml (2012) conducted research into expert and novices and examined how the introduction of a kiai (yell or grunt) would improve strength performers in both expert and novice groups. When defining their ‘experts’ some of these athletes were described with having as little as two years of accumulated practice in the studied domain of martial arts.

It has been proposed by Chi (2006) that within the research of expertise in sport there are two types of research samples. Firstly, absolute expertise which is a small sample of truly exceptional elite athletes that are studied with the intention of discovering how they have achieved the exceptional level and how they perform at that level. It was proposed that these individuals with ‘absolute expertise’ may have greater minds in the sense that they might be able to utilize more powerful domain general heuristics novices are not aware of or may naturally have a better memory capacity (Pascual-Leone, 1970; Simonton, 1977). Secondly, the relative approach which involves comparisons between expert and novices, and the aim is to understand how experts become experts so that less skilled athletes can learn from this and use it to improve their skill and knowledge (Chi, 2006). An example of a relative approach study is McPherson’s (2000) research, where collegiate varsity (experts) tennis players (who

all had over ten years of receiving formal instruction and all held the six singles positions on a NCAA Division 1A university team) planning strategies during a competitive game of tennis were compared to a novice group's planning strategy in a similar situation. However, it could be argued that these 'experts' did not hold a world ranking therefore the level of their expertise could be questioned. Swann, Moran and Piggot (2014) agree that elite/expert athlete status should be defined by one set of consistent and valid criteria and support the view of Williams and Ford (2008) who believe that Chi's approach includes quite large variability which in turn makes it difficult to compare findings across studies and sports. It would be argued that sports with rankings such as tennis may be easier to determine what an expert is. Sports with rankings allow for using expertise as a continuous variable rather than a categorical variable. Using measures such as golf handicaps (Bernier & Fournier, 2010; Beilock & Gray, 2012) and belt colour in martial arts (Welch & Tschampl, 2012) allows for objective sport specific measures. Of course, for team sports this will be impossible, however due to the difficulty of this Swann, Moran and Piggot (2014) exploring the question of how to define the construct of expertise in such sports and they suggest a taxonomy is needed for classifying expert samples in sport psychology research.

Calmeiro and Tenenbaum's (2011) research was an original and novel investigation, however the expertise level and the sample size of the two groups are questionable. Particularly in their high skilled group they had three performers with handicaps of 0, 13 and 18. A handicap of zero and 18 represent an extremely different level of performer. In addition, whilst this study provides an important insight into skill level differences in decision making of golfers, the very small sample size limits the generalizability of findings.

Swann et al. (2014) identified the above issue in their paper and conducted a systematic review of 91 studies between 2010-2013 that researched elite/expert athletes. They investigated papers that used the terms expert and elite and amongst these studies the athletes ranged from Olympic champions (Grant & Schempp, 2013), to professional performers (Jordet & Elferin-Grant, 2012) all the way to athletes who are simply part of a competitive team (Voss et al, 2010). As a result of this inconsistency in the research, there is a threat to the validity of this research of expertise in sport. In their

conclusion, Swann et al. (2014) proposed that definitions of elite and expert performance should be based on factors such as the athlete's highest level of performance, their success at that level and the amount of experience they have gained at that level. Suggestions were also made about the competitiveness of the sport within the specific country and different countries will perform different sports at considerably different levels.

There are clear problems with the inconsistency of the criteria used to define participants as "expert" athletes and as a result this threatens the validity of research on expertise in sport. Limited guidelines are available to help researchers define differing level of expertise in the study of sport. As previously mentioned research into sports such as golf may be able to differentiate the levels of expertise in their performers due to handicap systems (Bernier & Fournier, 2010; Beilock & Gray, 2012) and similarly in martial arts where belt colouring is a measurement (Welch & Tschampl, 2012) as this allows for more objective sport specific measures. However within sports such as soccer frameworks need to be in place in order to be able to categorise skill level of performers, as this all comes down to league level, country, team position and playing time.

CHAPTER 2

COMPETITIVE PRESSURE, DECISION MAKING AND PERFORMANCE

2.1 INRODUCTION

Within the sporting domain, high skilled performers will execute their chosen skill with a very high level of precision and ease, making few errors. However, often these same performers will perform poorly in high pressure situations. The following chapters will present research based on competitive pressure and stress and its effects on performance and, more specifically, how stress and pressure influences how an individual processes information.

Janis and Mann (1977) proposed that decision making during a stressful situation can only be a sound and rational decision if “the decision maker searches painstakingly for relevant information, assimilates information in an unbiased manner and appraises alternatives carefully before making a choice” (Janis, 1982, p.73). Janis and Mann (1977) term this as vigilance, however, when experiencing severe stress an individual might replace vigilance with hyper vigilance, which can result in disorganised and incomplete evaluations of a situation which may lead to incorrect or faulty decisions.

In relation to Epstein, Pacini, Denes-Raj, and Heier (1996) dual process theory, the decision making process is made up of two systems. System 1 is the intuitive-experiential system which acts fast, parallel and effortless but also with emotion. Due to its fast accessible heuristics, this system is thought to be used in situations of uncertainty or where decisions are ambiguous. System 2 is the opposite to system 1 in that it is a rational analytic system which acts slow, serial and effortful but also controlled and neutral. System 2 is thought to need active executive processes like planning and strategy formation. Linking to Janis and Mann (1977) system 2 would therefore relate to a rational decision. Based on the dual processing theory (Epstein, Pacini, Denes-Raj, & Heier, 1996), there has been a growing interest in which systems are responsible for making decisions during a stressful situation. As a sport such as golf is self-paced and requires planning and strategy formation, this thesis will be mostly measuring how a golfer uses system 2 to processes in formation within a golf setting.

However, it should be highlighted that a clear distinction between emotion and rational decisions cannot be made due to the difficulty of measuring the two (Pabst, Schoofs, Brand, Pawlikowski, Wolf, 2013).

Keinan (1987) examined the effects of stress empirically as he exposed people to three different conditions. The first being a controllable stress condition where participants were told they would receive a shock if they did not perform well, the second being uncontrollable stress where the participants would receive a shock regardless of their performance and the third being a control where no shock would be provided. It was presumed that if the individual knew that the shock could be removed by making the correct decision (controllable stress) that they would be motivated to scan and weigh all alternatives carefully. However, findings of this study revealed that those in the controllable and uncontrollable stress conditions made premature considerations with few alternatives to the solutions. They also made choices in a less systematic manner and made more errors. This suggests that under a stressful condition, regardless of it being controlled or uncontrolled, participants may have been using system one (emotion driven) to make decisions as they were less strategic in their decision making.

Stress and decision making has been a popular research area in the work place for a number of years. For example Kazmi, Amjad and Khan (2009) found that job stress was inversely related to job performance, which could be assumed that incorrect or less efficient decisions were being made in stressful situations. This type of research has practical implications as helping reducing stress and improving decision making in the work place is going to create more efficient employees which could potential make the employer more success.

Further research in firefighters by Dorner and Pfeifer (1993) found that when exposure to noise stress, firefighters focused on the general outline of a simulated fire and set priorities, while firefighters not exposed to stress focused on operational details and on an in-depth analysis of the task. These results reveal that stress changes qualitatively how we solve problems.

Much of the research in the stress and decision making literature is mainly focussed on cognitive tasks and it could be argued that due to the lack of research around stress and decision making in a motor skill it may lack external validity when transferring these findings in to the sport domain. At the present time, little is known about the decisional process under the influence of stress in sport and whether these decisional process change or are influenced by the presence of a stressor. It could be argued that athletes are constantly controlling skills when facing stressful situations which in turn could makes the skills being controlled more fragile and susceptible to disruption (Laborde, Dosseville & Kinrade, 2014).

There has however, been research conducted around stress and the outcome of a decision in sport. For example, Masters and Maxwell (2004) suggested that when experienced performers experience performance-related pressure they sometimes consciously change the mechanisms of the movement. Additional evidence that performance-related pressure may induce performers to deliberately manipulate their actions comes from a study by Nicholls, Holt, Polman, & James (2005). They identified the use of “technical adjustments” as one of the strategies used by a sample of elite adolescent golfers to deal with stress. Such adjustments included modifications to swing plane, stance, grip and technique. Similarly, Nicholls and Polman (2008) found that when under pressure, high skilled golfers will revert to a high frequency of swing thoughts, which are technical thoughts about their performance, which in turn could result in different control mechanisms.

In terms of the decision making process it is thought that if stress levels are too high, it might become difficult for the athlete to make rational decisions and invoke adaptive coping strategies to deal with the situation. The athlete will therefore react to stressful encounters in competitive situations with behaviours that are less than optimal, which may subsequently interferer with performance (Gill, 1986). Strategies such as avoidance coping may occur when an athlete is experiencing acute stress in training or competition (Polman, 2012). These avoidance coping strategies are maladaptive in the long term as although it may provide temporal relief from the stressful situation; such as blocking out an error or walking away from a referee who has made a bad decision, if the athlete is continuously avoiding a situation such as repeatedly making a technical error, then this kind of coping can become

detrimental (Polman, 2012). Furthermore, if the avoidance coping involves disengagement from the stressful event (such as walking off a golf course following a high scoring hole), the act of disengagement will cause higher levels of stress because the athlete cannot invoke this coping strategy without serious consequences (Carver & Scheier, 1998)

Kinrade, Jackson and Ashford (2010a) found that thinking too much under pressure can result in performance breakdown both at a motor and cognitive level. Interestingly, Kinrade, et al. (2010b) introduced the concept of decision making reinvestment. They developed a Decision-Specific Reinvestment Scale (DSRS), which comprised on six items specific to the conscious monitoring of the process involved in making a decision (decision reinvestment). A second factor which makes up the scale is decision rumination which focusses on negative evaluations of poor decisions.

Decision reinvestment is the conscious monitoring of the process leading up to a decision. Kinrade et al. (2010b) found that high scores on this scale reflect a strong tendency for conscious monitoring of the decision making process and parallels the conscious monitoring and control of movements in the motor domain (Masters et al. 1993). The second factor which is decision rumination assess the tendency to reflect on previous poor decisions. Martin and Tesser (1996) found that rumination typically involves repetitive thoughts about past events and current mood states and it is related to failure to achieve. Scott and McIntosh (1999) found that those who ruminate were more likely to experience more negative effects, greater worry and perform worse on cognitively demanding tasks.

When validating the DSRD scale, Kinrade et al (2010) found that the scores of 59 skilled team sports players correlated highly with coach's ratings of player's tendency to choke under pressure. Further research by Poolton, Siu and Masters (2011) found that referees with a higher tendency for decision rumination were found to be more influenced by home advantage in that they favoured the home team in the decisions they made. It is important to note, however that there is relatively little empirical support for the DSRS Scale due to it being a relatively new psychometric instrument.

More recently, Laborde, Dosseville and Kinrade (2014) conducted a study to explore the construct validity of the DSRS and its links with stress and coping appraisals. They gave over a thousand

participants the DSRS accompanied by the Movement Specific Reinvestment Scale (MSRS), the Preface for Intuition and Deliberate Inventory (PID) and the Melbourne Decision Making Questionnaire (MDMQ). In addition, they asked 100 handball players classified as high or low investors to complete surveys aimed to assess stressor intensity, stressor perceived controllability, coping effectiveness, subject performance and coping strategies with the coping inventory for complete sport over three games. They found that instinctive athletes scored lower on the DSRS than deliberative athletes. Further investigations found that low reinvestors scored higher on perceived controllability, coping effectiveness and subject performance than those who were high reinvestors, indicating that those who are low reinvestors may cope better under pressure.

Very little research has focussed on the cognitive processes that are used to make a decision and how these may alter during a stressful event. The below section will critically discuss a variety of theories which explain how stress and anxiety have an influence on performance in sport. Theories such as the multidimensional anxiety theory, the catastrophe theory and, more specifically the theory of reinvestment (Masters, 1992).

2.2 THEORETICAL EXPLANATIONS OF HOW STRESS AND PERFORMANCE PRESSURE MIGHT EFFECT THE DECISION MAKING PROCESS

The relationship between anxiety, arousal and performance pressure has long been an area of interest and widely researched in the world of sport. Early theories such as the Inverted-U (Yerkes & Dodson, 1908), propose that the best performance can be achieved with an average level of arousal. However, such theories have been deemed as too simplistic and as a result further theories such as the Multidimensional Theory of Anxiety (Martens et al, 1990) and the Catastrophe Model (Hardy & Fazey, 1987) have been proposed.

The Multidimensional Theory of Anxiety (Martens et al, 1990) is based on two separate types of anxiety, one being cognitive and the other being somatic. This theory predicts that an increase in cognitive state anxiety, which could be worry about performance or competitive pressure, has a

negative impact on performance. Cognitive anxiety may occur under performance pressure as an individual may experience negative concerns about their ability. On the other hand, the somatic component is the physiological effects of the performance pressure or anxiety, such as clammy hands, increase heart rate or shortness of breath (Morris, Davis and Hutchings, 1981). Martens et al (1990) developed the Competitive State Anxiety Inventory-2 (CSAI-2), which is made up of three dimensions; cognitive anxiety, somatic anxiety and self-confidence. Studies which have used this measure have found findings such as the dimensions of competitive anxiety tend to be influenced by gender, type of sport, level of ability and competitive experience (Martens et al., 1990; Clifton & Gill, 1994).

Criticisms of the Multidimensional Theory of Anxiety has emerged because most of the research has examined cognitive and somatic anxiety as two independent sub-components. Furthermore, Krane (1992) argues much of the research disregards the multivariate nature of the theory. Jones and Hardy (1990) also criticise how the research is measured. A lot of the research measures how scores vary between individuals with different anxiety levels. However, it is thought that the effect of changing anxiety levels upon an individual's actual performance is more important (Parfitt, Jones & Hardy, 1990).

To address some of the issues associated with the multidimensional theory, Hardy and Fazey (1988) proposed the catastrophe model. Similarities to the multidimensional theory of anxiety are that this theory proposes two sub-components. However, rather than using somatic anxiety, this theory uses physiological arousal. Within this model, physiological arousal is thought to have a direct effect on performance through the suppression of crucial cognitive and physiological resources (Hardy et al., 1992). Furthermore, physiological arousal could also cause an individual to interpret their physiological state in different ways (positive or negative) which in turn can have an effect on their performance. If an individual is experiencing low cognitive state anxiety (low performance pressure of worry), then their performance should remain stable, however the catastrophe occurs when the individual has high cognitive anxiety (worry about their performance). Following this there is a steep deterioration in performance. Hardy (1990) states that the Catastrophe model can predict either

positive or negative effects of physiological arousal on performance when there is an elevation in cognitive anxiety, however this depends on how high the cognitive anxiety is at the time. Hardy and Parfitt (1991), conducted a study with eight experienced basketball players who performed a set shooting task under conditions of high and low cognitive anxiety. Physiological arousal was also manipulated through physical work which enabled the researchers to increase or decrease physiological arousal. Findings revealed that the biggest decrements in performance were during the high cognitive anxiety condition. Hardy and Parfitt (1991), concluded that this study strongly supports the Catastrophe model (Hardy & Fazey, 1988).

However, limitations of this theory and its research have been put forward. Firstly, when addressing Hardy and Parfitt's (1991) research, it is impossible not to highlight their limited sample size of eight participants. Furthermore, they were categorised as experienced, however, very little information is provided about the level of experience these participants had. Further research by Hardy, Parfitt and Pates (1992) also acknowledge a number of flaws within their methodology (e.g. small sample size). Further limitations associated with the Catastrophe theory in that it fails to explain how the effects of cognitive anxiety and physiological arousal on performance occur (McNally, 2002). Other researchers have proposed that motivational issues influence findings (Eysenck, 1979), in that individuals who have high levels of anxiety could have greater variance between their present aspirations and their previous achievements. An additional assumption is interference, in that when high levels of anxiety occur the individual becomes distracted and preoccupied with task irrelevant factors rather than concentrating on the solution of the task (Hackfort & Schwenkmezger, 1989).

Masters (1992) proposed the theory of reinvestment, which suggests that the automatization of a task can be undone or disrupted if the performer tries to control a task or action consciously with declarative knowledge. "Reinvesting actions and perceptions with attention", was a phrase first used by Deikman (1969, p.31) when he argued that automatization can be undone. In his early research Masters (1992) conducted a study investigating how stress can affect performance differently depending on how that skill was learnt. This was demonstrated by placing novice golfers into either an explicit learning condition (participants were provided with technical instruction on how to putt a

golf ball), or implicit learning condition (participants were required to conduct a secondary task while putting). Once the learning phase was complete participants were involved in a second phase where they were exposed to a stress condition, which involved evaluation apprehension and financial inducement. Findings revealed that those who learned the task implicitly had less explicit knowledge of how to execute the skill performed better under stressful conditions. The research by Masters (1992) concluded that implicitly learned skills were less likely to fail under pressure than an explicitly learned skill due to less reinvestment happening in the implicitly learned skill. Since then Masters and other researchers have investigated 'reinvestment' and its effects on performance.

As discussed in the previous chapter Fitts and Posner's (1967) framework of skill learning is part of the reinvestment theory framework. Learning progresses from the declarative, cognitive stage where the performance is cognitively controlled in a step-by-step manner, when learning progresses performance becomes more procedural and automatic which requires little cognitive attention. In the early stages of learning there are rules which the performer cognitively attends to whereas later in the learning process this becomes automatic and the cognitive load changes. Masters (1992) proposed the progression regression hypothesis or reinvestment where high level performance can regress to early stages of skill development in which the execution are more reliant on verbal cues and explicit declarative knowledge (Anderson, 1982; Fitts & Posner, 1967). According to Masters (1992) during progression- regression, a disruption in performance occurs when an 'integrated' real time control structure that can run as an uninterrupted (for example, a professional golfers driving off the tee) unit is broken down back into smaller, separate independent units, similar to how it was originally attended to in a step-by-step fashion during the early stages of learning. This in turn slows down performance as each component is run separately instead of all together; as a result there is a gap in each unit which creates more room for error, which would not be present in the integrated autonomous structure (Beilock & Carr, 2001; Masters, 1992).

Masters, Polman and Hammond (1993) suggested that reinvestment and the disruption of an automatic skill could be a characteristic of personality and as a result may be subject to individual differences. Masters et al. (1993) suggested that cognitive failures as a result of reinvestments could

be due to an inherent flaw in cognitive processing which could cause disruption in some individuals but not all and at different levels. They developed a 20-item Reinvestment Scale which was made up of questions from previously validated scales; 12 items were taken from the self-conscious scale (Fenigstein, Scheier & Buss, 1975), 7 items were taken from the emotional control questionnaire (Roger & Nesshover, 1987) and 1 item was taken from the cognitive failure questionnaire (Broadbent, Cooper, FitzGerald & Parkes, 1982). All of these 20 items were associated with the inwards focus of attention to the mechanisms of self-movement. After creating and validating the Reinvestment Scale Masters et al. (1993) then tested this scale in a golf putting skill and found that those with high reinvestment scores were more likely to fail under pressure. Furthermore, in the same paper Masters et al. (1993) went on to test the Reinvestment Scale in university level squash and tennis players, which also demonstrated that those who score highly on the Reinvestment Scale also had lower levels of performance under pressure. This research demonstrated that the Reinvestment Scale can assess a predisposition towards performers who will reinvest controlled processes which may provide a valuable tool in predicting skill failure in a stressful environment which involves complex and rule bound skills (Masters et al. 1993). Lewis and Linder (1997) found that even the presence of a camera caused a decrease in performance when individuals were placed in a 'self-awareness' condition (the use of a video camera) during a putting skill as they had not adapted to performing in self-awareness-heightened environments. Linking to this thesis, if golfers are put under a stressful situation (such as a competition) depending if they are high reinvestors then their decision making or thought processes may become centered on mechanical and technical elements of their performance. More specifically higher skilled golfers who may be in the autonomous phase of learning (Fitts & Posner, 1967), may revert from effortless tactical and procedural decision making to step-by-step monitoring of their own performance as a result of experience pressure or stress.

In terms of the cognitive processes that are occurring during high pressure performance, there is very little research that provides specific insight into this. When studying stress and coping, Nicholls and Polman (2008) found that when under stress high skilled golfers will revert to a high frequency of swing thoughts, which are technical thoughts about their performance. This type of finding, although

not the sole purpose of Nicholls and Polman's (2008) research could provide an explanation for what may happen to a performer's cognitive processes during a stressful event. Based on the reinvestment theory (Masters, 1992), during a stressful event this research shows that an individual in the later stages of learning will experience self-directed attention, which in terms of cognitions may cause a performer to think about his or her technique and mechanical movements, rather than a tactical external focus.

Hardy, Mullen and Jones (1996) questioned Masters (1992) study as participants in the implicit learning group were required to perform articulatory suppression during the learning trials but not during the stress trial. Therefore they suspected that the implicit learning group may have improved during the stress trial simply because the task was easier. In response to this Hardy et al. (1996) conducted their own research replicating Masters (1992) golf putting study, however, adding in an implicit learning group which was required to carry out articulatory suppression during both the learning and the stress trials. Hardy et al. (1996) found that both implicit learning groups continued to improve performance under stress whereas the explicit learning group did not; supporting previous findings by Masters (1992).

Masters and Maxwell (2004) went on to further develop their research and as a result they redefined reinvestment as the "manipulation of conscious, explicit, rule based knowledge, by working memory, to control the mechanisms of one's movement during motor output" (p. 208). Furthermore, Masters and Maxwell (2008) conducted a review into research that had been conducted to support the theory of reinvestment. In most of the studies conducted around reinvestment performers were shown to drop in performance when provoked to consciously attend to their movements by pressure manipulations or self-focus instructions. Hardy et al. (2001), for example, showed this in skilled trampoline performers under pressure when they were required to shadow task-relevant declarative cues that evoked conscious attention to their movements. Further research by Beilock, Carr, MaccMahon and Startkes (2002) found that when experienced golfers putted under dual task conditions which were designed to attract attention away from putting they performed more accurately when in a skill focussed condition. As the skill focussed condition prompted participants to attend to their performance in a

step-by-step fashion this caused their performance to be compromised by attending to the process of skill execution, which is what Masters and Maxwell (2008) would call reinvestment. Furthermore, Beilock et al. (2002) conducted a second experiment within their paper which put experience soccer players in either dual-task or skill focussed conditions when performing a dribbling task with their dominant foot. They found very similar results to the putting task in that those performing the dual task condition were more accurate in their dribbling skills. This supports the theory of reinvestment, however, in their second study Beilock et al. (2002) tested novice or less proficient performers and found that these performers benefitted from attentional monitoring of step-by-step performance, which does provide a slight contradiction to the theory of reinvestment.

Linking the above to this thesis, it could be suggested that experienced golfers may experience reinvestment when put in a stressful or more pressured environment such as a competition (which is conducted in this thesis), however, lower skilled golfers may benefit from being in a higher pressured environment as they may benefit from the step-by-step monitoring of performance as found by Beilock et al. (2002).

It was proposed that the theory of reinvestment could potentially explain the Yips (Klampfl, Lobinger & Raab, 2013). Klampfl et al. (2013) studied whether the Yips; defined as a multi-etiological phenomenon consisting of involuntary movements during the execution of a skill, is caused by reinvestment. They used 19 yips effected golfers and put them in a skill focussed or non-skill focussed condition where participants were required to focus on audio tones and were asked to report whether the tones were high or low. Reinvestment was measured using the movement-specific reinvestment scale and yips behaviour was measured by putting performance and movement variability. Dual task performance showed that the manipulation task worked but the tendency to reinvest did not predict the behaviour of the yips effected golfers in either putting condition. Therefore it was concluded that reinvestment cannot be used to explain the yips. However, this is one of the few studies that have been conducted in an attempt to link reinvestment with the yips in a laboratory setting. Further research needs to look at how a performer learns. For example, if Master's (1992) theory of reinvestment is true and if people learn implicitly, then their chances of experiencing the yips could be

reduced. However, due to the multi-etiological nature of the yips other psychological or neurological mechanisms such as conditioned reactions may better explain the yips and should be investigated (Klampfl et al. 2013).

CHAPTER 3

RESEARCH METHODS FOR INVESTIGATING DECISION MAKING IN SPORT

3.1 LIMITATIONS IN PREVIOUS DECISION MAKING IN SPORT RESEARCH

The study of decision making and the underlying cognitive processes in sport is rapidly growing and therefore it is important that the most appropriate methodologies are used to investigate this area. The following chapter will present limitations associated with the data collection methods used to examine decision making in sport and puts forward an argument for the use of Think Aloud protocol analysis (Ericsson & Simon, 1993) for collecting in event decision making data.

A major issue when studying decision making in sport is that specific protocols to measure decision-making have often failed to reproduce representative performance conditions (Travassos et al, 2013). In addition, decision making in sport has a high degree of variability, especially in team sports, where the decision maker faces unpredictability from both, their team mates and opposition. Although studying decision making in a natural environment creates a high level of ecological validity. Ecologically more valid settings could, however, lack experimental control and lead to questionable cause-effect relationships (Marasso et al., 2014). Different types of data collection methods and their strength and weaknesses will be discussed further.

Delayed retrospective reports are among the most widely used approaches to gathering data on decision making in sport performance. With this type of data collection comes the assumption that individuals have access to their experiences and that their reports can accurately reflect the thought processes that occur during their real time performance. The majority of research has opted to use retrospective recall to gain insights into thoughts and actions that occur during performance. For example, Mulligan, McCracken and Hodges (2012) used retrospective interviews, prompted by video recordings, to investigate the decision quality in ice-hockey. They found that experts described decision-making situations as ‘familiar’ twice as often as non-experts.

However, cued retrospective recall of events has a number of important limitations. One issue that has been shown to affect reporting accuracy is memory decay (Ericsson & Simon, 1980; Nicholls & Polman, 2008). In addition, retrospective reports are also distorted by knowledge about success of efforts to resolve stressful events (Brown & Harris, 1978). This can also be linked to the issue of bias as Bahrick, Hall and Berger (1996) found that recall of student's high school grades was influenced by the attractiveness of the grade received. Researchers found that the grade A was recalled accurately 89% of the time but the grade D was only recalled 29% of the time.

Furthermore, research on memory has revealed that longer retention intervals result in lower recall accuracy. All types of memory uniformly and at predictable rates reduce accuracy unless the information is accessed and rehearsed during the delay (Bahrick, Hall, Goggin, Bahrick, & Berger, 1994). Tenenbaum and Elran (2003) examined the congruence between actual and retrospective reports for pre- and post-competition emotional states; these were studied separately and together. The results revealed that retrospective reports were not affected by the pre-post interference after a 72 hour delay. However, athletes underestimated the intensity of post competition unpleasant emotions. In addition, thoughts and feelings that were openly expressed after 72 hours were not fully congruent with thoughts and feelings reported in real time. Tenenbaum et al. (2002) also highlighted concerns of whether retrospective reports signify the athlete's schematic knowledge of how they generally think before and after a competition. Retrospective measures might be tapping 'a general schema' or overlearned set of emotions rather than the particular emotions experienced before an event. Eccles (2012) argues that during retrospective reports participants might be aware of general strategies and recall and report strategies directly and without preference to specific behaviour they produced. Such reporting would be encouraged when researchers ask participants to recall general states.

Nisbett and Wilson (1977) argued that when participants are asked about their past experiences, they are often unaware of the causes of their behaviour and report inaccurate beliefs concerning the cognitive processes that led to their behaviours. In experts some information may not be accessible due to skills being overlearned and information may be implicit and as a result will not be verbalised. Research by Maier (1931) highlighted how participants can provide invalid reports about their

thinking and cognitive processes. Furthermore, Nisbett and Wilson (1977) conducted a study where they provided participants a choice of four items of clothing and asked them to choose their favourite and provide reasoning behind their choice. Results showed that participants would choose an item of clothing mostly from the right side, rather than the left side by a factor of almost 4 to 1. All participants provided reasoning for their choice but none reported that they were influenced by the position of the clothing. Based on these findings Nisbett and Wilson (1977) proposed that individuals have specific limits on access to the thoughts mediating their decisions and actions.

It has also been proposed that individuals create fundamental assumptions about how the world generally works (meta-cognitions) which are known as implicit theories (Nisbett & Wilson, 1977). When an individual is asked to report on cognitive processing, they will report on the basis of the implicit causal theory that effectively matched the stimulus response conditions of the given situation (Eccles, 2012). Therefore, Eccles (2012, p.105) concluded (based on Nisbett and Wilson 1977, p.231) that maybe participants are asked to report “more that they can know”. Therefore, in this section, Ericsson and Simon’s protocol analysis method is presented, including their proposals for creating experimental conditions that maximise the validity of verbal reports.

3.2 THINK ALOUD PROTOCOL ANALYSIS METHODOLOGY

Ericsson and Simon (1980, 1993) identified a critical problem with subjects general descriptions of the cognitive processes and experiences is that such reports do not relate clearly to any specific observable behaviour. They highlight that when asking a participant to report on their cognitive processes used during many trials of an experiment we cannot rule out the possibility that the information they retrieve at the time of the verbal report is different from the information they retrieve while actually performing the experimental task.

As a result Ericsson and Simon (1980, 1993) proposed a verbal protocol analysis method. Protocol analysis is a process-tracing technique to identify the cognitive processes of individuals while completing a task. Individuals are asked to verbalise their thinking during or immediately after an

action in order to examine the sequences of a cognitive task or event occurring between the presentation of a problem and generation of an answer. Ericsson and Simon (1980, 1993), propose that the current contents of STM include information about the end products of mental processes, and an accurate retrieval of at least some of this STM content is possible via use of particular forms of verbal probing. Ericsson and Simon (1980, 1993) proposed three differentiating levels of verbalisations, Level 1, Level 2 and Level 3 verbalisations. Each level is characterised by the amount of additional processing involved in the production of the verbalisations.

Level 1 verbalisation is simply the vocalisation of inner speech where the individual does not need to make any effort to communicate his or her thoughts. It is a direct process in which thoughts that are already activated as verbal articulations are verbalised. For example, when an individual is asked to think aloud while taking part in a mental arithmetic task they may verbalise the following, “11 times 4,” “hmm if you carry over the 1 and add the 4”. Level 2 verbalisation involves the verbal encoding and vocalisation of an internal representation that is not originally in verbal code (Ericsson & Simon, 1990). For example, verbal encoding, vocalisation of scents, visual stimuli, or movement. With this level of verbalisation, only the information that is in the participants focus is to be verbalised. Level 3 verbalisation requires the individual to explain his or her thoughts, ideas or hypotheses or their motives. For example, explaining why a certain shot or club is selected in golf. Some researchers have argued that instructing participants to think aloud or consciously attend to a skill may interfere with thought processes and negatively impact on task performance. With Level 1 and Level 2 verbalisation, the sequence of thought processes involved in making a decision should remain intact as no additional information is required. Level 3 verbalisation involves explaining one’s thoughts and it requires attention to additional information and may change the sequence of cognitive processes. As a result Level 3 verbalisation is thought to be less valid as it requires an additional process of retrieval from the LTM.

Ericsson and Simon (1980) proposed that the only information about mental processes that an individual is thought to be able to access and in turn verbalise is that attended to in the STM during the execution of a task. With some exceptions, the intermediate and end products of those processes

are held in STM during task execution. It is these verbalisations or products which can allow the experimenter to make inferences about the processes themselves.

As a result of the above, a number of researchers have used the Think Aloud protocol analysis as a method of collecting information about an athlete's thought process in sport and golf putting in particular (Calmeiro and Tenenbaum, 2011), appraisals and coping in trap shooting (Calmeiro, Tenenbaum, Eccles, 2010), gender differences in stress, appraisal and coping in golf putting (Kaiseler, Polman & Nicholls, 2012) expert novice differences planning strategies in tennis (McPherson, 1993, McPherson & Kernodle, 2007) and decision making in poker (Germain & Tenenbaum, 2011).

Think Aloud is not without limitations. The social dynamic of the setting can lead a participant to augment verbalisation with descriptions and explanations of thought that are not part of their actual thoughts being experienced at that time (Eccles, 2012). In addition, when asking participants to verbalise their thoughts there is no independent means of assessing their completeness (Wilson, 1994). Furthermore, Ericsson and Simon (1993) acknowledge that even concurrent reports will be incomplete under some circumstances because some cognitive processes are not part of focused attention, or appear in a form that is not easily verbalisable.

As Level 3 verbalisation involves explaining one's thoughts it requires attention to additional information and may change the sequence of cognitive processes (Ericsson & Simon, 1993). Level 3 verbalisation, however, could provide further information to gain a fuller understanding of the thought processes in decision making in some sports. For example, in golf, players make numerous decisions about shot selection, and Level 2 verbalisation may not provide enough detail of the thought processes involved in this decision. Level 3 verbalisation may give a clearer explanation of the variables considered in shot selection.

A recent meta-analysis by Fox, Ericsson and Best (2011) compared performance on tasks that involved concurrent verbal reporting conditions with their matching silent control conditions. They found that instructing participants to merely verbalise their thoughts during a task did not alter performance, whereas directing participants to provide explanations for their thoughts actually

improved performance. For example, Gagne and Smith (1962) explained that asking participants to verbalise their reasoning when completing the Tower of Hanoi produced more efficient solutions (taking fewer moves), and suggested that the instruction to verbalise the reasons for moves induced more deliberate planning.

In the meta-analysis by Fox et al. (2011) the majority of tasks were cognitive. To the author of this thesis's knowledge no previous studies have examined the influence of think aloud protocol on motor performance. If TA is to be used more widely to examine decision making in sports it is important to establish if TA interferes with performance on sport tasks (Calmeiro & Tenenbaum, 2011). In terms of a motor skill, it can be argued that the level of skill that the performer possesses could also relate to the effect that thinking aloud and explaining one's thoughts has on performance. Hence, for skilled performers, which are assumed to be in the automatic phase of skill learning, it could be suggested that focussing attention on the skill itself degrades performance (Schmidt, 1982; Masters et al., 1993). It has been proposed that performers in the automatic phase of skill learning will execute the skill in an open-loop fashion where there is little conscious control and processing required. Whereas a novice will be in the closed loop, feedback driven mode, and attention demanding processing (Schmidt & Wrisberg, 2000).

In terms of thinking aloud during motor performance, high level performers may experience decrements in their performance due to interference with their open-loop mode of execution, whereas novice athletes may perform better as explaining thoughts may act as feedback for the task at hand. However, as this has not been investigated this can only be suggested. Therefore, it is important that further research examines whether verbalising during sport and golf performance interferes with task outcome in order to validate concurrent verbal protocols as a valid ecological method in the domain of sport (Calmeiro and Tenenbaum, 2011).

3.3 STUDIES THAT HAVE EMPLOYED THINK ALOUD METHODOLOGY

Think aloud protocol analysis has been employed in a variety of settings from nursing (Aitken & Mardegan, 2000), thought processes in golf (Calmerio & Tenenbaum, 2011), decision making when faced with a distraction (Hsu, Babeva, Feng, Hummer & Davison, 2014), and acute stress and coping strategies (Nicholls & Polman, 2008).

Aitken and Mardegan (2000) used think aloud protocol to uncover how nurses make decisions in a natural setting. They asked nurses to think aloud while conducting an assessment over a two hour period of care while caring for a critically ill patient and also to think aloud when attending to a patient. All the nurses were asked to think aloud, however, not to rationalise their actions. Although this study did not make any formal conclusions about how a nurse make decisions it did provide indications that thinking aloud is a valid and useful technique to examine clinical judgement in the natural setting.

Nicholls and Polman (2008) used think aloud at Level 2 (Ericsson & Simon, 1993) to investigate the stress and coping strategies of five high level golfers over the performance of six holes of golf. By asking golfers to think aloud while performing, they were able to implement an effective and valid technique to measure stress and coping as golfers experienced up to five stressors before reporting a coping strategy. Nicholl's and Polman (2008), however, did recognise the limitations of using such a methodology in that using only think aloud as a data collection technique they were unable to measure the intensity of the stressors that the participants were experiencing. For example, physiological measures such as heart rate could be used within the study to account for the physiological effects in addition to the psychological. Furthermore, it is not clear what effect the method of thinking aloud had on the performers and by asking the golfers to think aloud may have increased levels of stress in the performer.

Germain and Tenenbaum (2011) used think aloud protocol to assess decision making and thought processes in a cognitive task using different level poker players. All participants were asked to provide continuous verbal reports during each hand of Texas Hold 'Em poker player. This was treated

as a record of the participants ongoing decision making process, as the information verbalised represents a portion of the information currently being attended to (Ericsson and Simon, 1980). These verbal reports allowed the researchers to analyse the thought content of the poker players and uncover clear differences in the decision making processes between expert, intermediate and novice players.

Calmeiro, Tenenbaum and Eccles (2010) used the think aloud methodology to investigate appraisals and coping during trap shooting. This study used an immediate retrospective procedure as Ericsson and Simon (1993) proposed this for when concurrent reporting was not feasible given the nature of the task/sport. During this procedure participants were asked to report immediately after a shot to report the thoughts they experienced during the last 10 seconds of task performance. They found that the athletes in their study utilized a variety of coping strategies during competition. More specifically, they found that negative appraisals were most likely before and after a missed targets and positive appraisals were most likely before problem focussed coping and after emotion focussed coping. It is important to highlight that this study was able to provide a timeline of critical events within the target episode to frame the recall process through the use of Think Aloud procedures.

Calmeiro and Tenenbaum (2011) used verbal reports to identify the thought processes and patterns of performers and to compare these patterns and processes of experienced and novice golfers during a golf putting task. Three experienced golfers were used, which consisted of golfers who has participated in golf for between 11-15 years and had handicaps of 0, 13 and 18. In comparison three novice golfers were used who did not have a handicap. All participants were asked to verbalise everything that was going on in their mind (Level 2 verbalisation) during the performance of 20 putts from 12 feet on a practice green. Findings revealed that experienced players had a higher domain-specific knowledge as their thought processes centred on gathering information and planning. These higher level performers would produce more strategies and goals and they were more able to look for relevant information on the green which would aid them in being able to make more solutions to play the shot. Furthermore, these experienced players reported more diagnostic-related thoughts after the execution of the putt which were then used to plan the next putt. In comparison, beginners in this study reported more step-by-step monitoring of their motor performance as their thoughts were more

focused of the technical aspects of their performance. This was evident as the beginners reported more mechanical aspects of putting execution. It is important to note that the experienced golfers did not report much technical information which may indicate a higher level of automaticity of the skill (Calmeiro & Tenenbaum, 2011). Therefore, clear skill level differences were evident between high and low level performers and their thought processes. However, this study is not without its limitations. The extremely small sample size and the level of the performers in the experienced group are questionable. It could be argued that a golfers off a handicap of 0 is at a considerably higher level than that of a handicap of 18. Therefore the 'experienced' sample in itself could have had large variability in the verbal reports. Calmeiro and Tenenbaum (2011) themselves recommended that replication of this study was needed with a larger sample size including experts and intermediate level golfers. Finally, there was no check within the study on the effect of using think aloud protocol had on putting performance. This could have been achieved by including using a control condition where participants were not asked to verbalise their thinking.

The Think Aloud methodologies used in the above studies were Level 2 Think Aloud Verbalisation (Ericsson & Simon, 1993). Rose and Parfitt (2010) used a Think Aloud procedure which represents Level 3 Think Aloud. During their study Rose and Parfitt (2010) aimed to investigate the cognitive factors that influence affective responses during prescribed and self-selected exercise in low-active and high-active women exercise. Using Think Aloud Level 3, every 5 five minutes the women were asked to provide an affective response and explain the thought process that caused them to report that affective response. The women in this study were asked questions such as, "what ran through your mind to help you decide that you felt that way?" Rose and Parfitt (2010) identify that this may deviate from the 'truer' protocol analysis procedures as it asks participants for more detail, however, they thought it was necessary to gain a complete understanding of the cognitive factors underpinning the affective response. Similarly, within golf asking participants to explain thoughts and elaborate could provide a complete understanding of their decision making process.

McPherson (2000) investigated the planning strategies of collegiate varsity and beginner women tennis players between points during competition. Immediate recall interviews were conducted

between points. Participants were instructed to respond as accurately as possible to the following two questions concerning their thoughts during competition: (1) what were you thinking about while playing that point? And (2) what are you thinking about now? The second question required participants to report their actual thoughts about the next point or points, which was therefore thought that the verbal reports provided were more closely related to actual thought processes. Findings revealed that experts planned more for actions based on more sophisticated actions plans whereas novices rarely planned. McPherson (2000) aim of this research was to capture the natural thoughts of elite performers during actual competition. However, due to the nature of the open ended, high strategy sport such as tennis her data collection method could be defined as what Eccles (2012) proposes as immediate retrospective recall.

Cotterill, Sanders and Collins (2010) used think aloud protocol to investigate pre-performance routines in golfers. However, they used this method in a stimulated recall setting, as their participants were shown a set of video clips of themselves playing different golf shots. Following this these golfers were then interviewed and asked to verbalise the underlying cognitive processes relating to the specific observed behaviour. Cotterill et al. (2010) used the think aloud protocol as a starting point to then conduct follow up interviews to gain a better understanding of the participant's perspectives and understanding of their own pre-performance routine. Although using think aloud protocol in this way may have its merits, it does not provide in-event, concurrent data of what the golfer is actually thinking about during the performance of those pre-performance routines and therefore this study may lack ecological validity. It has been argued by some researchers that the level of detail provided by think aloud reports, namely, information corresponding to changes in states of working memory, is the most important level at which to study learning processes (Anderson, 1987). However, by choosing to use think aloud reports as a retrospective data collection method, Cotterill et al. (2010) may encounter problems with their participant's reports. Eccles (2012) argues that during retrospective reports participants might be aware of general strategies and recall and report strategies directly and without preference to specific behaviour they produced. Such reporting would be encouraged when researchers ask participants to recall general states.

The above studies provide clear examples of when and how Think Aloud protocol analysis can be used, especially for gathering concurrent data during performance or tasks. By reducing time delays and even collecting thoughts before task execution this provides more valid data as there is less chance for bias and memory decay to occur. However, it is important not to overlook the limitations that have been presented and criticism from multiple authors and as a result one of the main aims of this thesis is to take this into consideration when considering an appropriate methodology for collecting decision making data in sport.

3.4. AIMS OF PRESENT THESIS

The purpose of this thesis is to investigate the decision making processes in differing levels of golfers. However, initially the purpose of this thesis was to develop and implement a technique to measure decision making in golf. Only a small number of studies have used think aloud protocol to measure the decision making in sport (for example, McPherson, 1999, 2000; McPherson & Kenodle, 2007) and an even smaller number of studies have investigated decision making in golf using think aloud protocol (for example, Calmeiro & Tenenbaum, 2011). However, even in these studies only Level 2 verbalisations have been used (Ericsson and Simon, 1993). Level 3 verbalisation could provide further information to gain a full understanding of the thought processes in decision making in some sports. For example in golf, players make numerous decisions about shot selection, and Level 2 verbalisation may not provide enough detail of the thought processes involved in this decision. Level 3 verbalisation may give a clearer explanation of the variables considered in shot selection during golf performance. Therefore the initial stage of this thesis aimed at investigating the most appropriate methodology for collecting in-event concurrent data around decision making in high and low level golfers and throughout study 1 and 2, think aloud Level 2, Level 3 and retrospective methods of data collection were investigated.

Study 1's primary aim was to investigate if there were any detrimental effects on performance if high and low level participants used either Level 2, Level 3 or no verbalisation during a golf putting task. It

was predicted that a) participants in the Level 2 groups would perform as well as the control groups and b) high level participants in the Level 3 group would perform worse than both the control and the Level 2 high level participants; and novices in the Level 3 group could perform better than the control and Level 2 novice groups.

Study 1 had a second aim which was to identify differences in the decisions that are made between high and low level golfers at each level of verbalisation. It was predicted that higher skilled golfers will spend more time gathering information and planning the putt than lower skilled. Furthermore lower skilled golfers will verbalize more about technical aspects of their putting than higher skilled golfers.

Study 2's primary aim was to examine the congruence between cue retrospective recall over different time frames (10 minutes post, 24 hours post and 48 hours post performance) and Level 3 Think Aloud verbalisation. It was predicted that with increasing time there will be less correspondence between TA and retrospective recall. More specifically, as the time delay increases there will be a greater discrepancy in the content of information that is presented during TA and retrospective recall.

Once an appropriate methodology was found the second aim of this thesis was to uncover the differences in the decision making processes between high and low skilled golfers. Previous research in this area has found findings such as higher skilled performers will plan more and have more sophisticated action plans than lower skilled (Calmeiro & Tenenbaun, 2011; McPherson, 2000). Previous research, for example Calmeiro and Tenenbaum (2011) also have limitations due to their small sample size and their vague differentiation between their high and low skilled performers. Therefore this thesis aims to prevent these limitations through bigger sample size and larger differences between the higher and lower skilled performance, such as bigger differences in handicap and having groups with similar handicaps. This aim was measured through study 1 and 3.

Study 3 aimed to develop previous research and study 1's findings further by investigating the differences in decision making processes between high and intermediate level golfers over six full holes of golf using the TA methodology. It was predicted that skilled golfers will focus more on pre-

shot planning, whereas less skilled golfers will be more focussed on the technical elements of playing the shot at hand. Furthermore, it was predicted more information would be provided by skilled golfers after the shot execution to evaluate the shot.

The final aim of this thesis was to develop decision making and golf research a step further and investigate decision making under competitive pressure situations. Study 4 compared decisions made under control (practice) conditions and competition conditions. It was predicted that under stress higher level golfers are more likely to use technical rules and refer to their step-by-step mechanics of their swing in comparison to normal practice conditions.

CHAPTER 4

STUDY1

USING TA PROTOCOL TO ASSESS DECISION MAKING IN GOLF

In the previous chapter it was proposed that the Think Aloud (TA) methodology (Ericsson & Simon, 1993) is a valid method for obtaining in event data around decision making and the decision making process of sport performers, especially during a self-paced task such as golf. Much of the research that has used the Think Aloud protocol methodology has opted for using TA at Level 2 (Calmeiro & Tenenbaum, 2011; McPherson, 2000; Germain & Tenenbaum, 2011). Level 2 verbalisation involves the verbal encoding and vocalization of an internal representation that is not originally in verbal code. For example, verbal encoding and vocalization of scents, visual stimuli, or movement. With this level of verbalisation, only the information that is in the individual's focus is to be verbalized. On the other hand Level 3 verbalisation requires the individual to explain their thoughts, ideas or hypotheses or their motives (Ericsson & Simon, 1993). For example explaining why a certain shot or club is selected in golf. Some researchers have argued that instructing participants to think aloud or consciously attend to the skill may interfere with thought processes and negatively impact on task performance (Klatzky, 1984). It is thought that with Level 2 verbalisation the sequence of thought processes involved in making a decision should remain intact as no additional information is required. As Level 3 verbalisation involves explaining one's thoughts it requires attention to additional information and may change the sequence of cognitive processes (Ericsson & Simon, 1993). However, Level 3 verbalisation could provide further information to gain a full understanding of the thought processes in decision making in some sports. For example in golf, players make numerous decisions about shot selection, and Level 2 verbalisation may not provide enough detail of the thought processes involved in this decision making process. Level 3 verbalisation provides a clearer explanation of the variables considered in shot selection.

A recent meta-analysis by Fox, Ericsson and Best (2011) compared performance on tasks that involved concurrent verbal reporting conditions with their matching silent control conditions. They

found that instructing participants to merely verbalize their thoughts during a task did not alter task performance, whereas directing participants to provide explanations for their thoughts actually improved performance. For example Gagne and Smith (1962) explained that asking participants to verbalize their reasoning when completing the Tower of Hanoi produced more efficient solutions (taking fewer moves), and suggested that the instruction to verbalize the reasons for moves induced more deliberate planning.

In the meta-analysis by Fox et al. (2011) the majority of tasks were cognitive in nature. To our knowledge no previous studies have systematically examined the influence of think aloud protocol on motor performance. If TA is to be used more widely to examine decision making in sports it is important to establish if TA interferes with motor performance (Calmeiro & Tenenbaum, 2011). In terms of motor skills it can be argued that the level of skill that the performer possesses influence how thinking aloud and explaining one's thoughts influences performance. Hence, for skilled performers, which are assumed to be in the automatic phase of skill learning, it is suggested that focussing attention on the skill itself might degrade performance (Schmidt, 1982; Masters et al., 1996). It has been proposed that performers in the automatic phase of skill learning will execute the skill in an open-loop fashion where there is little conscious control and processing required. Whereas a novice will be in the closed loop, feedback driven mode, and attention demanding processing (Schmidt & Wrisberg, 2000). In terms of thinking aloud during performance of a motor task high level performers may experience decrements in their performance due to interference with their open-loop mode of execution, whereas novice athletes may perform better as explaining thoughts may act as feedback for the task at hand.

A number of studies have examined the role of skill level differences in cognitions (McPherson, 2000; Calmeiro & Tenenbaum, 2011; McCaffrey & Orlick, 1989; Thomas and Over, 1994).

McPherson (2000) found that experts in tennis used more elaborate and sophisticated action plans whereas novices rarely planned. In addition experts were able to create superior current event profiles which involved making a form of script and building a picture of the event which they can then attend to and access to make decision throughout competition. In golf McCaffey and Orlick (1989) reported

skilled golfers to have a greater pre-game and pre-shot planning, rehearsal and visualization than less skilled golfers. In addition, further research by Thomas and Over (1994) found that skilled golfers demonstrated higher levels of concentration, automaticity and spent less time dwelling on past mistakes.

Further research from Calmeiro and Tenenbaum (2011) investigated differences in the cognitions of experienced and novice golfers when performing a putting task. They found experienced golf players spent more time than beginners assessing the conditions and planning a putt. In addition, experienced players verbalized more diagnostic-related thoughts after the putt and followed these thoughts with planning the next putt. In contrast low skilled golfers focussed more on the technical aspect of the putt. Although this study is one of the few studies to utilise think aloud methodology in sport and decision making the paper poses a number of limitations. For example, the ‘experienced’ participants in this study were three golfers ranging from a handicap of 0, 13 and 18, these handicaps are vastly different and present large differences in expertise. Furthermore, the participant who had a handicap of zero had played 800 hours of golf in the last year in comparison to the participant who although was in the same condition group played of a handicap off 18 and had only played 60 hours of golf in the last year. In addition, it is important to add that although the three participants in the novice group did not have a handicap, one participant had played 60 hours of golf in the last year, which is very similar to a performer in the ‘experienced group’. Calmeiro and Tenenbaum, (2011) should consider increasing their participant size and using participants of a similar handicap level, especially in their ‘experienced’ group.

The primary purpose of Study 1 was to investigate whether think aloud had any detrimental consequences on performance by comparing the outcome of performance of both skilled and novice golfers taking part in either Level 2, Level 3 or no verbalisation during the performance of a golf putting task. As there is literature that suggests Level 2 verbalisation does not have a negative effect on performance (Ericsson & Simon, 1993; Fox et al., 2011), but Level 3 verbalisation may affect performance it was predicted that a) participants in the Level 2 verbalisation condition would perform as well as participants in the control conditions and b) that skilled participants in the Level 3

verbalisation condition would perform worse than both the control and Level 2 verbalisation condition and novice participants would perform better in the Level 3 verbalisation condition than in both the control and Level 2 verbalisation condition.

Further the verbalisations will be analysed to identify any differences between the volume and content that is produced during Level 2 and Level 3 verbalisation and also to investigate any differences in the decisions that are made between high and low level golfers at each level of verbalisation. Based on previous literature (Calmeiro & Tenenbaum, 2011) it was predicted that higher skilled golfers will spend more time gathering information and planning the putt than lower skilled. Furthermore, lower skilled golfers will verbalize more about technical aspects of their putting than higher skilled golfers.

METHOD

Participants

Participants in the skilled group were thirty male English golfers (age: $M = 16.9$ years, $sd = .82$; handicap: $M = 5.3$, $sd = 1.51$) who attended a further education college in the North of England. Each of these golfers played a minimum of once per week and had been playing for an average of 8.5 years.

Participants in the novice group were 18 males and 12 females (age: $M = 21.8$ years, $sd = 1.42$) who were all university students. All participants reported that they did not play golf on a regular basis and none had played golf in the month prior to testing. Participants had no prior experience of the experimental process.

Ethical approval was granted from the University ethics committee and written informed consent was provided by all participants.

Apparatus

Novice golfers all used the same right-handed putter, whereas skilled golfers used their own putters. The putting surface was an AstroTurf artificial indoor putting green. The putting hole was a standard

size with a diameter of 0.108 m. Thirty of the same brand golf balls were used throughout the testing. A digital voice recorder was used with a small microphone which attached to the participant's collar, and a wire placed inside the shirt connecting to the recording device which was put in the trouser pocket.

Procedures

Participants were recruited via a signup sheet that was on the student union notice board. Prior to conducting the study procedure all participants were asked to putt 10 balls from a 2.50 m distance. This pre-test acted to match the participants in the different conditions on ability; by placing an equal ability range of participants into the three conditions (Level 2 verbalisation, Level 3 verbalisation, no verbalisation control) based on the result out of 10 putts. Once allocated to a condition the participants were then asked to perform a further 30 putts from a distance of 3 meters on the flat indoor putting green. Instructions for the two think aloud protocols were adapted to golf putting based upon the guidelines set out by Ericsson and Simon (1993) and Nicholls and Polman (2008). Participants in the Level 2 verbalisation group were instructed to say out loud what they were thinking at all times before and after the execution of the putt. Participants in the Level 3 condition were given the same instructions, however, these participants were also asked to describe and explain their thoughts and provide an explanation for their actions. The participants in both conditions were instructed to do this throughout the 30 putts apart from when they were executing the putt. Participants were asked to verbalise on every thought prior to and after the putt if possible. The PhD candidate was stood approximately five meters away from the participant; this was thought to be far enough away not to disturb the participant but close enough to hear if they were verbalising. If the PhD candidate thought that the participant had been silent for 10 seconds instructions were then given to the participant to "please keep thinking aloud". Participants were wired up to the digital voice recorder, with a small microphone attached to their collar, and a wire placed inside the shirt connecting to the recording device. The small microphone recorded the verbalisation of thoughts of the participants and was used to ascertain that each participant used the correct level of verbalisation. The third group consisted of a control group. They were asked to perform 30 putts from the same distance as the other two groups

but without any think aloud instructions. All participants' scores were recorded, and scores were based on how many putts holed out of 30 putts with only putts that were fully holed counted as successful.

Before the start of the trial, all participants took part in a series of think aloud exercises to ensure that they could engage in the think aloud protocol adequately at the level that they were assigned to (Ericsson & Simon, 1993). Both the Level 2 and Level 3 verbalisation groups completed three different tasks: 1) counting the number of dots on a page, 2) an arithmetic exercise and 3) an anagram problem-solving task. Participants in the Level 2 condition were asked to complete the tasks aloud without explaining how they did them and the participants in the Level 3 verbalisation condition were asked to think aloud when completing the exercises but explain how they completed the exercise. Participants took part in these exercises until they had grasped the TA process; which took no longer than 30 minutes. Participants were then given a short comfort break before taking part in the formal part of the study. This exercise took part in meeting room in a close proximity to the putting green.

The participants in both the Level 2 and Level 3 verbalisation groups were then asked to think aloud as instructed while they performed the 30 putts. Recording continued until the golfers had completed all 30 putts.

Data analysis

Performance outcome

A 2 (skill) x 3 (condition) analysis of variance was conducted to explore if there were differences in pre-test putting performance (number of putts holed) between the three groups. To analyse performance on the main putting task the number of putts holed out of 30 was calculated for each participant and a 2 (skill) x 3 (condition) analysis of variance was conducted.

Data analysis of content

Each participant's verbal reports from the Level 2 and Level 3 verbalisation conditions were transcribed verbatim. Following checks for relevance and consistency each transcript was subjected to

a line by line content analysis (Maykut & Morehouse, 1994) by the PhD candidate to identify statements which related to the decision making process of each shot played. Individual elements of ‘meaningful information’ were considered and coded. Similar to Nicholls and Polman (2008) the verbalizations by the participants that were coded were relevant to the task, which in this case meant verbalizations associated with golf performance. Data which were not relevant to the task, such as verbalizations about what they has for tea last night, a loved one, and their favourite football team, were removed from the data set. Units of information were coded according to categories derived from a modified version of Calmeiro and Tenenbaum’s (2011) coding scheme (see Table 1). There was little conflict between the assignments of categories, therefore no conflict rules for deciding between categories were required. The PhD supervisor independently and blindly analysed a 10% sample of the raw data. The codes identified by the PhD supervisor were compared to codes identified to the PhD candidate and a percentage of similarity was calculated. The level of agreement between the PhD candidate and PhD supervisor was 89%. Discrepancies between supervisor and student were identified. Each discrepancy was discussed by both, with the PhD candidate justifying their choice of category. In all cases both PhD supervisor and candidate were able to agree on the category assigned after discussion. In all cases the original theme identified by the student was used.

Following transcription of the data a 2 (skill) x 2 (condition) ANOVA was conducted to explore the difference in the amount of data (words) produced during Level 2 and Level 3 verbalisation and the two ability levels. Based on an adaptation of Calmeiro and Tenenbaum (2011) coding scheme the units of information that were coded were analysed using a 2 (skill) x 2 (condition) MANOVA to investigate the difference in the total frequency of themes that were verbalized during Level 2 and Level 3 verbalisation for both high and low skilled golfers. Significant multivariate effects were followed up with univariate ANOVA and independent t-tests with Bonferroni correction.

A MANOVA was used as we have two or more dependant variables with one or more independent variable (Dancey & Reidy, 2004; Pallant, 2007). Furthermore, a MANOVA was chosen over an ANOVA in order to control for an inflated type 1 error (Pallant, 2007; Huberty & Morris, 1989), in that the more analyses that are run, the more likely it is to find a significant result. It is thought that

MANOVA controls or adjusts for the increased risk of type 1 error. However, it must be noted that Huberty and Morris (1989) do challenge this notion in their paper. An alternative to conducting a MANOVA is to conduct multiple ANOVA's. Huberty & Morris (1989) argue that from a statistical point of view, conducting a MANOVA should not be used as a preliminary step to multiple ANOVAS and also argue using a MONOVA to control for type 1 error is a myth. They do, however, acknowledge that a MANOVA followed by multiple ANOVA's is a popular analysis route to take in the behaviour sciences, hence why this method was chosen for this study.

Table 4.1. Coding scheme framework adapted from Calmeiro and Tenenbaum (2011)

Theme	Description	Example of raw data quote
Gathering Information	reflected participants' search for relevant characteristics of the environment	"there's a break left," "there's a ridge on the middle of the green"
Planning	Reference to planning a shot, for example targets to aim for, power of putt.	"need to aim more right," "I need to be a bit more firm"
Technical Instruction	Specified technical aspects of the performance	"arms bent," "feet are parallel"
Reflection	Reflected on what had happened in terms of process or evaluation of the putt	"just missed left," "it broke at the end," "yes, good putt"
Self-encouragement	Refers to any positive words relating to self-encouragement.	"you can do this", "concentrate on this"

RESULTS

Performance

The first 2 (skill) x 3 (condition) ANOVA examined pre- test performance (number of successful puts out of 10 attempts). As expected there was a significant main effect for skill ($F(1,54) = 10.73$, $p = .002$, $\eta_p^2 = .17$) with skilled players ($M = 4.83$, $sd = 2.23$) outperforming novice players ($M = 3.03$, $s = 1.87$), however, there was no significant main effect for condition ($F(2,54) = .05$, $p = .95$, $\eta_p^2 = .002$) or interaction between skill and condition ($F(2,54) = .01$, $p = .98$, $\eta_p^2 < .001$). This finding implies that pre-test performance across conditions was equivalent.

The second 2 (skill) x 3 (condition) ANOVA analysed test performance (number of successful putts out of 30 attempts). For descriptive statistics see table 2. A significant main effect was found for skill ($F(1,54) = 20.76$, $p < .001$, $\eta_p^2 = .28$). Skilled golfers performed better ($M = 10.97$, $sd = 4.82$) than novice golfers ($M = 5.87$, $s = 3.96$). No significant main effect was found for condition ($F(2,54) = 2.79$, $p = .07$, $\eta_p^2 = .09$), however, the p value approached the significance level. From the means it can be seen that both the Level 2 verbalisation s group ($M = 9.45$, $s = 5.24$) and the Level 3 Verbalisation group ($M = 9.25$, $s = 5.22$) were more successful than the control group ($M = 6.55$, $s = 4.45$). There was no significant interaction between skill and condition ($F(2,54) = .28$, $p = .75$, $\eta_p^2 = .01$).

Table 4.2. Mean and (standard deviation) test performance (successful putts out of 30) as a function of skill and condition.

Skill	Control	Level 2	Level 3
Skilled	9.40 (3.24)	12.30 (4.97)	11.20 (5.92)
Novice	3.70 (3.65)	6.60 (3.89)	7.30 (3.74)
Total	6.55 (4.45)	9.45 (5.24)	9.25 (5.22)

Verbalisation of content

Table 4.3 presents descriptive statistics for the volume of verbal data provided (number of words) during test performance for the skilled and novice golfers in the Level 2 and Level 3 verbalisation conditions. A 2 (skill) by 2 (condition) ANOVA showed a significant condition main effect ($F(1,36) = 66.31, p < .001, \eta_p^2 = .64$). Level 3 verbal protocol resulted in significantly more words verbalized ($M = 385, s = 110$) compared to Level 2 verbal protocol ($M = 141, sd = 69$). There was no significant main effect for skill ($F(1,36) = .01, p = .89, \eta_p^2 < .001$) nor was there a significant interaction ($F(1,36) = .03; p = .85, \eta_p^2 = .001$).

Table 4.3. Mean and (standard deviation) volume of verbal data provided (number of words) during test performance as a function of skill and condition.

Skill	Level 2	Level 3
Skilled	136.70 (73.99)	385.30 (122.58)
Novice	145.90 (67.05)	383.80 (103.42)
Total	141.30 (68.88)	384.55 (110.38)

Once verbal data was thematically analysed (see table 4.1), the frequency of verbalisation of each theme was compared with a 2 (skill) x 2 (condition) MANOVA. Table 4.4 shows descriptive statistics for the frequency of verbalisation of each data theme for the skilled and novice golfers in the Level 2 and Level 3 verbalisation conditions.

Table 4.4. Mean and (standard deviation) frequency of verbalisation of each data theme during test performance as a function of skill and condition.

Measure	Level 2		Level 3	
	Skilled	Novice	Skilled	Novice
Gathering information	1.00 (1.33)	0.00 (0.00)	3.00 (2.00)	0.70 (1.64)
Self-Encouragement	2.30 (2.36)	4.40 (3.81)	3.10 (3.03)	2.40 (1.86)
Planning	10.30 (7.46)	7.00 (4.00)	15.30 (3.43)	11.00 (6.56)
Reflection	10.20 (3.73)	15.40 (7.47)	16.10 (6.34)	16.80 (5.12)
Technical instruction	4.40 (4.79)	1.60 (1.89)	2.80 (2.89)	8.90 (3.14)

There was a significant multivariate interaction between skill and condition (Wilks' $\lambda = .46$, $F(5, 32) = 5.15$, $p = .001$, $\eta_p^2 = .46$), with univariate ANOVA's indicating an interaction only for the theme Technical Instruction ($F(1, 36) = 17.68$, $p < .001$, $\eta_p^2 = .33$). Independent t-tests with Bonferroni correction indicated novice golfers verbalized more about technical instruction than skilled golfers in the level 3 condition ($t(18) = 4.51$, $p < .001$), but not in the level 2 condition ($t(18) = 1.72$, $p = .10$).

There was also a significant multivariate effect for skill (Wilks' $\lambda = .65$, $F(5, 32) = 3.41$, $p = .014$, $\eta_p^2 = .35$) with skilled golfers verbalising more frequently than novice golfers about gathering information ($F(1, 36) = 12.24$, $p = .001$, $\eta_p^2 = .25$) and planning shots ($F(1, 36) = 4.56$, $p = .04$, $\eta_p^2 = .11$).

Finally, there was a significant multivariate effect for condition (Wilks' $\lambda = .40$, $F(5, 32) = 9.56$, $p < .001$, $\eta_p^2 = .60$), with more verbalisation in the Level 3 than Level 2 condition about gathering information ($F(1.36) = 8.19$, $p = .007$, $\eta_p^2 = .19$), planning shots ($F(1.36) = 6.39$, $p = .016$, $\eta_p^2 = .15$), and technical instruction ($F(1.36) = 2.43$, $p = .011$, $\eta_p^2 = .17$).

DISCUSSION

The primary purpose of Study 1 was to investigate the effects of different levels of verbalisation on motor performance (putting) and decision making in a sample of skilled and novice golfers. As expected, the skilled golfers holed more putts. However, contrary to predictions the use of verbalisation at either Level 2 or Level 3 did not influence performance across skill level. This indicates that Level 3 TA verbalisation, requiring explanations of a performer's thought processes, is not associated with decreases in motor performance in comparison to Level 2 TA verbalisation or no-verbalisation irrespective of the skill level of the performer. Analysis of the content of the data revealed that Level 3 verbalisation produced a larger amount of verbal data than Level 2 independent of skill level. In addition the secondary purpose of Study 1 was to identify any differences in the decisions that are made between high and low level golfers at each level of verbalisation. Findings revealed differences were apparent in the factors influencing decision making between the skilled and novice participants.

Recent research (Calmeiro & Tenenbaum, 2011) has expressed a need to determine whether verbalizing during motor performance (putting) interferes with task outcome. The results of the present study suggest that regardless of verbalisation or skill level task outcome is not affected. These findings were contrary to predictions. Hence, it was expected that relatively novice performers would benefit from thinking aloud at Level 3 whereas skilled performance would show a decrement in performance. The latter prediction was based on the notion that skilled performance is said to be controlled in an open loop fashion and use of explicit knowledge would interfere with performance

(e.g., Masters, Polman, & Hammond, 1996). For novice performers on the other hand, performance is more likely characterized as closed loop and feedback driven, requiring attention demanding processing. Hence, hypothesis testing is an important aspect of skill acquisition during the early stage of the learning process. It is possible that the skilled performers in the present study were not as expert as anticipated. Although their golfing handicap indicated a high level of ability the number of putts holed (36.67% across the 3 conditions) would indicate scope for improvement. Current statistics from the USA PGA Tour show that the best performer achieves an average success rate of 64.7% for putts from 9 feet (K J Choi; on 1st September 2013) whereas the worst performer had a success rate of 19% (N Colsearts) and the average success rate was 48.82% (PGATour, 2013).

In addition, we did not require participants to verbalize thoughts during the actual striking of the ball. As such the verbalisation might not have interfered with the automatic execution of the putting action. Overall, the results suggest that verbalisation at Level 3 can be a viable technique to obtain information on decision making in golf, without harming performance.

An important additional aim of the present study was to examine the content of the verbalisation at the different levels. The differences in volume and content across Level 2 and Level 3 TA in the present study provides evidence for the distinction between the two methodologies as well as the validity of TA to gather information on decision making during the execution of a discrete complex motor skill. Hence, across both levels significantly more information was provided during Level 3 TA than during Level 2 TA. In addition, qualitatively different information was provided by both the low and skilled performers during the Level 2 and 3 TA. The findings showed that skilled golfers used qualitatively different decision making rules compared to novice performers (Calmeiro & Tenenbaum, 2011). High skilled golfers verbalize more about gathering information and planning before they take their putt. Similar results were reported by Calmeiro and Tenenbaum (2011), in that high level golfers in their study also reported greater use of gathering information and planning. Similarly, McPherson and Kernodle (2003) found that professional tennis players accessed more extensive and well-developed condition concepts during competition than novices.

Interestingly Calmeiro and Tenenbaum (2011) also found that lower skilled golfers focused on technical aspects of the putt. Given the opportunity to provide additional information, novice participants in the Level 3 verbalisation groups were able to provide extra information around what technical aspects they deemed as appropriate to execute their putt. However, due to the novice participants in the Level 3 conditions being able to verbalize information that is not directly needed during the performance of a task it might be that this information is not a product of any cognitive processing mediating performance (Ericsson & Simon, 1980). In fact this information could occur by accessing implicit causal theories (Eccles, 2012). Experts, in this respect, have been shown to suffer from 'expert-induced amnesia'. That is they are less able to pay attention to automated procedural knowledge (the way they execute the skill) because these processes are assumed to take place without attentional demands (Beilock & Carr, 2004). However, Beilock and Carr (2004) have identified that athletes need to be aware of this kind of decision making information to learn and improve from past performances, by asking participants to verbalize their thoughts during performance it is enabling them to consciously learn and potentially develop and improve.

A further explanation for the low skilled group results could be that verbal protocols measure what is conscious and easy to verbalize, therefore when engaging in a putting task which would be deemed as a difficult task to a novice, verbalisation s about technical aspects of a putt may be the most conscious and easiest thing that can be verbalized at this level of ability (Ericsson & Simon, 1993).

Notwithstanding this, novice performers appear to use different information to make decisions than expert performers.

Participants in the Level 3 verbalisation group verbalized more about gathering information before they played the shot, planning their shot, and technical instruction than those in the Level 2 verbalisation group. These findings demonstrate that Level 3 verbalisation produce more information about the decision making prior to the putt being taken. Gagne and Smith (1962) found that when asking participants to verbalize a reason for each move during the Tower of Hanoi puzzle resulted in more deliberate planning, this is evident here as participants who were asked to verbalize in the level 3 condition presented more planning related themes.

Furthermore, Rose and Parfitt (2010) used TA reports at Level 3 by asking participants to elaborate on their verbalisation's, which means that participants are verbalizing more detail than is contained in their recalled thoughts. The authors argued that the procedure of asking for further information was necessary to gain a full understanding of cognitive factors and an insight into the decision making processes. Therefore asking participants to provide explanations (TA Level 3) could be a useful tool for investigating the decision making process.

It is important to note that this study has progressed previous research (Calmeiro & Tenenbaum, 2011) further by having a much larger sample size and having significantly higher skilled performers in the 'experienced' group. Calmeiro and Tenenbaum's (2011) 'experienced' group consisted of 3 participants with a mean handicap of 10.3, whereas the current study had 30 participants in the experienced group with a mean handicap of 5.1. Furthermore, some of the novices in Calmeiro and Tenenbaum's (2011) paper had played up to 60 hours of golf in the year previous to participating in the study, however, the 30 novices in the current study did not play golf on a regular basis and none had played golf in the month prior to testing. Although the process of collecting this type of data may be time consuming, larger sample sizes are important in order to reduce sampling bias and improve the validity of the research (Coolican, 2004).

This study provides support for the use of Think aloud at both Level 2 and Level 3 as a method of obtaining information around the thought process of performers in order to gain a greater understanding into how high and low skilled golfers create and process information in order to make decisions. Decision making is not always a conscious process and an important limitation of the present study is that it cannot assess what happens to the decision making process outside of awareness (Bowers, Regehr, Balthazard, Parker, 1990; Jacoby, Lindsay, & Toth, 1992; Wegner, 1994). A further limitation is the use of an artificial putting green. Future studies could use TA to explore the conscious decision making of golfers putting on an outdoor grass surface and when playing a round of golf on a real course. In these situations golfers have more variables to consider when deciding what shot to play and what club to use. TA could provide rich information on the decision making processes of golfers of differing levels of skill and experience in such situations.

From an applied perspective it could be argued that the development of expertise in golf requires not only the development of the motor skill but also thought processes. Skilled golfers spend more time gathering information and planning their shots than novices. Therefore, a golfer in the early stages of learning may be aided in their development by coaching and tuition about variables that should be considered when planning a shot. Further research using TA protocol would be necessary to gain a clearer understanding of what are the most important variables that a golfer should consider when planning a shot, this information could then be incorporated into coaching practices.

In conclusion, Level 3 verbalisation has been criticised for changing the sequence of thoughts and providing a posteriori interpretations and generalisations (Fox, Ericsson & Best, 2011). This study has provided evidence that it does not negatively influence motor performance outcome during golf and that there are clear differences in the types of verbalisation s made between Level 2 and Level 3 verbalisation s and between skilled and novice golfers. The findings of the present study support TA verbalisation as a valid method for data collection when measuring behaviour or thought process's during a self-paced event such as golf putting. Further research is needed to validate the use of think aloud methodology in comparison to other popular data collection methods such as retrospective recall via interviews.

CHAPTER 5

STUDY 2

COMPARISON BETWEEN THINK ALOUD PROTOCOL AND RETROSPECTIVE RECALL IN ASSESSING DECISION MAKING IN GOLF.

Study1 found that Level 3 Think Aloud verbalisation or asking participants to explain their verbalisation s during golf performance (why they are performing a certain type of shot) not only provides more qualitative information about the golfers thought process but it was also found to have no detrimental effects on the actual performance, therefore it could be a valuable tool for investigating decision making in self-paced sports such as golf. The study of decision making and the underlying cognitive processes in sport is rapidly growing and therefore it is important that the most appropriate methodologies are used to investigate this area. There are a limited number of studies that have employed the Think Aloud method to investigate decision making in sport (McPherson & Kenodle, 2007; Calmerio & Tenenbaum, 2011; Germain & Tenenbaum, 2011) as most previous research has chosen other means such as retrospective interviews. For example, Macquet (2009) studied expert volleyball players and their decision making process using self-confrontational interviews, which were conducted between the 2nd and 5th day following a volleyball match. It was concluded that players used their experience to carry out an action. In addition, Mulligan, McCracken and Hodges (2012) used retrospective interviews, prompted by video recordings, to investigate the decision quality in ice-hockey. They found that experts described decision-making situations as ‘familiar’ twice as often as non-experts.

Both types of data collection methods have their limitations. For example issues associated with retrospective methods are memory decay (Ericsson & Simon, 1980; Nicholls & Polman, 2008), bias (Bahrck, Hall & Berger, 1996) as well as participant motivation to provide accurate reports (Bahrck, Hall, Goggin, Bahrck, & Berger, 1994). Tenenbaum et al. (2002) also highlighted concerns of whether retrospective reports signify the athlete’s schematic knowledge of how they generally think

before and after a competition. Retrospective measures might be tapping 'a general schema' or overlearned set of rules rather than the particular rules used during an event. Eccles (2012) argues that during retrospective reports participants might be aware of general strategies and recall and report strategies directly and without preference to specific behaviour they produced. Such reporting would be encouraged when researchers ask participants to recall general states. Think Aloud verbalisation at Level 3 on the other hand has been criticised for changing the sequence of thoughts and providing a posteriori interpretations and generalisations (Fox, Ericsson & Best, 2011). It provides opportunities to add information which might not have been used directly during performance and as such is not a product of the cognitive processes mediating performance. However, based on the problems associated with retrospective accounts Level 3 verbalisation is currently probably the least biased way to gather relatively accurate decision making data during actual performance in comparison to other delayed retrospective methods. This is particularly the case when the participant provides information prior to the execution of the skill to be performed as would be the case in golf. Hence, in such a situation the information provided is not confounded by the result of the action.

As a result of the above limitations it is important to examine the congruence between different research methodologies. Verbal protocols have recently been shown a useful tool to examine stress and coping in sport (Nicholls & Polman, 2008; Kaiseler, Polman, & Nicholls, 2012), tactical decisions in tennis (McPherson, 1994, 1999a, 1999b, 2000), verbal problem representations in volleyball (McPherson & Vickers, 2004) and verbalisation of thoughts during golf putting (Calmeiro & Tenenbaum, 2011). In addition, verbal protocols can be used during actual sporting performance enhancing ecological validity of the data. Retrospective recall, on the other hand, provides easier ways to collect data in particular in the domain of sport. The aim of Study 2 therefore was to examine the congruence between cued retrospective recall in relation to Level 3 TA verbalisation. This was accomplished by comparing the similarity of data provided by golfers during TA verbalisation in comparison to retrospective recall delayed (10 minutes) after performance, 24 hours after performance and 48 hours after performance of six holes of golf. Potential differences between TA verbalisation and retrospective recall were examined in the content of the information (similarity of themes)

provided as well as the amount of information (number of themes). It was predicted that with increasing time there will be less correspondence between TA and retrospective recall. More specifically, as the time delay increases there will be a greater discrepancy in the content of information that is presented during TA and retrospective recall. No prediction was made with regard to the amount of information provided.

METHOD

Participants

Participants were 6 male, skilled golfers (M age 30.5 years, M handicap 5.5), and all members of the same golf club. Participants had no prior experience of the experimental process. The primary research institution provided ethical approval and written consent was provided prior to participation in the study.

Apparatus

Each golfer played with their own golf clubs on the same six holes of the same golf course. Participant's verbalisations were recorded using a Sennheiser USA ENG G3 wireless digital voice recorder. The recording device was placed in the pocket of the participant, with a wire running inside the shirt connecting to a microphone attached to the collar. A score card was used to mark the number of shots taken on each hole.

Procedure

Before the performance of the six holes of golf commenced, participants were briefed on how to conduct Level 3 verbalisation of their thoughts (Simon & Ericsson, 1993). Participants took part in a series of TA exercises which included 1) counting the number of dots on a page, 2) an arithmetic exercise and 3) an anagram problem-solving task, and asked to TA when completing the exercises and also explain how they completed the exercise.

Each of the golfers played six holes of golf accompanied by the researcher. During this, participants were asked to describe their thoughts before and after the execution of each golf shot and provide an explanation for their actions. The participants were instructed to talk continuously throughout the six holes apart from when they were executing their shot. The PhD candidate was stood approximately five meters away from the participant; this was thought to be far enough away not to disturb the participant but close enough to hear if they were verbalising. If the PhD candidate thought that the participant had been silent for 20 seconds instructions were then given to the participant to “please keep thinking aloud”. Scores were recorded on a pencil and paper score sheet. The time between study 1 and 2 has changed from 10 to 20 seconds given that participants are now playing a whole round of golf rather than putting; more variables are being considered and as a result it may take more time to formulate a thought and verbalise that thought. The thoughts were recorded until the golfers had completed all six holes. Each golfer played on the same golf course with their own golf clubs. The PhD candidate followed the participant round the golf course making sure to keep around a five meter distance at all times, in order to reduce any effects on the golfers decisions making.

Following the completion of the six holes each participant was then asked to take part in three semi-structured interviews. The first being immediately after performance, the second 24 hours after performance and the third 48 hours after performance. Each interview involved asking semi-structured questions about the decision making that occurred during 2 separate holes for each interview. The two holes chosen at each interview were picked at random for each participant. An example of some key questions asked were “What club did you use?”, “What kind of shot did you play and why?”, “Where there any environmental factors that you had to consider when playing your shot?” Each interview was conducted at the same time of day and took approximately 20 minutes to complete.

Data Analysis

Each participant’s verbal reports from TA and interviews were transcribed verbatim. Following checks for relevance and consistency each transcript was subjected to a line by line content analysis

(Maykut & Morehouse, 1994) by the PhD candidate to identify statements which related to the decision making process of each shot played. Individual elements of ‘meaningful information’ were considered and coded. Similar to Nicholls and Polman (2008) the verbalizations by the participants that were coded were relevant to the task, which in this case meant verbalizations associated with golf performance. Data which were not relevant to the task, such as verbalizations about what they had for tea last night, a loved one, and their favourite football team, were removed from the data set. Units of information were coded according to categories derived from a modified version of Nicholls and Polman’s (2008) coding scheme (see Table 1). This coding scheme was used as this is the only previous study to utilise think aloud during a full round of golf. In addition, it provided a wide range of themes that may emerge during golf performance and the many variables which may be considered when playing golf. Thirty-four first-order themes were initially identified and then related themes were grouped into 11 second-order themes. There was little conflict between the assignments of categories, therefore no conflict rules for deciding between categories were required. The PhD supervisor independently and blindly analysed a 10% sample of the raw data. The codes identified by the PhD supervisor were compared to codes identified by the PhD candidate and a percentage of similarity was calculated. The level of agreement between the PhD candidate and PhD supervisor was 71%. Discrepancies between supervisor and student were identified. Each discrepancy was discussed by both, with the PhD candidate justifying their choice of category. In all cases both PhD supervisor and candidate were able to agree on the category assigned after discussion. In all cases the original theme identified by the student was used.

Table 5.1: First and second order themes identified from think aloud and interview data.

Second order theme	First order theme	Description	Example of 'Raw' Data Quote
Course conditions	Quality of greens	Mention of grass length, or obstacles on the green which could affect the run of the ball	"The green has been sanded so it's bobbly"
	Course hazards	Anything stopping the player's view the green or anything which could disturb play	"Can't see the hole because of the huge mound in front of me"
	Rough	Being in the rough	"I finished on the left side of the rough"
Course management	Lie of ball	When the golfer refers to the lie of the ball	"the lie is not the best"
	Playing bunker shot	Being in the bunker	"It's in the bunker that's horrendous"
	Club selection	Any reference to which club has been selected	"I'm using a driver because..."
	Pin position	Where the pin is located on the green	"It's a blue flag which indicates the pin is at the back portion of the green"
	Movement of Green	How the ball will move on the green	"It's going to move left to right"
	Distance to pin	How far the shot being played is from the pin	"this is a 350 yard drive to the green"
	Tee position	Where the tee is positioned on the green	"the tee is toward the back of the green"
Distractions	Having to wait at tees	Waiting to play a shot due to either slow play or green keepers	"I could do with that old fella hurrying up"
	Researcher	Referring to the researcher	"I feel an idiot doing this in front of you"

	Dirt on the ball	Having any form of mud or dirt on the ball	“the ball was dirty”
	Temperature	Any reference to how hot or cold the player is	“I’m really hot under this hat”
Environment	Wind	Wind is considered in relation to shot decision.	“the wind is moving left to right and slightly into so I am going to use....”
	Tree	A tree obstructing the intended line of next shot or is taken into consideration of next shot.	“the trees are reachable from this tee”
	Rain	Any reference to rain	“it’s starting to rain but it’s not too bad”
Mistakes	Shot error	Any reference to a shot error after shot has been taken. Either physical (swing fault) or mental (club selection)	“I’ve hit that too hard”, “I’ve fluffed that” “I should of used a ... iron”
Performance	Result of shot	Describing how the shot has finished	“that’s finished up on the fairway”
	Happy with the shot	Positive statements about the shot just played	“that’s exactly how I wanted to hit it”
	Negative words	Using any kind of negative words or cursing before or after a shot has been taken	“I am a rubbish golfer”
	Short putts	Putts from within 5 feet	“it was about 3 foot and I just stroked it in for a par”
Score	Score	Any reference to score for the hole or round	“I needed to putt this for a birdie”
	Number of putts	Concerns about the number of putts played during the hole or round.	“I’m going to try and 2 putt par”
Safety	Play Safe	Choosing to play a safer or less cautious shot.	“I need to play a safe shot here”

	Risk	Playing a shot with a more high risk element.	“there’s a bit of risk in this shot but if it pays off it will be worth it”
Pre-Performance	Practice swing	Taking a practice swing before hitting the shot	“a couple of practice strokes looking at the hole”
	Cleaning the ball	Cleaning the ball before the next shot	“I will just clean the ball up”
	Pre-performance words	Words said before shots are played	“OK ready”
	Targets to aim for	Objects or parts of the course that are used as targets for shots.	“I’ve picked the church steeple in the background to aim for”
	Overall aim of shot	Specifying exactly what is intended in the shot	“I want this to bend round the tree and then I can chip it onto the green”
Reflection	‘Last time I played this shot’	Any reference to what they did previously (last shot or last week) when playing a similar shot	“Like the last putt, I don’t have to worry about the pace too much”
	‘Last time I played this hole’	Any reference to what they did previously when playing the same hole.	“Last time I played this hole, I hit it onto the road”
Feelings/Emotions	Anxious	When a golfer refers to being nervous or anxious	“I’m always a bit anxious on the first shot of the first hole.
	Confidence	Stating that the performer is feeling confident about a shot or hole	“I know I can hit this shot well”

Number of themes

The number of first-order themes each participant identified as influencing their decision making on each hole was calculated for the TA and interview data. Paired samples t-tests were conducted to identify any differences between the number of themes identified via TA and interview at each interview time point.

Similarity of themes

Percentage similarity of first-order themes identified on each shot during TA and interview was calculated at each interview time point. A one-way repeated measures ANOVA was then conducted to determine any significant differences in the percentage similarity between TA and interview across the three interview time points.

To establish how the data collected at TA and interview differed; the most frequently cited second-order themes using each method of data collection were identified. Mean differences in frequency of citation of each theme between TA and interview were calculated for each interview time point. One-sample t-tests were then conducted to establish on which second-order themes TA and interview differed at each time point.

RESULTS

Table 5.1 displays the themes identified by the golfers during TA and interview that influenced their decision making during six holes of golf. Variables identified are organised into first-order and second-order themes, with descriptions (inclusion rules) and examples of raw data provided.

Number of themes

Table 5.2 displays the mean number of first-order themes that golfers identified as influencing their decision making during two holes of golf, with a comparison made between data collected using TA and interview at the three interview time points (interview immediately after performance, 24 hours after performance, and 48 hours after performance). Related t-tests indicated that quantitatively the mean number of first-order themes identified during TA did not differ from the number identified during the interview immediately after performance or 24 hours after performance ($p > .05$). However, significantly more themes were identified via TA than at interview 48 hours after performance ($t(5) = 3.44$; $p < .05$, $\eta^2 = .70$).

Table 5.2: Number of first order themes identified during think aloud of two holes (during performance) and interview at the three time conditions; ten minutes, 24 hours and 48 hours after performance.

Think Aloud over two holes		Vs.	Interview	
M	SD	Time of Interview	M	SD
37.50	8.73	10 minutes	35.33	16.51
41.00	8.27	24 hours	36.00	11.61
51.21	16.31	48 hours	37.21	9.45

Note* - each think aloud score is the mean number of themes that emerged at two different holes from the six that were played. Therefore, the table presented is a comparison of the mean number of themes that emerged during the performance of two holes where participants were thinking aloud and what they reported during interview about those two holes.

Similarity of themes

Table 5.3 shows the percentage similarity between TA and interview for the first-order themes identified by golfers as variables influencing decision making on each shot played. Percentage similarity at each time point was relatively low (ranging between 38 and 41%). One-way repeated measures ANOVA indicated no significant difference in percentage similarity across the three time points ($F(2, 4) = .17$; $p < .05$, $\eta^2 = .08$).

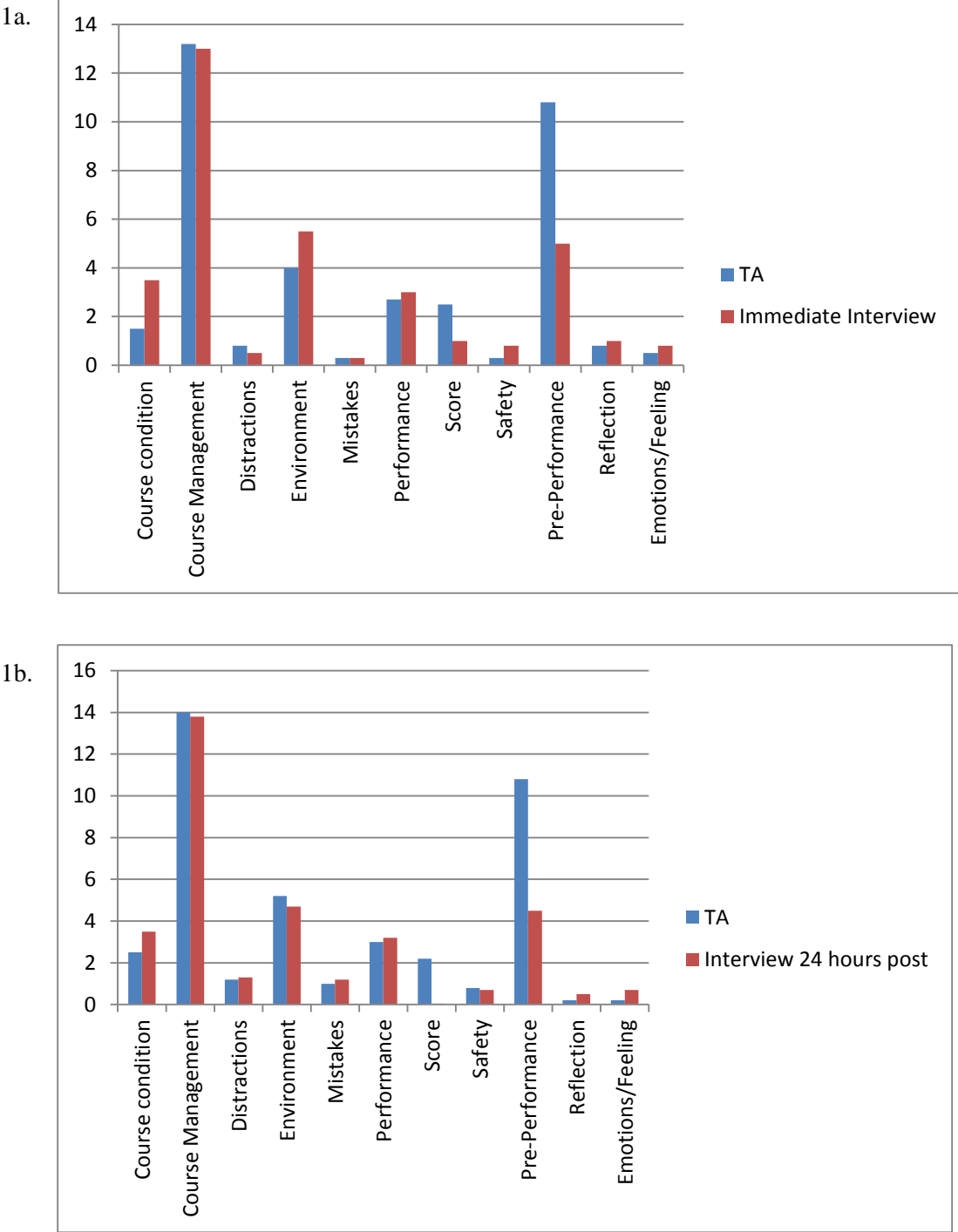
Table 5.3: Percentage similarity in themes identified during think aloud and at interview.

Comparison	Percentage of Similarity	
	M	SD
Think Aloud vs. ten minute Interview	40.66	8.73
Think Aloud vs. 24 Hour Interview	37.83	14.83
Think Aloud vs. 48 Hour Interview	40.16	12.04

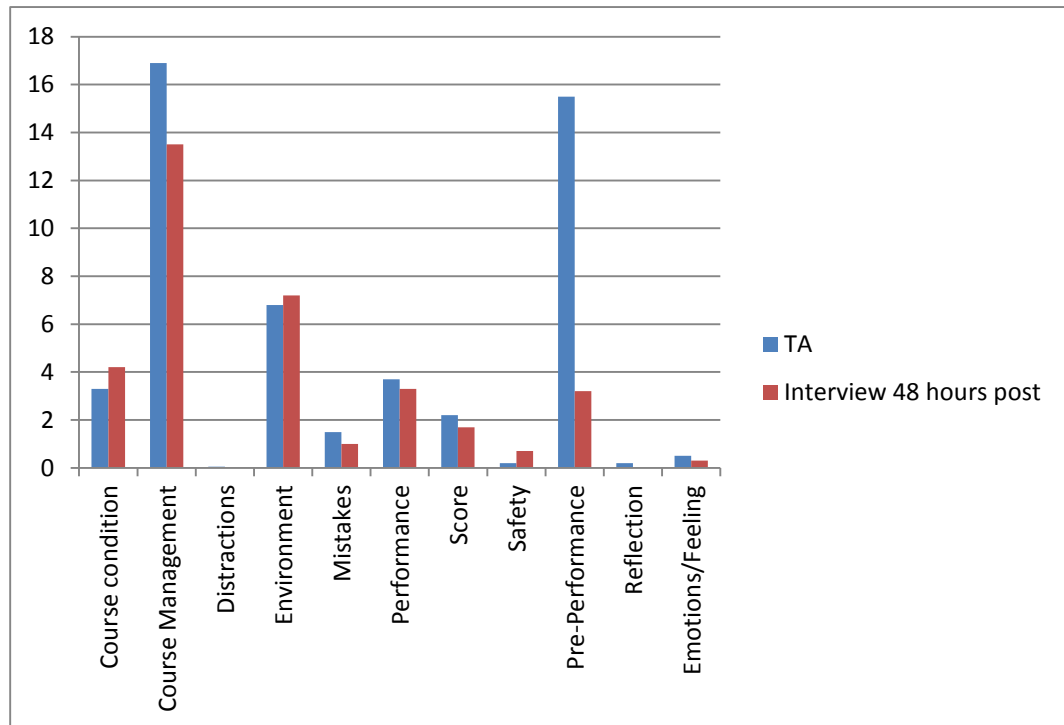
Figure 5.1 shows the mean difference between TA and interview in the number of times each second-order theme was identified as a variable influencing a decision, with comparisons displayed for immediate interview vs. TA (1a), 24 hours post performance interview vs. TA (1b), and 48 hours post performance interview vs. TA (1c). One sample t-tests indicated that pre-performance activity was more frequently cited as a variable that influenced decisions when data was collected via TA than at immediate interview ($t(5) = 3.06$; $p < .05$, $\eta^2 = .65$), 24 hours post performance interview ($t(5) = 3.06$; $p < .05$, $\eta^2 = .65$), and 48 hours post performance interview ($t(5) = 5.83$; $p < .05$, $\eta^2 = .90$). Course management was also cited more frequently during TA than at interview 48 hours post performance ($t(5) = 3.49$; $p = .02$, $\eta^2 = .71$). Whilst course condition was cited more frequently at immediate interview ($t(5) =$

2.93; $p = .03$. $\text{Eta}^2 = .63$), and feelings/emotions at 24 hour interview ($t(5) = 3.16$; $p = .03$, $\text{Eta}^2 = .61$) than during TA. This suggests that over time participants report qualitatively different factors which influenced decision making.

Figure 5.1: Mean frequency of second-order themes that were cited during think aloud (during performance) and interviews; (a) 10 minutes post performance (b) 24 hours post-performance (c) 48 hours post performance



1c.



DISCUSSION

The primary purpose of Study 2 was to examine the congruence in self-reported decision making rules during TA and at different time intervals after performance. Results indicated that quantitatively the mean number of first-order themes identified during TA did not differ from the number identified during the interview immediately after performance or 24 hours after performance. However, significantly more themes were identified via TA than at interview 48 hours after performance. This may relate to memory decay and on the whole, as time passes participant's reports about previous events becomes less accurate (Ptacek, Smith, Espe, & Raffety, 1994). Although the quantity of themes identified were relatively similar when analysing the similarity between the two types of data collection methods it was found that there was only a 38%-41% correspondence between TA and interview for the first-order themes identified by golfers as variables influencing decision making on each shot played.

Relatively large differences in the types of second-order themes that were emerging in TA in comparison to retrospective interviews were observed. The variable pre-performance activity; which included such first-order themes as a practice swing, cleaning of the ball, pre-performance words or stating a target to aim for, was found to be more frequently cited as a variable that influenced decisions when data was collected via TA than via an immediate interview, 24 hour post interview and 48 hour post interview. In addition, the course management variable; which included first-order themes such as the lie of the ball, club selection and pin position was also a variable that was cited more frequently during TA than at interview 48 hours post performance. Furthermore, the course condition variable; which included such first-order themes as quality of greens, course hazards and the rough was cited more frequently at immediate interview, than during TA as well as feelings/emotions; which included such first-order themes as anxiousness and confidence were cited more frequently at 24 hour interview than during TA.

The results of the present study suggest significant discrepancies in the type of information used during actual performance and what is reported retrospectively. This would provide support for the

use of TA at Level 3 as this allows collection of data during performance of the task (golf performance), which in turn minimises the event-recall period and increases the likelihood of collecting accurate data (Folkman & Moskowitz, 2004).

There are some potential explanations why information during TA differs in quality from retrospective recall. For example, the increased report of pre-performance activity during TA in comparison to retrospective recall might be due to such behaviours being relatively automatic and executed without little conscious thought. As such these behaviours are less likely to be reported retrospectively. An explanation for differences in the variable course condition may be due to retrospective reports being distorted by knowledge about success or efforts (Brown & Harris, 1978). Therefore, as the course condition variable includes such first-order themes as quality of greens, course hazards and the rough it could be assumed that these may have been prominent in the golfers mind as being reasons for a shot being successful or unsuccessful. This could be linked to attribution theory (Weiner, 1985), which suggests that behaviours are attributed to certain internal or external factors. In the case of the course condition variable factors such as course hazards and the rough could have been retrospectively attributed to the outcome of the shot played. For example, if the shot played was deemed as unsuccessful, then the participant is more likely to attribute this to external factors such as course hazards. Furthermore, if variables were distorted by knowledge of success or failure as mentioned by Brown and Harris (1978) then they could only be reported as retrospective reflections which would make it impossible to be cited during TA. This also relates to the issue of bias. Bahrnick, Hall and Berger (1996) found that recall of student's high school grades were influenced by the attractiveness of the grade received. This could have been the case during golf performance as retrospective reports may have been distorted by the result of the shot played which again can only be reported during retrospective interview methodology.

Although there seems to be very little previous research to support the present study's results, Tenenbaum and Elran (2003) studied the congruence between actual and retrospective reports for pre- and post-competition emotional states. The results revealed that thoughts and feelings that were openly expressed after 72 hours were not fully congruent with thoughts and feelings reported in real

time. Although this was free expression rather than closed ended responses, Tenenbaum and Elran (2003) state that free expression of thoughts and emotions cannot be fully trusted when reported retrospectively. In addition, by asking golfers to continuously TA during putting performance Calmeiro and Tenenbaum (2011) were able to successfully use TA as a tool to uncover patterns of cognitive processing used by golfers during putting. Calmeiro and Tenenbaum (2011) and the present study provide support for the use of TA as a valid method of data collection when measuring behaviour or thought process's during an event.

A limitation of the current study is concerned with the low reliability of the coding scheme. Due to the nature of the study where specific comparisons were being made between think aloud and interview it was thought a high frequency of themes were important in order make a true comparison of the two types of data collection. Furthermore, Nicholls and Polman (2008) coding scheme was used as a starting point of the analysis as it was the only study to employ think aloud during a whole game of golf. However, a clearer definition of categories is required in future research. Further limitations of this study include sample size and recommendations for replication of this study include recruitment of a larger sample, including differing levels of golfers and a more homogenous sample regarding gender.

Further use of think aloud at Level 3 could be used from a coaching perspective as it allows golf coaches to be able to measure their client's/performer's thought processes during performance. This has multiple benefits such as the coach being able to assess what the performer consciously attends to during performance which may provide an indication of their experience and knowledge base about the sport. Another benefit of this method from a coaching perspective would be that it could provide the coach with instant feedback as to whether or not the client/performer consciously remembers and engages in the coaching points provided previously.

The findings of the present study suggest that obtaining information about decision making using retrospective recall has a number of limitations. In particular, this information appears to be influenced by memory decay and bias. Being able to measure the thought process concurrently

enables researchers to collect data during performance of golf and other sports which would minimise the event-recall period and increase the likelihood of collecting accurate data (Folkman & Moskowitz, 2004; Ptacek, Smith, Espe, & Raffety, 1994; Smith, Leffingwell, & Ptacek, 1999; Stone et al., 1998). Therefore, Think Aloud verbalisation at Level 3 seems to be a viable data collection method when investigating the decision making process during golf performance.

CHAPTER 6

STUDY 3

A COMPARISON OF THE DECISION MAKING PROCESS BETWEEN HIGH SKILLED AND LOW SKILLED GOLFERS

Study 2 found large discrepancies in the information provided during Think Aloud Level 3 and retrospective interviews, in that there was only a 38%-41% similarity in the data provided in event during performance where participants were thinking aloud in comparison to the information that participants provided about what they were thinking during performance following performance in retrospective interviews. As a result of Study 2's findings and in addition to the findings of Study 1 that Think Aloud at Level 3 did not have a negative effect of putting performance the current study aimed to use Think Aloud at Level 3 as a method for collecting in-event data around decision making during golf performance. Furthermore, Study 3 aims to address one of the limitations in Study 1 by conducting a field study, where golfers will be playing on an official golf course and playing the full range of golf shots, in comparison to an artificial putting green as used in Study 1.

A popular methodology to examine decision making in sport has been the expert-novice paradigm. By examining how athletes of different ability process information and make decisions has provided insight into how with increasing skill level athletes make use of qualitatively and quantitatively different sources of information. It has been found that experts in many different areas (e.g., chess, poker, tennis) display superior decision-making skills. McPherson and Kernodle (2007) found that professional tennis players generated more advanced tactical solutions than advanced beginners during game play. In chess, Grandmaster players search more quickly and have superior pattern recognition than players of a lower level (Connors, Burns and Compitelli, 2011; de Groot, 1946). Further research in poker by Germain and Tenenbaum (2011) found that expert players reported processing more thoughts than intermediate players and novice players as well as attending to situational relevant cues while novices focused on basic poker considerations and irrelevant cues.

In the game of golf performers are faced with a variety of decisions such as the appropriate club to use, what type of shot to play and how far to hit the ball. Each decision requires the consideration of many environmental factors such as weather conditions, hazards and lie of the ball. Calmeiro and Tenenbaum (2011) studied decision making during a golf putting task by asking three experienced golfers and three novice participants to think aloud whilst putting. Experienced player's cognitive processes centered on gathering information and planning, while beginners focused on technical aspects of the putt. Furthermore, experienced golfers were more able to look for relevant information on the green and engage in more solutions to play the shot. Experienced players also verbalized more diagnostic-related thoughts after the putt and followed these thoughts with planning the next shot, whereas beginners rarely diagnosed difficulties with performance. Beginners verbalized more technical and mechanical aspects of their shot whereas experienced players did not. Whilst this study provides an important insight into expertise and decision making in golf only three experienced and three beginner golfers were studied. In addition, the putting task was conducted on an artificial indoor putting green, thus limiting the ecological validity of the task. A greater insight into decision making processes in golf could be gained by examining decision making on a real course where a greater range of factors need to be considered when taking a shot.

Further research examining expertise in golf was conducted by Thomas and Over (1994) who compared the psychological and psychomotor skills of skilled and less skilled golfers. Participants completed the Golf Performance Survey. The skilled golfers reported greater mental preparation, higher level of concentration, fewer negative emotions and thoughts, greater psychomotor automaticity and more commitment to golf. Other studies have found expert novice differences. McCaffrey and Orlick (1989) found that skilled golfers reported greater pregame and pre-shot planning, rehearsal and visualization than did less accomplished golfers. All of these studies share a common theme which suggests that higher levels golfers spend more time planning their shot than lower level golfers.

Most of the research previously conducted in this area has used self-reports (Thomas & Over, 1994) or retrospective reports (McCaffrey & Orlick, 1989). These types of data collection methods, however, may produce biased or distorted reports due to memory decay and adding meaning based on the events outcome, and therefore there is a need for concurrent data collection. Further issues with retrospective reports are the concern of whether retrospective reports signify the athlete's schematic knowledge of how they generally feel before and after a competition (Tennenbaum, Lloyd, Pretty, & Hanin, 2002). More recent research in to the cognitive processes in sport, has adopted the Think Aloud (TA) or verbal protocol as an effective tool for obtaining concurrent data and in turn minimizing potential hazards such as memory decay or bias. Although TA methodologies have not been used extensively in the domain of sport there is a growing body of studies that have employed this method in a variety of domains such as stress and coping (Nicholls & Polman, 2008; Kaiseler, Polman, & Nicholls, 2012), tactical decisions in tennis (McPherson, 1994, 1999a, 1999b, 2000), verbal problem representations in volleyball (McPherson & Vickers, 2004) and verbalisation of thoughts during golf putting (Calmeiro & Tenenbaum, 2011).

McPherson (1999a, 1999b, 2000) and McPherson and Thomas (1989), have conducted a series of studies that used verbal report methodology to examine problem representations of high and low-skilled players during simulated and actual tennis performance. These studies highlighted differences between novice and expert tennis players. In particular, experts planned their actions based on elaborate and sophisticated action plans, whereas novices rarely planned and lacked the memory structures that experts had.

Williams, Davids and Williams (1999) proposed that research into decision making needs to involve more realistic paradigms, more extensive use of qualitative (i.e. structured and unstructured interview techniques) and idiographic (i.e. single case study designs) approaches in the investigation of expert-novice differences in decision making in sport. This is exactly what the proposed investigation aims to do as the use of the think aloud method (Ericsson & Simon, 1993) allows athletes to verbalise their

thoughts that they have generated regarding the decision made in the course of performing the task (Ericsson & Simon, 1984).

The present study aims to extend the work of Calmerio and Tenenbaum (2011) by investigating the differences in decision making processes between six high and six lower level golfers over six full holes of golf using the TA methodology. This extends the previous work as the study considers the whole game of golf rather than just one area such as putting. Based on previous research about the decision making processes in skilled and novice golfers it was predicted that skilled golfers will focus more on pre-shot planning, whereas less skilled golfers will be more focussed on the technical elements of playing the shot at hand. Furthermore, it was predicted more information would be provided by skilled golfers after the shot execution to evaluate the shot.

METHOD

Participants

A total of 12 male participants were involved. Six skilled golfers (Mean age: 16.5, mean handicap: 4) who were linked to the England Golf associated, and six male low skilled golfers (Mean age: 24.3, Mean handicap: 20). Participants had no prior experience of the experimental process. The primary research institution provided ethical approval and written consent was provided prior to participation in the study.

Materials

Each golfer played with their own golf clubs on the same six holes of the same golf course. Participant's verbalisations were recorded using a Sennheiser USA ENG G3 wireless digital voice recorder. The recording device was placed in the pocket of the participant, with a wire running inside the shirt connecting to a microphone attached to the collar. A score card was used to mark the number of shots taken on each hole.

Procedure

Before the performance of the six holes of golf commenced, participants were briefed on how to conduct TA (Simon & Ericsson, 1993). Participants took part in a series of TA exercises which included 1) counting the number of dots on a page; 2) an arithmetic exercise and 3) an anagram problem-solving task, and were asked to TA when completing the exercises and also explain how they completed the exercise.

Each of the golfers played six holes of golf accompanied by a researcher. During this, participants were asked to describe their thoughts before and after the execution of each shot and provide an explanation for their actions. The participants were instructed to talk continuously throughout the six holes apart from when they were executing their shot. The PhD candidate was stood approximately five meters away from the participant; this was thought to be far enough away not to disturb the participant but close enough to hear if they were verbalising. If the PhD candidate thought that the participant had been silent for 20 seconds instructions were then given to the participant to “please keep thinking aloud”. The PhD candidate followed the participant round the golf course making sure to keep around a five meter distance at all times, in order to reduce any effects on the golfers decisions making. Scores were recorded on a pencil and paper score sheet. The thoughts were recorded until the golfers had completed all six holes.

Data Analysis

Each participant’s verbal reports from TA and interviews were transcribed verbatim. Following checks for relevance and consistency each transcript was subjected to a line by line content analysis (Maykut & Morehouse, 1994) by the first author to identify statements which related to the decision making process of each shot played. Only verbalisations relevant to the decision making on the task were included in the analysis. Individual elements of ‘meaningful information’ were considered and coded. Similar to Nicholls and Polman (2008) the verbalizations by the participants that were coded were relevant to the task, which in this case meant verbalizations associated with golf performance. Data which were not relevant to the task, such as verbalizations about what they had for tea last night,

a loved one, and their favourite football team, were removed from the data set. Shot evaluations, following the striking of the ball were included as they were deemed relevant to the cognitive process. According to Calmeiro and Tenenbaum (2011) describing and evaluating the outcome and diagnosing the shot is used to diagnose and update subsequent performance strategies.

These verbal reports were quantitatively analysed according to a coding scheme developed by Calmeiro and Tenenbaum's (2011) for assessing verbal reports during a putting task. This scheme was further developed for the current study and some themes have been removed or modified (see table 6.1). This coding scheme was adapted as Calmeiro and Tenenbaum's (2011) work was one of the only studies that have investigated golfers thought processes during performance. In addition, the coding framework used in study 2 was found to have low reliability and included some themes that may be necessarily be associated with decision making. Therefore, Calmeiro and Tenenbaum's (2011) framework was adopted as these themes were deemed more relevant to the decision making process. Following transcription each participant's verbal reports were classified into the following categories/themes: (a) Gathering information, (b) Club selection (c) Planning (d) Technical Instruction, (e) Shot Evaluation and (f) Pre-Performance Routine. There was little conflict between the assignments of categories, therefore no conflict rules for deciding between categories were required. The PhD supervisor independently and blindly analysed a 10% sample of the raw data. The codes identified by the PhD supervisor were compared to codes identified to the PhD candidate and a percentage of similarity was calculated. The level of agreement between the PhD candidate and PhD supervisor was 95%. Discrepancies between supervisor and student were identified. Each discrepancy was discussed by both, with the PhD candidate justifying their choice of category. In all cases both PhD supervisor and candidate were able to agree on the category assigned after discussion. In all cases the original theme identified by the student was used.

Comparisons were made between high and low skilled golfers on the mean number of thoughts that were verbalised during each shot and the mean number of verbalisations in each theme per shot using Mann-Whitney tests. The data was then split into wood/iron shots and putting, with each type of shot

analysed separately. The percentage of shots where a theme was verbalised was calculated and Mann-Whitney tests were used to compare differences between high and low skilled golfers.

To analyse thought sequences, coded thoughts for each shot were organised in a sequential manner. At each step of a thought sequence the percentage frequency for the occurrence of each theme was calculated, this providing a clear indication of what thoughts were occurring at which stage in the decision making sequence.

Table 6.1. Themes used to code verbalisations

Theme	Description	Example of raw data quote
Gathering Information	reflected participants' search for relevant characteristics of the environment	"there's a break left," "it is mostly uphill", "there is a tree on the right" "the wind is blowing left to right".
Club Selection	Selecting the appropriate club for the shot in hand.	"I'm using a driver", "I'm using a 7 iron".
Planning	referred to the definition of actions or strategies to reach a goal	"I'm aiming for the left edge of the green", "aim two cups right," "hit firm at the hole"
Technical Instruction	specified technical aspects of the motor performance	"arms bent," "feet are parallel", "using my new grip".
Shot Evaluation	reflected what had happened in terms of process or evaluation of the action	"[the ball] flew that by," "it broke at the end," "good putt", "I'm on the green".
Pre-Performance routine	Any sequence of task relevant thoughts and actions which the golfer engages in systematically prior to taking his shot.	"just using my pre-performance routine", "one, two three, putt".

RESULTS

Number of thoughts

A Mann-Whitney test revealed there was a significant difference in the amount of thoughts that were verbalised during each shot between high and low level golfers ($U = 1.50$, $p = .008$, $d = 2.17$) in that high level golfers verbalised significantly more themes during each shot ($m = 3.48$) compared to low level golfers ($m = 2.33$).

Content of verbalisations

Overall, high level players verbalised significantly more thoughts about Planning, and Pre-Shot Routine whereas less skilled golfers verbalised more thoughts relating to Technical Instruction (see Table 6.2).

Table 6.2: Means and Standard Deviations of the amount of themes verbalised among high and low level golfers.

Theme	Mean	Standard deviation	Man Whitney U	p	d
Gathering Information					
High					
Low	29.50	8.43	7.00	.09	1.23
	19.16	9.86			
Planning					
High	31.00	8.60	2.00	.009	2.07
Low	15.00	6.69			
Pre-Shot Routine					
High	4.83	4.31	.50	.002	-5.56
Low	.16	.41			
Club Selection					
High	8.17	6.69	17.00	.93	-0.16
Low	9.00	3.03			
Technical Instruction					
High	1.83	2.23	1.50	.004	-2.46
Low	7.33	1.75			
Shot Evaluation					
High	17.33	4.59	12.50	.394	.69
Low	14.17	4.83			

Percentage of shots where a theme is used

Man-Whitney U test for wood/iron shots showed differences for the themes Gathering Information ($U = 4.5$, $p = .028$), Club Selection ($U = 3.00$, $p = .028$) and Planning ($U = .00$, $p = .004$) between the high and low level golfers. The high level golfers gathered information on more shots (88% vs 65%), considered Club Selection more often (88% vs 65%) and used Planning on more shots (82% vs. 52%) compared to the low level golfers.

Significant differences were also found in the decision making of the golfers during their putting shots. High level golfers verbalised about Planning on a greater proportion of putts than low skilled golfer (59% vs 19%, $U = 2.00$, $p = .010$).

Order of thoughts

During wood and iron play 100% of high level golfers had at least 2 thoughts per shot, 89% had 3 thoughts, 70% had 4 thoughts, 33% had 5 thoughts, 14% 6 thoughts, and 12% had 7 thoughts. In comparison low level golfers all had at least one thought per shot, 84% had 2 thoughts, 57% had 3 thoughts, 25% had 4 thoughts, and 9% had 5 thoughts. High level golfers first thought was to gather information, then select the club, then plan the shot, and finally evaluate. Low level golfers first thought was to gather information, then select a club. The main difference with low level golfers was a lack of planning, since their most common third thought was to evaluate rather than plan (see table 6.3).

Table 6.3. Percentage of shots where a theme was verbalised in order for high (HL) and low level (LL) golfers when hitting wood and iron shot

Theme	Thought 1		Thought 2		Thought 3		Thought 4		Thought 5		Thought 6		Thought 7	
	HL	LL	HL	LL	HL	LL	HL	LL	HL	LL	HL	LL	HL	LL
No thoughts	0	0	0	16	11	43	30	75	67	91	86	N A	88	N A
Gathering Information	86	64	3	6	17	11	13	1	2	1	0	N A	2	N A
Club Selection	1	10	54	33	10	1	4	2	6	0	0	N A	0	N A
Planning	10	14	26	22	39	19	7	7	4	0	9	N A	0	N A
Evaluation	3	8	4	19	17	24	39	15	19	7	2	N A	6	N A
Pre-Shot Routine	0	0	4	0	4	0	4	0	0	0	2	N A	2	N A
Technical Instruction	0	2	2	4	2	2	3	1	2	1	0	N A	2	N A

All higher level golfers had a minimum of one thought during their putting performance, however, only 65% of putts had two thoughts and 47% had 3 thoughts. Low level golfers also had a minimum of one thought during their putting performance, however, only 52% of putts had two thoughts and 21% had 3 thoughts. For high level golfers the most common first thought when putting was to gather information, their second thought was to plan and their third thought was to evaluate (see table 6.4). In comparison, low level golfers most common first thought was to gather information, however, the most common second and third thoughts were to evaluate. Although planning did occur at thought two in low level golfers it was considerably lower in occurrence, with only 19% of second thoughts involving planning for low skill golfers compared to 34% of high skilled golfers.

Table 6.4. Percentage of shots where a theme was verbalised in order for high (HL) and low level (LL) golfers during putting performance.

Themes	Thought 1		Thought 2		Thought 3	
	HL	LL	HL	LL	HL	LL
No Thoughts	0	0	35	48	63	79
Gathering Information	56	72	6	2	6	0
Club Selection	0	5	6	1	0	0
Planning	25	7	34	19	0	2
Evaluation	19	14	19	30	31	19
Pre-Shot Routine	0	0	0	0	0	0
Technical Instruction	0	2	0	0	0	0

Discussion

The aim of this study was to investigate the difference in the decision making process between high and lower skilled golfers over six full holes of golf using the TA methodology. Higher skilled golfers provided more verbalisations per shot taken than lower skilled golfers. As predicted higher skilled golfers verbalised more about planning shots whereas lower skilled golfers verbalised more about technical instruction, this was the case for wood/iron shots and for putting. Contrary to predictions there was no evidence of higher skilled golfers providing more verbalisations in the evaluation of a shot.

The results of the present study were consistent with previous findings by Calmeiro and Tenenbaum (2011) who studied the thought process of different level golfers during a putting task on an artificial surface. They found that experienced players verbalized more about planning their shot than lower skilled golfers. High level participants in the current study also used more planning strategies and goals which guided the execution of a shot. This is also consistent with research by McPherson (2000) who found that experienced, higher level tennis players planned their actions based on sophisticated action plans whereas novices rarely planned.

Beilock et al. (2002) found that expert golfers' generic descriptions of a putt consisted largely of assessing and planning. Experts also made less reference to putting mechanics in their episodic recollections than novices. This is consistent with the finding in the present study that lower level golfers verbalised more technical instructions than higher level golfers. Beilock et al. proposed that a novice's performance of a skill is based on declarative knowledge that is held in working memory and is attended to in a step-by-step fashion (Anderson, 1982, 1983; Fitts & Posner, 1967). Low level golfers are likely to be in the cognitive phase of learning (Fitts & Posner, 1967) which is characterized as using explicit, technical information to skill execution whereas the high level golfers are more likely in the autonomous phase of skill learning. This stage is characterized by the use of implicit knowledge.

A further explanation for the low skilled group results could be that verbal protocols measure what is conscious and easy to verbalize, therefore when engaging in a golf shot which would be deemed as a difficult task to a novice, verbalisation s about technical aspects of a putt may be the most conscious and easiest thing that can be verbalized at this level of ability (Tuffing, Roring & Ericsson, 2007).

In the present study high level golfers verbalized more with regard to their pre-performance routines. A number of benefits have been identified in using such pre-performance routines in sport. For example pre-performance routines prevent the golfer from devoting attention to the mechanism of an automatic skill (Boutcher, 1992). Within golf there is a large amount of ‘thinking time’ and as a result it is thought that performers may be more susceptible to distraction by task irrelevant external and internal stimuli (Jackson & Baker, 2001). Therefore, it has been suggested that if a performer implements the use of a structured routine prior to performance this will benefit performance (Kingston and Hardy, 2001). Pre-Performance routines have been defined as a ‘sequence of task-relevant thoughts and actions which an athlete engages in systematically prior to his or her performance of a specific sport skill’ (Moran, 1996, p. 177). Lidor and Tenenbaum (1993) promote the use of a structured routine prior to performance as they believe it to be an extremely important behavioural technique to help performers reach high levels of achievement in sport.

The most common sequence of thought for a higher level golfer when hitting a wood or iron shot consisted on gathering information, selecting the most appropriate club, planning the shot and then providing an evaluation and diagnostic following the execution of the shot. This thought sequence is similar to the sequence found in the experienced golfers in Calmeiro and Tenenbaum’s (2011) golf putting study, with the addition of the club selection to the current study. Although the current study involves golfers playing 6 different holes, which arguably presents each golfer with more variables and decisional factors to take into account there are similarities between the two sets of research findings. Calmeiro and Tenenbaum (2011) found that increased pre-shot planning and planning strategies guide the execution of the shot in experienced golfers. As a result during the current study higher level golfers were able to look for relevant information on the course and engage in more

verbalisation s about how they were going to play the shot and where they were going to hit it. This was also the case during putting performance in the high level group in that the most common sequence of thought involved the golfer gathering information, planning the putt and then providing an evaluation. In contrast, the most common sequence of thought for a lower level golfer when hitting wood/iron shots included gathering information, selecting the most appropriate club and then providing an evaluation and diagnostic following the execution of the shot. Most of the time low level golfers failed to include any planning or strategy based thoughts in to their process. This was also evident whilst putting.

The theory of expertise induced amnesia (Beilock & Carr, 2001) proposes that experts who have undergone years of practice will create a domain specific amnesia. That is, if the skill is supported by procedural knowledge that automates real-time performance, then episodic memory for this performance should be minimized. Due to expert knowledge being automatic during real time skill execution, experts may neither attend to nor remember the step-by-step unfolding of their performances. This theory could provide support for why the high level group did not report technical motor skill related instructions as their step-by-step unfolding of their golf shot was not attended to. Ericsson and Smith (1991) found that expert chess players reported that the best move or a small number of moves just popped into their heads, whereas the novices report a serial process of generating and evaluating several possible moves in succession supporting this explanation.

This study has a number of practical implications, firstly from the findings it is clear that higher skilled golfers perform with instructions guided towards external focus (hitting a target). The thoughts of planning, which were displayed in higher level golfers involve aiming where the performer wants to hit the ball, which is an external focus. This finding links with Perkins-Ceccatto, Passmore and Lee (2003), who found that when highly skilled golfers performed better when they were told to concentrate on hitting the ball as close to a target as possible as opposed to asking them to concentrate on technical swing thoughts which were internal. In contrast lower level golfers performed better with the internal focus of attention on technical thoughts about their swing form. Less skilled golfers in the

current study displayed more technical instructional thoughts which when related to Perkins-Cecatto et al. (2003) imply that those at the lower skilled level should be given instructions based on technique to promote an internal focus. Whereas higher skilled learners in the automatic phase of learning should have less focus on the technical and should be guided towards an external, tactical focus when being coached.

However, further research from Marchant, Clough, Crawshaw and Levy (2009) found that when novice participants moved from internal to external focus instructions during a dart throwing task their accuracy improved and in turn those moving from external to internal experienced a reduction in accuracy. In a further study participants using external focus instructions were more accurate and scored more bulls eyes than those using an internal focus (Marchant et al, 2009). Further research with higher level golfers (mean handicap 5.5) found that when comparing internal focus, proximal external focus (position of club face, keeping club face square) and distal external focus (flight of ball after it had left the club face and the direction in which they intended to hit the ball) the distal external focus group performed more accurately with the internal group being the least accurate. This result occurred even when participants were put in anxiety condition (Bell & Hardy, 2009). In addition, Wulf, Lauterbach, & Toole, (1999) have demonstrated that the adoption of an external focus of attention is preferable for the learning of complex motor tasks. These findings would therefore suggest that both experts and novices perform better when using an external focus of attention. From a practical perspective therefore it could be proposed the coaches should encourage lower skilled performers to plan their shots and educate the players around the appropriate targets to focus on.

Furthermore there are practical implications from the findings around pre-performance routines. As these were found to be present in the higher skilled golfers and almost non-existent in the low skilled, the pre-performance routine could be a valuable bridging mechanism between high and low skill development. As previously mentioned there are a number of benefits have been identified in using such pre-performance routines in sport, one of which is that they prevent the golfer devoting attention to the mechanism of an automatic skill (Boutcher, 1992). Therefore, once the performer starts to reach

the automatic stage of learning (Fitts & Posner, 1967) introducing a pre-performance routine could be a valuable tool to help maintain an externally focused swing.

This study is not without its limitations; one limitation is the assumption that the higher level golfers are in the autonomous phase of learning as this was not tested before data collection commenced. Although technical verbalisation s were significantly lower in the high skilled group they were still evidence in some high level golfers, indicating that some of the golfers in this group may have still been in the associative phase of learning (Fitts and Posner, 1967). Due to this more variability of golfers' level of ability could be recommended. For example, using participants with lower handicaps in comparison to those who have never played golf before (true novices) or introducing an 'intermediate' group. Although this study used six participants in each group and this may be considered a relatively small sample size, this is still a progression and improvement in comparison to similar previous research (Calmeiro & Tenenbaum). Calmeiro and Tenenbaum's (2011) 'experienced' group consisted of 3 participants with a mean handicap pf 10.3, whereas the current study had six participants in the experienced group with a mean handicap of four. Therefore, this study has provided both original contributions to previous literature and developed previous literature further by improving the validity and application to the whole game of golf.

Although, not quite a limitation but something that needs to be discussed is that this study did not measure the flexibility of attentional focus in the higher level golfers. More specifically, how a higher level golfer's attentional focus changed from external to internal at various points through their performance was not measured. An example of this can be found by Gray (2004) who demonstrated that a high level skill is not characterised by one type of attentional allocation, however, when paying below average the baseball batters in this study demonstrated an increase of attention to skill focus. Furthermore, when the batters achieved high quality skill the focus became less skill focussed and more proceduralised. This may be something to consider in future research.

The present study demonstrates clear differences between the thought patterns of high and low level golfers. It is clear that higher level golfers focus more on planning their shots and identifying appropriate strategies to reach their desired goal, whereas lower level golfers plan less and engage in more technical instruction. Skill development and attentional focus patterns have been discussed as possible explanations for this (Perkins-Ceccato et al, 2003; Schmidt, 1982). This information could be used by coaches, athletes or sport psychologists to improve the structure of the thought processes or pre-shot routines so that golfers are attending to appropriate stimuli within their environment when planning shots.

CHAPTER 7

STUDY 4

DECISION MAKING IN GOLF DURING COMPETITION AND PRACTICE

The vast majority of previous research that has investigated expert-novices paradigm has examined differences in behaviour, physical and psychological characteristics and cognitive functioning in athletes (McPherson & Kernodle, 2007; Germain & Tenenbaum, 2011). However, when examining decision making in sport the main focus has been on behavioural outcomes rather than the thought process or mechanisms involved during the time between a thought and an action.

Study 3 found clear differences in the thought processes of high and low skilled golfers. More specifically that higher skilled golfers verbalised more about planning their shot in comparison to lower skilled golfers who verbalised more about technical instructions to aid their performance. As previously discussed Calmerio and Tenenbaum (2011) found very similar findings that experienced player's cognitive processes centred on gathering information and planning, while beginners focused on technical aspects. Furthermore, experienced golfers were more able to look for relevant information on the green and verbalized more diagnostic-related thoughts after the putt and followed these thoughts with planning the next shot. Beginners verbalized more technical and mechanical aspects of their shot whereas experienced players did not.

The studies on decision making in sport have mainly focused on differences between experts and novices with few examining differences between expert and intermediate level athletes. This is an important issue because comparing athletes at different levels of ability allows to piece together the developing thought process that is occurring through the stages of skill development. McPherson and colleagues, for example, compared novice and varsity level tennis players (McPherson, 2000) and advanced beginners and entry level professional tennis players (McPherson & Kenodle, 2007)

decision making patterns. These studies showed that professional tennis players exhibited more advanced problem representations than advanced beginners. Furthermore, entry level professionals monitored actions to develop tactics while advanced beginners monitored actions to correct failed serve or shot techniques. These studies suggest that professional level tennis players have a procedural thought base, based on tactics and not step-by-step thoughts of the execution of the tennis skill. Advanced novices, on the other hand, have a declarative thought base resulting in mechanical corrections when experiencing a failed shot.

In sport it has been shown that under situations of stress athletes might show a decrement in performance. This has been labelled choking; the decrease in athletic performance because of disruption in the execution of habitual processes under situations of stress or pressure (Beilock & Gray, 2007). A number of explanations have been put forward to explain why athletes might choke under pressure. As previously discussed in the literature review, reinvestment theory (Masters, 1993) predicts that during times of stress or pressure changes occur in cognitive processing. That is, the automaticity of a task becomes undone or disrupted as the performer tries to control a task or action consciously with declarative knowledge. Reinvestment theory is closely related to Fitts and Posners's (1967) framework of skill learning which suggest that when learning a motor skill individuals go through three stages called the cognitive, intermediate and autonomous phase. In the declarative, cognitive stage performance is cognitively controlled in a step-by-step manner. When learning progresses performance becomes more procedural and automatic with little need for cognitive attention. Skill failure under pressure according to reinvestment theory is a consequence of the progression-regression hypothesis. According to Masters (1992) during progression regression a disruption in performance occurs when an 'integrated' real time control structure that can run as an uninterrupted unit (a professional golfers driving off the tee) is broken down back into smaller, separate independent units, similar to how it was originally attended to in a step-by-step fashion during the early stages of skill learning. This in turn slows down performance as each component is run separately instead of all together; as a result there is a gap in each unit which creates more room

for error, which would not be present in the integrated autonomous structure (Beilock & Carr, 2001; Masters 1992).

Masters, Polman and Hammond (1993) suggested that reinvestment and the disruption of an automatic skill could be a characteristic of personality and as a result may be subject to individual differences. Masters et al (1993) suggested that cognitive failures as a result of reinvestments could be due to an inherent flaw in cognitive processing which could cause disruption in some individuals but not all and at different levels. Poolton and Masters (2009) argue that if an athlete is coached in a way that increases physical awareness of the movements then this will result in the athlete being more vulnerable to sudden breakdowns of skill under pressure. More recently Kinrade et al. (2010b) introduced the concept of decision making reinvestment. They developed a Decision-Specific Reinvestment Scale, which comprised of six items specific to the conscious monitoring or the process involved in making a decision (decision reinvestment). A second factor which makes up the scale is decision rumination which focusses on negative evaluations of poor decisions. When validating this scale, Kinrade et al (2010) found that the scores of 59 skilled team sports players correlated highly with coach's ratings of player's tendency to choke under pressure. Poolton, Siu and Masters (2011) found that referees with a higher tendency for decision rumination were found to be more influenced by home advantage in that they favoured the home team in the decisions they made

Although empirical evidence has been provided that reinvestment as an explanation for choking under pressure and as a personality characteristic to date few studies have examined what the thought process are which occur during times of pressure situations and how this influences the decision making process. When studying stress and coping Nicholls and Polman (2008) found that when under stress high level golfers reverted to a high frequency of swing thoughts, which are technical thoughts about their performance. Although not the purpose of Nicholls and Polman's (2008) research their findings provide an explanation for what may happen to a performers cognitive processes during a stressful event. Based on the reinvestment theory (Masters, 1992), during a stressful event this research shows that an higher ability individual in the later stages of learning will experience self-

directed attention, which in terms of cognitions may cause a performer to think about his or her technique and mechanical movements, rather than a tactical external focus.

This study aims to investigate whether stress through the introduction of a competition with monetary prizes will influence performance and the thought process in high and intermediate level golfers.

Intermediate level golfers were used in this study, as mentioned earlier in this introduction studies on decision making in sport have mainly focused on differences between experts and novices with few examining differences between expert and intermediate level athletes. As the earlier studies of this thesis have compared high and low ability levels; possibly those in the cognitive and autonomous phases of skill development, it is thought that by comparing athletes at different levels of ability, in this case intermediate (associative level) may allow us to explore the thought process that is occurring through the stages of skill development. Based on previous research and theories of reinvestment (Masters, 1992; Masters et al, 1993) and in particular reinvestment related to decision making it was predicted that under stress higher level golfers are more likely to use technical rules and refer to their step-by-step mechanics of their swing in comparison to normal practice conditions. Furthermore, as the intermediate level golfers may be in the associative phase of learning they are more likely to already be attending to technical mechanisms whilst performing and as a result will not report more technical information during competition in comparison to practice.

METHOD

Participants

A total of 16 (15 male; 1 female) participants were involved in the study. Eight skilled golfers (M age: 17.50, sd = 1.19; M handicap: 2.25, sd = 1.75; M years playing experience 8.00, sd = 1.16), and eight intermediate level golfers (7 male; 1 female), (M age: 17.25, sd = .46; M handicap: 9.62, sd = .91; M years playing experience: 4.00, sd = 1.06) and were all members of the same golf club and college.

Participants had no prior experience of the experimental process. The primary research institution provided ethical approval and written consent was provided prior to participation in the study.

Materials

Each golfer played with their own golf clubs on the same six holes of the same golf course.

Participant's verbalisations were recorded using a Sennheiser USA ENG G3 wireless digital voice recorder. The recording device was placed in the pocket of the participant, with a wire running inside the shirt connecting to a microphone attached to the collar. A score card was used to mark the number of shots taken on each hole.

Each golfer completed the Decision Specific Reinvestment Scale (DSRS; Kinrade et al., 2010). The 13-item DSRS assess and individual's predisposition for exerting conscious control over their decision-making process and consist of two factors. Decision reinvestment assesses a respondent's tendency to consciously monitor the processes leading up to the decision whereas rumination measures the tendency to reflect upon previous poor decisions. The DSRS is scored on a scale from 0-5, with 0 being extremely uncharacteristic to 4 being extremely characteristic. Good reliability has been shown (Cronbach alpha = .89 and .91 for the reinvestment and rumination factors respectively). In addition the scale has shown adequate factorial structure (Kinrade et al, 2010b).

Procedure

Initially participant were briefed about the study and asked to complete the DSRS (Kinrade et al, 2010b). Before playing of the six holes of golf commenced, participants were briefed on how to conduct level 3 verbalisation of their thoughts (Simon & Ericsson, 1993). Participants took part in a series of TA exercises which included 1) counting the number of dots on a page, 2) an arithmetic exercise and 3) an anagram problem-solving task, and were asked to TA when completing the exercises and also explain how they completed the exercise.

During the whole study participants played alone and were accompanied by a researcher. During this, participants were asked to describe their thoughts before and after the execution of each golf shot and

provide an explanation for their actions. The participants were instructed to talk continuously throughout the six holes apart from when they were executing their shot. The PhD candidate was stood approximately five meters away from the participant; this was thought to be far enough away not to disturb the participant but close enough to hear if they were verbalising. If the PhD candidate thought that the participant had been silent for 20 seconds instructions were then given to the participant to “please keep thinking aloud”. The PhD candidate followed the participant round the golf course making sure to keep around a five meter distance at all times, in order to reduce any effects on the golfers decisions making. The thoughts were recorded until the golfers had completed all six holes.

The study involved two phases. Phase 1 was a practice round where each golfer played six holes of golf whilst thinking aloud. Participants were briefed prior to the study that this was a practice round and their scores were not being recorded; although the researcher was taking a note of their score. Phase two was a competition phase where golfers were briefed prior to taking part that they would be playing the exact same holes as their practice day, however, this was a competition and participants were competing for prizes. Prizes were given to the top three performers and these consisted of £100 voucher for golf merchandise for the winner, £70 voucher for second place and £30 voucher for third place. As golfers were between the ages of 16-18 and studying golf related courses this was deemed a valued prize. The pressure manipulation phase of this study was similar to previous work by Vine and Wilson (2010) and Vine, More and Wilson (2011). They created cognitive anxiety through setting up a competition whereby participants were informed that the individuals with the best performance would receive a £50 prize (in our case £100 for first, £79 for second and £30 for third place). In addition, participants were told that their scores would be compared to others (Vine, More & Wilson, 2011). Similarly, in the current study participants were told the competition was built into their curriculum. As they were all part of a further education golf college their lecturer made them aware that this was a competition and it would replace their normal timetable on the specific days. In addition, participants were notified that their scores would be presented back to the whole class the following week to be reviewed.

Presentation of the study conditions was counterbalanced to eliminate practice effect. To create a more realistic competition environment, a presentation afternoon followed the completion of the study where all golfers were congratulated on their performance, all scores were read out and prizes were awarded to the top three performers.

As the competition was played over 6 holes which is 1/3rd of a total round of golf (18 Holes), full handicaps were divided by 3 providing a 6 hole handicap for each player. For example an 18 hole 12 handicap would be a 6 hole 4 handicap. The competition was run as a stroke play event which is a standard format for golf competitions and the adjusted handicaps were subtracted from the final score.

Data Analysis

Each participant's verbal reports from TA and interviews were transcribed verbatim. Following checks for relevance and consistency each transcript was subjected to a line by line content analysis (Maykut & Morehouse, 1994) to identify statements which related to the decision making process of each shot played. Only verbalisations relevant to the decision making on the task were included in the analysis. Individual elements of 'meaningful information' were considered and coded. Similar to Nicholls and Polman (2008) the verbalizations by the participants that were coded were relevant to the task, which in this case meant verbalizations associated with golf performance. Data which were not relevant to the task, such as verbalizations about what they had for tea last night, a loved one, and their favourite football team, were removed from the data set. Shot evaluations, following the striking of the ball were included as they were deemed relevant to the cognitive process. According to Calmeiro and Tenenbaum (2011) describing and evaluating the outcome and diagnosing the shot is used to diagnose and update subsequent performance strategies.

These verbal reports were quantitatively analysed according to a coding scheme developed by Calmeiro and Tenenbaum's (2011) for assessing verbal reports during a putting task. This scheme was further developed for the current study and some themes have been removed or modified (see Table 4.1). Following transcription each participant's verbal reports were classified into the following categories: (a) gathering information, (b) Club selection (c) Planning (d) Technical instruction, (e)

Shot evaluation and (f) Dwelling on past shot. Dwelling on past shot was added to the coding scheme of this data due to this theme emerging frequently in this specific data set, however, was not present in previous studies. Wood and iron shots were also investigated separately to putting, however, both were analysed using the same coding scheme. There was little conflict between the assignments of categories, therefore no conflict rules for deciding between categories were required. The PhD supervisor independently and blindly analysed a 10% sample of the raw data. The codes identified by the PhD supervisor were compared to codes identified to the PhD candidate and a percentage of similarity was calculated. The level of agreement between the PhD candidate and PhD supervisor was 95%. Discrepancies between supervisor and student were identified. Each discrepancy was discussed by both, with the PhD candidate justifying their choice of category. In all cases both PhD supervisor and candidate were able to agree on the category assigned after discussion. In all cases the original theme identified by the student was used.

Initially a Wilcoxon test was conducted to compare the scores of the performance (number of shots taken per round of six holes) in practice and competition. To analyse the content of participants verbalisations a 2 (skill) x 2 (condition) mixed analysis of variance was conducted to examine the total amount of verbalisation s of each theme produced by of the two skills levels (high and intermediate level golfers) across the two conditions (practice and competition).

A Man Whitney U test was conducted to investigate significant differences in the percentage number of shots where each theme was used between high and intermediate level golfers during both practice and competition. A Wilcoxon test was conducted to investigate the difference between all 16 golfers verbalisations in practice compared to competition, and then further Wilcoxon tests were carried out in order to investigate the difference in high level golfer's verbalisation in practice and competition and intermediate level golfers verbalisation in practice compared to competition.

To analyse thought sequences of both high and intermediate level golfers, coded units of information for each shot were organised in a sequential manner. Percentage frequencies of the amount of verbalisation of each category were calculated at each step of the thought sequence for both wood/iron

shots and putting, this provided a clear indication of what categories (thoughts) were occurring at which stage in the thought sequence.

Pearson's correlations were conducted between all the coding variables and the decision reinvestment and rumination scores from the DSRS. Correlations were also conducted for these variables during separate practice and competition conditions and for both high and low skilled performers. The magnitude of correlations were 0-0.3 being low, 0.31-0.5 being moderate and greater than 0.5 being high (Dancey & Reidy, 2004).

RESULTS

Table 7.1 shows the coding scheme that was developed to analyse the verbal reports in this study. A description of the theme and an example of when this theme was used during the verbal reports is also provided.

Performance

Overall no differences were observed in the number of shots taken between the practice and competition condition ($Z = -.90$, $P = .37$). Similarly, no difference between the two conditions was found for the high level ($Z = .00$, $P = 1.00$) or intermediate ($Z = -1.11$, $P = .26$) golfers (see Table 7.2).

Table 7.1: Themes used to code high and intermediate level golfer verbalisations during the performance of six holes of golf during practice and competition.

Theme	Description	Example of raw data quote
Gathering Information	reflected participants' search for relevant characteristics of the environment	"there's a break left," "it is mostly uphill", "there is a tree on the right" "the wind is blowing left to right".
Club Selection	Selecting the appropriate club for the shot in hand.	"I'm using a driver", "I'm using a 7 iron".
Planning	referred to the definition of actions or strategies to reach a goal	"I want to get this onto the green for a 2 putt", "if I aim to the middle of the fairway I will have a good angle into the green"
Technical Instruction	specified technical aspects of the motor performance	"arms bent," "feet are parallel", "using my new grip".
Shot Evaluation	reflected what had happened in terms of process or evaluation of the action	"[the ball] flew that by," "it broke at the end," "good putt", "I'm on the green".
Dwelling on past shot or hole	Any reference to a previous shot played during that round of golf.	"ahh I wish I had holed that putt on the 3 rd ", "if I hadn't of sliced that driver, I would be level par now".

Table 7.2: Mean and Standard Deviations for the number of shots taken in practice and competition phases.

	Practice		Competition	
Level of performance	Mean number of shots taken	Standard Deviation	Mean number of shots taken	Standard Deviation
High	22.50	1.30	22.50	1.92
Intermediate	23.00	2.39	21.75	2.12
All	22.75	1.87	22.12	1.99

Content of verbalisations

ANOVA found that there was a significant difference between practice and competition for the theme Gather information ($F(1,14) = 4.85$, $P = .045$; $\text{Eta}^2 = .26$). More themes around Gathering Information were found in practice than competition (see Table 7.3). With regard to skill level differences were found for the theme Dwell ($F(1,14) = 6.29$, $P = .03$; $\text{Eta}^2 = .31$), Plan ($F(1,14) = 15.20$, $P = .002$; $\text{Eta}^2 = .52$) and Evaluation ($F(1,14) = 7.44$, $P = .02$; $\text{Eta}^2 = .34$). Higher level golfers reported more Dwelling, Planning and shot evaluation than intermediate level golfers (see Table 7.3). There was no significant interaction between skill and condition for any of the themes.

Table 7.3: Means and Standard Deviations of the amount of themes verbalised between high and intermediate level golfers and the sample as a whole during practice and competition phases.

Theme	Practice		Competition	
	Mean	Standard deviation	Mean	Standard deviation
Gathering information				
High	26.62	5.90	21.12	7.12
Intermediate	19.75	6.92	18.12	7.56
All	23.18	7.15	19.62	7.26
Planning				
High	29.25	9.48	28.25	8.44
Intermediate	14.75	5.80	17.87	3.35
All	22.00	10.66	23.06	8.20
Club Selection				
High	9.00	2.82	7.12	2.10
Intermediate	6.00	2.97	6.00	3.11
All	7.50	3.20	6.56	2.63
Technical instruction				
High	1.37	2.06	2.5	2.26
Intermediate	1.87	2.16	1.25	1.16
All	1.62	2.06	1.87	1.85
Shot evaluation				
High	22.75	5.73	20.25	4.77
Intermediate	15.75	4.13	14.75	4.65
All	19.25	6.04	17.50	5.36
Dwelling on past shot				
High	5.12	4.32	7.50	6.74
Intermediate	1.25	1.28	1.87	2.10
All	3.18	3.67	4.68	5.62

Percentage of shots where a theme is used

When comparing high level and intermediate level golfers during the practice round, significant differences were found for the themes Club selection ($U = 12$, $P = .03$) and Planning ($U = 5.00$, $P = .004$) for wood/iron shots and Planning ($U = 2.00$, $P = .002$) and Evaluation ($U = 2.00$, $P = .002$) for putting. High level golfers used more Club selection and Planning than the intermediate golfers for wood/iron shots and more Planning and Evaluation for their putts. For the competition round only a difference was found for Planning during putting ($U = 10.0$; $P = .02$). High level golfers used significantly more Planning than the intermediate golfers.

Significant differences were found between the themes Gathering information ($Z = -2.67$, $P = .008$) in wood/iron shots when comparing practice and competition. More shots included gathering information during competition compared to practice (79% vs. 60%). Furthermore a significant difference was in the theme Technical Instruction during putting ($Z = -2.25$, $P = .024$). Technical Instructions were used more in competition than practice (7% vs. 2%).

No significant difference was found in low level golfers in any theme between practice and competition. For high level golfers there was a significant difference in the theme Gathering information between practice and competition ($Z = -2.03$, $P = .02$) when hitting wood/iron shots. During practice more shots included gathering information than competition (87% vs. 61%). A significant difference was also found in the theme Technical instruction during putting between practice and competition ($Z = -2.03$, $P = .04$). More technical instruction was used during competition than practice (10% vs. 1%).

Order of Thoughts

Table 7.4 provides an overview of the total percentage of themes that were verbalised at each stage of the decision (thought) process for high and intermediate level golfers during practice and competition when hitting wood/iron shot and Table 7.5 provides this information for putting. The most common

first thoughts for both high and intermediate level golfers in both practice and competition for wood/iron shots was to gather information. The second most common thought for a high level golfer is to select their club, whereas the intermediate level most common second thoughts are split between club selection and planning. The third most common thought for the high level golfer is to plan whereas for the intermediate level golfer they have a higher percentage of evaluating. The higher level golfers fourth most common thought is to evaluate, which is similar for the intermediate level golfer. However, a large percentage of thought processes stop for the intermediate level golfers after three thoughts.

When examining the differences in practice and competition it is evident that the high level golfer's gathered more information in the first instance during practice than competition. Interestingly, during competition, intermediate level golfers first thought of gathering information was higher than the high level golfers (13% difference). Intermediate level golfers also change their second most common thoughts from club selection during practice to planning during competition.

The most common first thought for both high level and intermediate golfers for putting was to gather information. Although the most common second thought verbalised for both skill level golfers was to plan, high level golfers verbalise a much higher percentage of planning; 50% during practice and 44% during competition than intermediate level golfers who verbalised 33% of planning during practice and 24% during competition. The most common third thought for both level of golfer was to evaluate and a small percentage of high level golfers verbalised up to four thoughts whereas intermediate level golfers verbalised a maximum of three thoughts during competition and four thoughts during practice.

Table 7.4: Total percentage of thoughts produced in order for high (HL) and intermediate (IL) level golfers during wood/iron shot in both practice and competition.

Themes	Thought 1		Thought 2		Thought 3		Thought 4		Thought 5	
	HL	IL	HL	IL	HL	IL	HL	IL	HL	IL
No thoughts										
Practice	0%	0%	4%	7%	11%	32%	26%	62%	76%	92%
Competition	0%	0%	5%	10%	18%	29%	35%	65%	83%	95%
Gathering information										
Practice	67%	67%	9%	8%	12%	9%	5%	0%	1%	0%
Competition	43%	56%	7%	7%	8%	9%	2%	0%	0%	0%
Club Selection										
Practice	5%	6%	51%	33%	9%	5%	4%	0%	0%	0%
Competition	10%	15%	47%	24%	3%	2%	0%	0%	0%	0%
Planning										
Practice	16%	18%	26%	28%	47%	16%	10%	6%	4%	0%
Competition	23%	20%	28%	36%	48%	21%	7%	4%	2%	0%
Evaluation										
Practice	3%	6%	6%	22%	16%	29%	51%	27%	19%	8%
Competition	5%	5%	13%	18%	18%	29%	47%	27%	15%	5%
Dwelling										
Practice	7%	2%	4%	0%	4%	4%	1%	0%	0%	0%
Competition	12%	4%	0%	0%	2%	0%	2%	2%	0%	0%
Technical Instruction										
Practice	0%	1%	0%	2%	1%	5%	3%	5%	0%	0%
Competition	3%	0%	0%	5%	3%	10%	1%	2%	0%	0%

Table 7.5: Total percentage of thoughts produced in order for high (HL) and intermediate (IL) level golfers during putting in both practice and competition.

Themes	Thought 1		Thought 2		Thought 3		Thought 4	
	HL	IL	HL	IL	HL	IL	HL	IL
No thoughts								
Practice	0%	0%	16%	29%	38%	58%	79%	93%
Competition	0%	0%	30%	31%	50%	59%	89%	NA
Gathering information								
Practice	51%	67%	12%	8%	0%	0%	4%	0%
Competition	58%	61%	1%	9%	0%	0%	0%	NA
Club Selection								
Practice	2%	0%	2%	10%	0%	0%	0%	0%
Competition	0%	4%	1%	2%	0%	0%	0%	NA
Planning								
Practice	22%	14%	50%	33%	11%	7%	6%	0%
Competition	21%	15%	44%	35%	11%	0%	0%	NA
Evaluation								
Practice	14%	14%	15%	19%	40%	35%	11%	7%
Competition	13%	16%	16%	17%	37%	41%	9%	NA
Dwelling								
Practice	11%	5%	3%	0%	0%	0%	0%	0%
Competition	6%	4%	4%	2%	1%	0%	0%	NA
Technical Instruction								
Practice	0%	0%	2%	2%	3%	0%	0%	0%
Competition	2%	0%	4%	4%	1%	0%	0%	NA

Correlation analysis

Pearson's correlations were conducted between Technical Instructions produced during practice and competition and the two factors (decision reinvestment and decision rumination) of the DSRS.

Overall (all 16 participants) there was a low correlation between Decisional Reinvestment and Technical Instruction ($r = -.05$, $p = .86$) and a moderate correlation between Decisional Rumination and Technical Instruction ($r = .32$, $p = .23$) during the practice stage. However there was a fairly high correlation for Technical Instruction produced during competition and Decision Reinvestment ($r = -.62$, $p = .01$).

When analysing both levels of performer separately no correlations were found between Technical Instructions and the practice stage, however, in the higher skilled golfer group there was strong positive and significant correlation between Technical Instructions and Decision Reinvestment ($r = .74$, $p = .03$). In the intermediate skilled group there was found to be a high correlation between Technical Instruction provided during the competition stage and Decision Rumination ($r = .63$, $p = .09$).

Pearson's correlations were also conducted between the total amount of decisional factors verbalised and both decision reinvestment and decision rumination on the whole, during practice and competition and also analysing high and intermediate skilled golfers separately. Low correlations were observed between the total of number of decisional factors verbalised and decisional reinvestment ($r = .11$, $p = .68$) as well as decisional rumination ($r = -.09$, $p = .72$). In addition when analysing practice and competition separately low correlations were found between the total number of decisional factors verbalised during practice ($r = .15$, $p = .61$) and also decisional rumination ($r = -.14$, $p = .59$). Similar findings were found during competition and decisional reinvestment ($r = .09$, $p = .72$) and decisional rumination ($r = .04$, $p = .89$).

Further Pearson's correlations were low for decisional factor verbalised in high level performers between practice and decisional reinvestment ($r = .14$, $p = .73$) as well as decision rumination ($r = -$

.14, $p = .75$). Similar findings were also found in high level golfers between competition and decisional reinvestment ($r = .02$, $p = .97$) and decisional rumination ($r = .36$, $p = .38$).

Finally, Pearson's correlations were moderate for decisional factor verbalised in intermediate skilled performers between practice and decisional reinvestment ($r = -.46$, $p = .26$) and decisional rumination ($r = .47$, $p = .24$). Similarly, when looking at the competition condition and decisional reinvestment ($r = -.34$, $p = .41$) and decisional rumination ($r = .35$, $p = .40$).

DISCUSSION

This study aimed to investigate whether the introduction of stress influenced performance and thought process in high and intermediate level golfers. Results support the main hypothesis; under stress high level golfers were more likely to use technical rules and refer to their step-by-step mechanics of their swing in comparison to normal practice conditions. In addition, differences in decision making were apparent between the expert and intermediate level golfers.

Although the introduction of stress did not influence performance, overall, the present study found that golfers, independent of level of expertise, gathered more information and used more technical verbalisations during practice compared to competition. In addition, the expert golfers verbalized more technical putting instructions in competition than practice. A possible explanation for these findings is that in situations with increased levels of stress golfers are more likely to focus on the internal and technical aspects of performance rather than external or tactical considerations. Such an observation would be in line with reinvestment theory (Masters, 1992) which suggests that the pressure of competitive stress can make athletes focus on the step-by-step mechanisms of their shot rather than focussing on external targets and plans. Similar results have been reported by Beilock and Carr (2001) who also suggested that under competitive stress procedural thoughts and automatic skill execution is replaced by a step-by-step monitoring and control which can interfere with skill execution and performance.

Further findings from the DSRS found relationships between decision reinvestment and the verbalising of technical information during competitions, especially in the high level group. Kinrade et al. (2010b) also found that in 59 skilled team sports players' decisional specific reinvestment score correlated highly with coaches ratings of player's tendency to be affected by pressure. Recent research by Laborde, Dosseville and Kinrade (2014) explored the construct validity of the Decision-Specific Reinvestment Scale and its links with stress and coping appraisals. They found that instinctive athletes scored lower on the DSRS than deliberative athletes. Further investigations found that low reinvestors scored higher on perceived controllability, coping effectiveness and subject performance than those who were high reinvestors, indicating that those who are low reinvestors may cope better under pressure. Although during the current study no performance decrements were evident the findings to provide a possible explanation of how competition or pressure can change the thought process of the higher level performer. Furthermore in the intermediate group there was a relationship between decision rumination and technical information that was verbalised during competition, which means that those who are more prone to dwell on past shots may be more influenced during competition and their thought process may become more technical.

The present study also demonstrated differences in the quality and sequence of thoughts related to decision making between the intermediate and expert golfers. This further supports the findings from study 3 as higher level golfers displayed thoughts centred on planning whereas lower skilled golfers provided more technical thoughts during performance. In addition, higher skilled golfers were more likely to gather information about their surroundings, selection of their club, plan their shot and then evaluate whereas lower skilled golfers demonstrated much less planning thoughts. Further support of these findings have been found in laboratory golf studies by Beilock et al. (2002) and Calmeiro and Tenenbaum (2011) skilled golfers were more likely to use planning prior to shot execution and evaluation following shot completion compared to the intermediate golfers. The use of diagnostic thoughts following the execution of a shot can be considered an important aspect for future skill development. Research by Jonker et al. (2012) for example has indicated that those athletes who are able to reflect on what they have done were more likely to achieve elite status. In addition, McCaffrey

and Orlick (1989) self-report research indicated that touring professionals used planning and self-evaluation more systematically. It appears that dwelling on previous shots during golf might be important for skill development. Although this research was conducted in more ecologically valid way the study can't infer whether the ability to reflect and evaluate previous shots was the consequence or pre-requisite of being a more skilled golfer.

Alternatively, research has demonstrated that dwelling on past performances can have a detrimental effect on mood (Lyubomirsky, Boehm, Kasri, & Zehm, 2011). In addition, mental skill training packages in sport often emphasise playing in the moment and planning ahead (Rotella, 2007).

Particular in golf there is a significant amount of time between shots allowing for golfers to dwell on previous mistakes. This would suggest that although shot evaluation might be beneficial for skill development, it is important that the golfer is also able to let go of irrelevant information when hitting the next shot.

Similar to other expert/novice studies in sport (McPherson & Kenodle, 2007) and golf (Beilock et al., 2002; Calmeiro & Tenenbaum, 2011) the high level golfers in the present study made more use of planning (i.e., club selection and planning the shot) for their wood/iron shots and putts (planning shot) compared to the intermediate players during practice. For the competitive phase the high level golfers only engaged in more planning during their putting. This could possibly be because it is thought that, "putting is the heart of golf", and "the objective of golf is to put the ball in the hole" (Rotella, 2007, pg. 144). More specifically statistics show that the top ranked players on the PGA average around 28.3 putts per round which makes up approximately 39% of the total shots played on a course with a par of 72 (www.pgatour.com/webcom/stats/stat). In comparison only 25% of shots are played off the tee, which may explain why players are committing more time to planning their putts during competition.

The present study also analysed the sequence of thoughts related to decision making. Consistent with the notion of increased pre-shot planning in experts (McCaffrey & Orlick, 1989; Thomas & Over, 1994) the high level golfers most common thought process during wood/iron shots in practice and

competition was gathering information, select a club, plan the shot and evaluate. Intermediate golfers also gathered information and selected the club as their first and second thought for their wood/iron shots during both practice and competition. However, they rarely engaged in shot planning and also infrequently evaluated their shot. In many instances intermediate golfers only had two thoughts. The findings in the present study are in line with those of McPherson (2000) in expert tennis players. She showed that expert tennis player's access and associate more varied, sophisticated, and interrelated concepts than novices and process more information relating to the current event profiles and action plan profiles for developing and planning response selections. The present study suggests that the sequence of thought processes in golf with increasing expertise become invariant across situations.

Club selection in golf is an important aspect as is the consideration on how to hit the shot. Developing expertise appears to be associated more with the latter. This might be partly due to higher level golfers having more options in their repertoire to hit the shot. In addition, higher level golfers take more note of the lay-out of the course and other environmental factors. This observation is in line with the findings by Thomas and Over (1994) who showed skilled golfers gave greater thought to how best to play the course and shots and reported having a more consistent pre-shot routine that involved planning and mental rehearsal. However, longitudinal research is required to assess whether planning of the shot develops with increasing skill level (lower handicap) or whether through coaching golfers can speed up this process and improve their game.

During putting all golfers would gather information, plan and evaluate during practice and competition. However, whereas the intermediate level golfers generally did not have more than two thoughts during both practice and completion the expert golfers generally had only two thoughts during competition. Overall the expert golfers produced a higher number of thoughts prior to execution of putts. Most shots in golf are played on the green with the putter (www.pgatour.com). It is therefore not surprising that the expert golfers had more thought processes. However, it appears that the competitive setting reduced the number of thoughts prior to skill execution. An explanation for this could be that the present study asked golfers for explicit knowledge when playing practice and completion golf. This is knowledge of their game that is rule based and available to consciousness

(Reber, 1993). It might be that higher level golfers engage in behaviours which have become automatic and as such become less verbalisable. The performers may be attending less overall to the general processes they use to play a shot in golf. Beilock and Carr (2001) proposed the theory of 'expert amnesia' where due to the wealth of generic knowledge about golf higher level golfers may find it difficult to recall information about their specific performance. However, when it comes to putting the higher levels golfers may put a higher level of importance on the putt which could result in recalling of more technical elements of their putting performance during competition. Beilock et al. (2002) placed high level golfers in a novel situation (an unusual shaped putter) which required them to pay more attention to the steps involved and as a result these golfers were more able to store this information in their episodic memory and recall it much easier. As this becomes a new skill for the participant they will use explicit strategies to learn. Therefore this may be equivalent to stress and there would be a regression to an earlier mode of skill execution. The introduction of the competition, as previously mentioned could have been similar to the novel task provided by Beilock et al. (2002) and as a result high skilled participants in this study were able to recall step-by-step technical information about their putting.

It is important to highlight a number of limitations as firstly decision making is not always a conscious process and an important limitation of the present study is that it cannot assess what happens to the decision making process outside of awareness (Bowers et al., 1990; Jacoby, Lindsay, & Toth, 1992; Wegner, 1994). That being said, the study is aiming to identify what the performer consciously attends to and uncover the differences between two skill levels.

Furthermore, the study aimed to put differing levels of golfers under higher levels of stress through their participation in a competitive situation. It is recommended that future research looks at the extent to which these performers perceive the competition as a stressful or anxious situation and one way of doing that would be for participants to complete a pre-performance questionnaire such as the Competitive State Anxiety Inventory- 2 (Martens, 1990) prior to competing. In addition attaching heart rate monitors to participants and collecting salivary cortisol samples (Coetsee, 2011) during

practice and competition would also provide a further variable which could be used to measure stress levels.

This study presented a number of important findings. Firstly, that when faced with the pressure of a competition higher level golfers' thought process changed and possibly regressed to less automatic and a more mechanical step-by-step process. Secondly, clear differences in the thought processes of high and intermediate level golfers during both practice and competition were found. The study has highlighted that although those in the higher level group did show a more sophisticated sequence of thoughts, these golfers still demonstrate a clear weakness in their thought process in comparison to the intermediate level golfers in that they spend more time dwelling on past shots which they can no longer control. This study does provide coaches, psychologists and golfers with key findings that higher level golfers do display more consistent thought processes than lower level golfers. However, future research could aim investigate the less common but detrimental cognitions that higher level golfers bring to their game in order to separate the 'good' from the 'great'.

CHAPTER 8

GENERAL DISCUSSION

The purpose of this thesis was to first explore a suitable methodology to examine decision making in sport and secondly to explore the role of skill level differences and pressure on the decision making process. In particular, this thesis used the sport of golf to examine whether thinking aloud was a suitable methodology to do this and how decision making in golf varied based on skill level and under a pressure situation.

8.1 REVIEW OF FINDINGS

Study 1 employed Think Aloud protocol to investigate differences in decision making between high and low skilled golfers during a putting task and to examine the difference verbalisation instruction between skill levels that contribute to the performance outcome. This study had a second aim which was to investigate if the think aloud protocol interfered with motor performance. All golfers were in one of three verbalisation conditions: (a) Level 2 verbalisation, (b) Level 3 verbalisation, (c) no verbalisation control condition. It was found that the use of think aloud verbalisations at either Level 2 or Level 3 did not impair putting performance compared to the control condition. Since no performance decrements were evident, think aloud was proposed to be a viable method for exploring decision making in golf. In addition, a higher volume of verbalisations were present in the Level 3 Think Aloud group and differences were found in the decision making between high and low skilled golfers. High skilled golfers verbalised more about gathering information and planning before taking their putt, whereas lower skilled golfers focussed more on the technical aspects of their putting.

Study 2 conducted an investigation into the most appropriate method of collecting decision making data in golf. Study 2 compared the think aloud protocol and retrospective recall (interview at different time frames post performance) to establish if there were discrepancies in the reported variables influencing

decision making in golf. Each participant's verbal reports recorded during think aloud and interview were transcribed verbatim and units of information were coded according to 34 different first order themes, and 11 second order themes. Large discrepancies were found between the information reported during think aloud and at interview, with only 38-41% similarity in variables reported to influence decision making on each hole. In particular, at interview, participants did not report the pre-performance activity that was engaged in during the six holes. For example, the choosing of targets to aim for on a shot, cleaning of the ball, and practice shots performed, while this was reported using think aloud but not during interview. These findings suggest retrospective recall of decision making is limited since relevant information is lost due to memory decay or participants refer to a general schema (Eccles, 2012). Future research should record decision making processes in event, employing the think aloud protocol.

Studies 1 and 2 both support the use for Think Aloud as an appropriate method for collecting in event decision making data. Study 1 demonstrated that contrary to previous findings in other areas of performance (Klatzky, 1984) thinking aloud at Level 3 does not have a negative effect on motor performance. In fact it provided the researcher with a more detailed data set about the golfer's thought process in event. Study 2 also provided evidence to further support the Think Aloud methodology as large discrepancies were found between the information provided during think aloud and the information provided during retrospective interviews. Therefore, based on these two sets of findings, study 3 and 4 opted to use Think Aloud at Level 3 to investigate the decision making processes between varying levels of skilled golfers and in different levels of pressured situations.

Study 3 aimed to develop and contribute to previous research in decision making in sport by comparing high and low skilled golfer's thought process throughout the performance of the same six holes using Think Aloud at Level 3. Wood/iron shots were separated from putting and analysed separately. During wood/iron shots, higher skilled golfers centered their decisions around gathering information significantly more than lower skilled golfers. Similarly, during putting, higher skilled golfers planned their putts significantly more than lower skilled golfers. The findings of this study are consistent with theories of skill acquisition (Fitts & Posner, 1967; Beilock et al. 2002), in that the higher skilled golfers

were more focussed on external tactical factors during their performance and less reliant on step-by-step monitoring of their performance. Further analysis of the order in which decisions were made between the two skill levels, revealed that the most common sequence of thought during wood/iron shots for a high skilled golfer was to gather information, select the club, plan and then provide an evaluation following the execution, in comparison to a low skilled golfer's sequence, which involved gathering information, selecting the club and then to evaluating the shot. This was similar during putting, as high skilled golfers gathered information, planned and executed whereas low skilled golfers planned significantly less and, therefore, the most common second thought was to evaluate.

Study 4 aimed to progress the findings of Study 3 in two ways, firstly by introducing an intermediate skill level and secondly by introducing a stressor of a competition to the performance. All 16 participants (8 in the high skilled group and 8 in the low skilled group) played both a practice round of six holes and a competition round of the same six holes whilst thinking aloud. The competition phase of the experiment involved participants winning valuable prizes worth up to £100 and the competition was set up as an official club stroke play competition in order to create as close to a competition environment as possible. A presentation ceremony took place following the completion of the competition. Findings revealed that the introduction of a monetary prize resulted in the high skilled group to verbalise more technical rules during competition than the practice round. No differences in the outcome of the performance (shots taken) were found. Further findings revealed that higher skilled golfers reported more about planning and evaluating after the shot had been performed and that high skilled golfers would dwell on previous shots more than intermediate skilled golfers. However no differences were found in the frequency of reported themes for intermediate level golfers between practice and competition. Results were broken down in to wood/iron shots and putting. It was found that during wood/iron shots higher skilled golfers verbalised about selecting their club and planning in more shots than the intermediate skilled golfers and during competition the higher skilled golfers verbalised more about planning their putts in comparison to intermediate level. Further analysis of the order in which golfers made decisions during wood/iron shots revealed very similar findings to study 3 in that during practice and competition a high skilled golfer was most likely to gather information, select

the club, plan their shot and evaluate after execution, whereas intermediate skilled golfer's third thought during practice would most likely be to evaluate the shot rather than plan. During competition, however, the intermediate skilled golfer would be most likely to gather information, plan and then evaluate. Although club selection was evident, it was never the most common thought in the process. This demonstrates differences in the thought process of high and intermediate levels golfers and when linking it to the low skilled performers in study 3 another skill level difference can be seen. This difference is evident in the planning variable as intermediate level golfers will engage in high levels of planning, whereas lower skilled golfers will not. Which can create a decision making continuum from low to intermediate and higher skilled golfers.

In study 4 both high and intermediate skilled golfers during putting in practice and competition would gather information, plan and evaluate their putt after execution. However, higher skilled golfers displayed on average more thoughts during the putting process than intermediate skilled golfers. This study demonstrated that during competition, high skilled golfers will revert to earlier stages of information processing which could possibly be a results of reinvestment (Masters, 1992) and that high and intermediate skilled golfers use different decisional rules and display different thought patterns during performance in both practice and competition.

8.2 CRITICAL EVALUATION AND LIMITATIONS

Throughout all of the studies conducted in this thesis, there will be the limitation that decision making is not always a conscious process and that one cannot access what happens to the decision making process outside of awareness. Unconscious processing is difficult to verbalise and the mechanisms that mediate the process of unconscious processing are still widely discussed in cognitive psychology (Nisbett & Wilson, 1977; Deheane et al., 1998; Elsner et al., 2008). For example, Nisbett and Wilson (1977) highlighted how an individual's ability to provide valid reports of cognitive processes could prove difficult. In their study on selecting items in a clothing shop it was found that participants would prefer items presented to the right of them above the ones to the left by a factor of 4 to 1.

However, none of the participants indicated that the positioning of the items was related to their decision making process. Nisbett and Wilson (1977) argue that there are limits to what can be accessed consciously. Instead participants may give implicit theories about their thought process. If a performer does not have direct verbal access to their control process, especially if they are automatic, it may lead to a performer reporting cues that they expect or have been told are important. This is an important issue, hence in sport golfers are taught to develop pre-performance routines and make these as automatic as possible. As such, golfers might report what they should do rather what they actually do.

Two ways in which implicit knowledge has attempted to be investigated are through cue occlusion and eye movement recording. Cue occlusion research has found that skilled participants use advance cues to anticipate their opponents' actions (Mann, Williams, Ward & Janelle, 2007). Ward, Williams and Bennet (2002) demonstrated that expert athlete's decision making skills could be directly related to gaze behaviour. Campbell and Moran (2014) measured gaze patterns in professional, elite-amateur and club level golfers. They asked participants to read the shape of a virtual golf green from six different positions and found that professional golfers were more economical with their gaze patterns, which consisted of fewer fixations of longer durations in comparison to elite-amateur and club level golfers. Further research in football and decision making has found gaze behaviour that was towards open space with more fixations of less duration lead to more effective decision (Mann, Farrow, Shuttleworth & Hopwood, 2009). Such research is related to Milner and Goodale's (1995) findings of different visual pathways regulating action. They proposed two different pathways for the visual system, one for action and one for perception. Goodale and Milner (1992) demonstrated that in neuropsychological studies of patients there was a dissociation between object directed action and object recognition. Therefore, an athlete may not always be able to verbalise their action but rather their object recognition. Although both cue occlusion and eye movement recordings might provide information on possible unconscious sources used for decision making these are difficult to implement in real sporting situations and as such might lack ecological validity. In addition, the role

of the perceptual system varies across different sports. Whereas fast team games would benefit from accurate decision making which is quick this is of little relevance to self-paced sporting activities.

By asking participants to think aloud using level 3 verbalisation (which was done throughout all of this thesis) Ericsson and Simon (1993) argue that this type of think aloud may not actually represent the actual decision-making process as it may trigger the verbalisation of data that possibly would not be heeded if a different set of instructions were used (Level 2 TA). This contention had some support in the present thesis. Hence in study 1 participants using Level 3 think aloud produced a higher volume verbalisations in comparison to those who verbalised using Level 2, although verbalising using Level 3 think aloud did not impair performance.

Nisbett and Wilson (1977) argue that Level 3 TA is asking participants to access cognitions that are not accessible and as a result implicit theories may emerge. However, this form of data collection was thought to provide more detailed data about the golfer's decisional processes and contribute to the golf coaching and research environment by providing comprehensive results that show differences between how a higher and lower skilled golfer processes information in both practice and competitive settings. Problems associated with Level 2 Think Aloud is that there is no independent means of assessing their completeness (Wilson, 1994). Furthermore, Ericsson and Simon (1993) acknowledge that even concurrent reports will be incomplete under some circumstances because some cognitive processes are not part of focused attention, or appear in a form that is not easily verbalisable. Therefore, Level 2 Think Aloud verbalisation may not provide enough detail of the thought processes involved in the decision during golf performance.

A further criticism of using think aloud can be found in research by Ball, Marsh, Litchfield, Cook and Booth (2015). They provided evidence for the argument that think aloud may reduce the likelihood of participants being able to verbalise some thought processes that are less easy to verbalise. The study in question examined a problem solving task and was based on how individuals may find it difficult to describe the process of solving a problem. Findings of this study could be limited by the speed at which the solution came to mind (Maier, 1931) or that the solution process is non-reportable by nature

(Knoblich, Ohlsson, & Roney, 2001). Ball et al. (2015) based their study on the ‘special-process’ theory (Bowden, Jung-Beeman, Fleck, & Kounios, 2005). This theory suggests insight and non-insight problems have different mechanisms. Insight problems involve the special process theory (Bowden et al., 2005), where insight involves non-reportable processes that function at an implicit and non-conscious level in order to change the current unsuccessful representation of a problem into a new reorganized representation that can lead to a solution. Ball et al. (2015) argue that if the opportunity to engage in conscious speech based processing is reduced then this should enable more effective ‘special processing’ to take place at a non-conscious level that can more readily gain strength and emerge into consciousness. Ball et al. (2015) conducted a study that involved distracting speech-based processing using either articulatory suppression or irrelevant speech and found support for verbal overshadowing which supported the special-process theory of insight. Based on Ball et al. (2015) argument, using think aloud verbalisation may limit the extent to which data of decision making in golf can be collected as asking participants to think aloud inhibits the ability for non-conscious processing to emerge into consciousness.

Schooler and Engdttler-Schooler (1990) provided evidence for verbal overshadowing and found that a disruptive effect occurs through verbally reporting as verbal-overshadowing occurs as the formation of a verbally biased memory representation that overshadows original visual memory. It is argued that by asking participants to explain and describe in an exhausting way such as what might be required in Level 3 verbalisation may result in reactive effects on task process and can influence the performance of a task. However, as golf is not a ‘problem solving’ task and those in the higher skilled groups may find verbalising at this level easy and accessible it could be argued that depending on the participants learning journey or how familiar they are with the task could result in less disruption. As such the role of task characteristics on TA would require further research.

To investigate whether what is verbalised during performance is congruent with actual behaviour, further research could investigate whether a golfer’s concurrent real time verbalisation match their behaviour through behaviour analysis or observations. This can be done either from real time researcher observations or video observations following performance. Webster et al. (2013) conducted

similar research in coaching behaviour. Although they did not collect coaches' thoughts in event, they still were able to compare the congruence between coaches' own perceptions from interviews and compared those to actual coaching behaviour observed via video. With the increase of programs to observe and analysis sport behaviour (e.g. sport coach) it will be easier in the future to conduct such studies.

Another issue relates to the ecological validity of the studies. First, study one was conducted on an artificial indoor putting green. This was done to maintain a high level of experimental control.

Similarly, in study 3 and 4 the golfers played on their own. In normal golf competitions are conducted in groups of 2 to 4. In addition, the golfers experienced different environmental conditions which might have contributed to variation in behaviour on the course.

A critical question of this thesis may be that participants were not asked to verbalise their thoughts during the actual playing of the shot (swing and execution of the ball). Although it is noted that it is possible that thoughts arising during the actual swing of the club influenced behaviour. However, this was done in order to reduce the possibility of concurrent verbalisation disrupting motor performance. According to Schmidt and Wrisberg (2000) executing a movement in a conscious manner often tends to what they have termed as paralysis by analysis. Although performers were not directed in terms of what to focus their thoughts on and clear differences were found between high and low skilled golfers in terms of what was verbalised, participants were not instructed to verbalise during performance in order to try and reduce any sort of interference with the motor movement. In addition, Masters and Maxwell (2008) put forward the theory of reinvestment which proposes that if an individual is required to consciously control movements online then this explicit process could reduce the function of working memory which deliberates automatic processing and breaking down skills (Masters & Maxwell, 2004). Although this is thought to mainly occur when an individual is under pressure, by asking participants to verbalise thought processes during performance when they are not used to doing so could have an adverse effect on the execution process of the skill.

An important limitation of study 4 included the lack of an objective assessment of stress levels. This could have been done through attaching heart rate monitors to participants and collecting salivary cortisol samples (Coetzee, 2011) during practice and competition as this would provide a further variable which could be used to measure stress levels. In addition, if participants were to complete a pre-performance questionnaire such as the Competitions State Anxiety Inventory- 2 (Martens, 1990) prior to competing and practice this would provide an indication of the extent to which the performers perceive the competition as stressful or anxious.

A further potential limitation to this thesis is skill level of the 'high skilled' participant. Although handicaps did range from 2.25-5.3 which are deemed as relatively high level it could be argued that these participants are not elite and therefore, may not be in the automatic stage of learning (Fitts & Posner, 1967). For example, in study 1 although the high skilled groups golfing handicap indicated a high level of ability the number of putts holed (36.67% across the 3 conditions) would indicate scope for improvement. Polman (2012) argued that there are inconsistencies in the criteria among expertise literature. A lot of the research conducted in this thesis contained relatively young participants in the high skilled groups (as young as 16) and it could be argued that these participants have not yet achieved their maximum potential of 'expert performance' as they have not experienced ten years of intense preparation (Chase & Simon 1973) or experienced the correct number of years where deliberate practice has been employed to improve specific aspects of that domain specific performance (Ericsson et al, 1993). Considering these issues, this thesis chose to refer to the participants as 'high skilled'. Calmeiro and Tenenbaum (2011) have used 'experienced' participants with handicaps as high as 18 and 13. As such this thesis has used higher skilled of golfers with handicaps as low as 0 (scratch). Overall, the use of the golf handicap system provides researchers with an objective measure of ability. However, it cannot clarify in which stage of the learning process a golfer is. Since golf is not an overlearned skill this will be difficult to determine.

Finally, although to the best of the author of this PhD's knowledge there are no gender differences in verbalisation ability or decision making in golf, it is evident throughout this thesis that all but one

participant was male. Therefore, it is possible that the under representation of female golfers within this thesis constitutes as a confounding variable.

8.3 THEORETICAL IMPLICATIONS

This thesis makes an original contribution to the understanding of decision making in sport research and has a number of important implications. Firstly, that Think Aloud verbalisation appears to be an appropriate method of data collection when measuring behaviour or thought processes during a self-paced event such as golf. Being able to measure the thought process concurrently enables researchers to collect data during performance of golf and other sports which would minimise the event-recall period and increase the likelihood of collecting accurate data (Folkman & Moskowitz, 2004; Ptacek, Smith, Espe, & Raffety, 1994; Smith, Leffingwell, & Ptacek, 1999; Stone et al., 1998).

By using think aloud verbalisation in both an artificial and real environment this thesis has been able to identify mechanisms that facilitate a more superior performance (Ericsson & Smith, 1991). It has been proposed that through thousands of hours of domain specific practice performers will develop a higher cognitive processing mechanism that is extremely specific to that domain (Ericsson & Lehman, 1996). Although specific number of hours were not used as a measure within this thesis, it was assumed that those with lower handicaps had accumulated more hours of domain specific deliberate practice (Ericsson, 2006), and as a result this thesis provided support and evidence that those higher level golfers displayed more tactical, external cognitive processing mechanisms. These more sophisticated mechanisms correspond with Fitts and Posner's (1967) model of skill development as the higher level golfers displayed evidence of automaticity in that they would report minimal technical step-by-step mechanical processes during performance. In addition, the findings from the lower skilled performers in this thesis correspond with the skill development literature in that their thought process was centred on declarative knowledge of their performance (Beilock et al., 2002) and involved step-by-step mechanical processes as proposed by Fitts and Posner (1967) when classifying performers in the earlier, cognitive phase of learning.

Results found in Study 4 extend the application of Masters (1993) theory of reinvestment to decision making in golf. As high skilled golfers were focussing more on the step-by-step mechanisms of their shot at hand rather than focussing on their external targets and plans which could have been due to the increased pressure during competition. Masters, Beilock and Carr (2001) proposed that high skilled golfers have a procedural thought base and therefore if they have to explicitly monitor performance due to pressure (in this case a competition) this will create a step-by-step monitoring and control of complex, procedural knowledge. As this complex procedural knowledge would usually be automatic, this step-by-step monitoring may disrupt skill execution. Although the result of a competition did not cause a decrease in performance for high skilled golfers, it did cause golfers to attend to the step-by-step monitoring of their putting skill in more shots than it did in practice. Furthermore, findings from the Decision Reinvestment Scale demonstrated that those participants in the high level group who were more susceptible to reinvest found to report more technical thoughts during competition. This coincides with Kinrade et al. (2010b) who found that high scores on this scale reflect a strong tendency for conscious monitoring of the decision making process and parallels the conscious monitoring and control of movements in the motor domain (Masters et al., 1993).

8.4 APPLIED IMPLICATIONS

This thesis also makes an original contribution to the applied world of golf. As an applied tool Think Aloud can help a player and coach better understand the variables that a player considers when playing a shot and the amount of information gathering and planning that goes into a shot. Therefore, it could be argued that the development of expertise in golf requires not only the development of the motor skill but also thought processes. Skilled golfers spend more time gathering information and planning their shots than novices. Therefore, a golfer in the early stages of learning may be aided in their development by coaching and tuition about variables that should be considered when planning a shot.

Later on in a golfer's development, coaches, athletes or sport psychologists could use the information provided in this thesis to improve the structure of the thought processes or pre-shot routines of a golfer so that they are attending to appropriate stimuli within their environment at certain times of their shot delivery. This exact process has already been used by the author of this thesis. Elite level golfers have engaged in the think aloud process and their verbalisations have been transcribed and analysed by both the author of this thesis and the golfers coach. The golfer, coach and author of this thesis have then worked together to create reports for the golfer. Following this, interventions were implemented to improve decision making during golf performance. These elite level golfers have also reported that this tool has helped them to be more aware of how and what they think about during performance, which has improved their all-round golf game.

Furthermore, coaches and sports psychologists can use the information in this thesis to identify what may be happening to a golfer's performance when faced with the pressure of a competition. If a coach is able to identify players who are more prone to reinvestment then the coach could work with the golfer to focus on appropriate environmental stimuli during competition.

In addition, a higher variability of golfers needs to be investigated in order to be able to measure what true elite level golfers (European tour and PGA) think about in comparison to those who are 'high level', 'intermediate level' and 'beginner level' as this would allow for a continuum to be created and aid coaches in identifying the decisional process level of their performer.

8.5 FUTURE RESEARCH DIRECTIONS

Further research using TA protocol could be used to gain a clearer understanding of what are the most important variables that a golfer should consider during each stage of the decision making process. This would involve a more refined micro analysis which could inform the golfer of strategies which are successful or unsuccessful in their execution. For example, investigating the exact variables that are most appropriate when gathering information, planning a shot, followed by what are the most appropriate reflections and evaluations that should be provided following shot execution. This could

be obtained by conducting similar research on the next level of performer, such as those playing at professional levels such as European Tour and PGA standard, in addition to study those who are 'high level', 'intermediate level' and 'beginner level' as this would allow for a continuum to be created and aid coaches in identifying the decisional process level of their performer. Furthermore, it could be recommended to conduct very similar research on female golfers in order to investigate gender differences and provide conclusive evidence from data that has investigated a wider population.

Think aloud protocol analysis has the ability to collect real time in event data, which is more ecologically valid. Therefore this type of data collection method would be ideal for collecting data in areas such as stress and coping. Furthermore, this could also be used to examine psychological skills used during performance and the psychological preparation strategies that differing levels of golfers use during performance. Gathering this type of data on elite level performers will not only add to the current academic literature but also inform coaches, players and sport psychologists of how those at the top gathering and process information as well as deal with the high pressured situations in sport.

8.6 CONCLUSIONS

The central theme of this thesis extended the application of Fitts and Posner's (1967) theory of skill acquisition to decision making in golf, as those in the earlier stages of learning exhibited characteristics of cognitive learners where they will attend to a motor skill in a step-by-step mechanical fashion which is operated by declarative knowledge. As a performer progresses, this motor skill becomes more automatic, focusses less and less of the cognitive processing of the skill and will focus on other areas of the performance such as tactics or the external environment. This thesis has found exactly that, as those golfers in the low skilled groups focussed on technical step-by-step information to guide their execution whereas those in the higher skilled groups, focussed much less on the technical aspects of performance and more on the external and tactical aspects of performance such as gathering environmental information and planning each shot at hand. Furthermore, this thesis also extended the application of Maters (1993) theory of reinvestment to decision making in golf as it

found that when placed in a stressful or higher pressured environment, those in the higher stages of learning or those who were higher skilled would sometimes regress and cognitively attend to the more technical aspects of their motor skill.

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APPENDIX A

STUDY 1 INFORMATION SHEET FOR GROUP 1

Group 1 Level 2 think aloud

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E-mail - RCJPolman@uclan.ac.uk

Dear participant,

My name is Amy Whitehead and I am a Phd student at the University of Central Lancashire. I am conducting my first study for my Phd, supervised by Professor Remco Polman, which is investigating how different types of verbalisation effect putting performance. If you chose to participate in this study you will be performing 30 putts on an indoor putting green from 3 meters. This will be broken down into three sets of 10 putts with a one minute break between each set and should take no longer than approximately ten minutes. You will be asked to use level 2 think aloud recall, which require's you to verbalise out loud what you are thinking during each putt; full instructions of how to do this will be given prior to the experiment. Participation in the study is voluntary, and if you choose to participate you are free to withdraw at any time up until the end of the study. If you do choose to withdraw, your data will be shredded. You will remain anonymous throughout the study and your name and email given on the signup sheet will only be used to organise time slots for your participation and after you have participated in the study your name and email will not be used as you name will be replace with a number. During the study when your name and details will be provided, this information with be stored securely in a locked filling cabinet, furthermore you will not be named in any academic reports. Please indicate verbally whether or not you would like to participate in this study. If you have any further questions please feel free to contact me at the above address.

Thank you for your participation,

Kindest Regards,

Amy Whitehead

APPENDIX B

STUDY 1 INFORMATION SHEET FOR GROUP 2

Brief: Group 2: Level 3 think aloud

Amy Whitehead

E-mail –AWhitehead1@uclan.ac.uk

School of Psychology

Darwin Building

University of Central Lancashire, Preston

Supervisor: Remco Polman

Email- RCJPolman@uclan.ac.uk

Dear participant,

My name is Amy Whitehead and I am a Phd student at the University of Central Lancashire. I am conducting my first study for my Phd, supervised by Professor Remco Polman, which is investigating how different types of verbalisation effect putting performance. If you chose to participate in this study you will be performing 30 putts on an indoor putting green from 3 meters. This will be broken down into three sets of 10 putts with a one minute break between each set and should take no longer than approximately ten minutes. You will be asked to use level 3 think aloud recall, which require's you to verbalise and provide explanations of your thoughts of the putting task and provide an explanation of why you performed the putting task in the way that you did. A more thorough explanation of how to do this will be given prior to conducting the experiment. Participation in the study is voluntary, and if you choose to participate you are free to withdraw at any time up until the end of the study. If you do choose to withdraw, your data will be shredded. You will remain anonymous throughout the study and your name and email given on the signup sheet will only be used to organise time slots for your participation and after you have participated in the study your name and email will not be used as you name will be replace with a number. During the study when your name and details will be provided, this information with be stored securely in a locked filling cabinet, furthermore you will not be named in any academic reports. Please indicate verbally whether or not you would like to participate in this study. If you have any further questions please feel free to contact me at the above address.

Thank you for your participation,

Kindest Regards,

Amy Whitehead

APPENDIX C

STUDY 1 INFORMATION SHEET FOR GROUP 3

Brief: Group 3: Control

Amy Whitehead

School of Psychology

Darwin Building

University of Central Lancashire, Preston

Supervisor: Remco Polman

E-mail –AWhitehead1@uclan.ac.uk

Dear participant,

My name is Amy Whitehead and I am a Phd student at the University of Central Lancashire. I am conducting my first study for my Phd, supervised by Professor Remco Polman, which is investigating how different types of verbalisation effect putting performance. If you chose to participate in this study you will be performing 30 putts on an indoor putting green from 3 meters. This will be broken down into three sets of 10 putts with a one minute break between each set and should take no longer than approximately ten minutes. Participation in the study is voluntary, and if you choose to participate you are free to withdraw at any time up until the end of the study. If you do choose to withdraw, your data will be shredded. You will remain anonymous throughout the study and your name and email given on the signup sheet will only be used to organise time slots for your participation and after you have participated in the study your name and email will not be used as you name will be replace with a number. During the study when your name and details will be provided, this information with be stored securely in a locked filling cabinet, furthermore you will not be named in any academic reports. Please indicate verbally whether or not you would like to participate in this study. If you have any further questions please feel free to contact me at the above address.

Thank you for your participation,

Kindest Regards,

Amy Whitehead

APPENDIX D

THINK ALOUD EXERCISES USED IN STUDY 1

THINK ALOUD INSTRUCTIONS FOR LEVEL 2 THINK ALOUD PARTICIPANTS

In this experiment we are interested in what you think about whilst executing the golf putting task. In order to do this we are going to ask you to **THINK ALOUD** during the completion of the golf putting task.

What we mean by think aloud is that we want you to say your thoughts out loud while you are getting ready to execute the task and while you are hitting the 30 putts. We would like you to talk aloud as much as you comfortably can during this time. Don't try to plan or explain what you say. Just act as if you are alone and speaking to yourself. Keep talking while you are thinking and putting golf balls. If you are silent for a long time we will remind you to keep talking. We would like you to talk aloud throughout this period apart from when you are about to move the club backwards to hit the putt. As soon as you have finished hitting the putt we would like you to continue thinking aloud.

We want you to think those thoughts out loud as they occur to you. Don't explain your thoughts to someone else! Just say what you are thinking – even if this doesn't always seem grammatical or you're afraid it won't make sense!

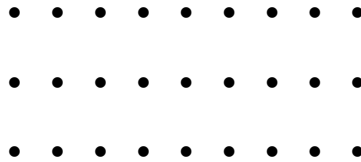
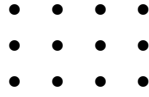
It is important that you keep talking.

We will record your thoughts.

Do you understand what we want you to do?

We will begin with a practice trial. Please think aloud while you generate your answer. We are going to show you a dot grid and ask you to tell us how many dots there are in the grid.

THINK ALOUD WARM UP SHEET FOR PARTICIPANTS



$$74 + 36 =$$

$$3 + 4 + 8 + 2 + 3 =$$

APPENDIX E

THINK ALOUD EXERCISES USED IN ALL STUDIES

THINK ALOUD INSTRUCTIONS FOR LEVEL 3 THINK ALOUD PARTICIPANTS

In this experiment we are interested in what you think about whilst executing the golf putting task. In order to do this we are going to ask you to **THINK ALOUD** during the completion of the golf putting task.

What we mean by think aloud is that we want you to say your thoughts out loud while you are getting ready to execute the task and while you are hitting the 30 putts (STUDY 1) OR playing your six holes of golf (STUDY 2, 3 AND 4). We would like you to talk aloud as much as you comfortably can during this time. Just act as if you are alone and speaking to yourself. Keep talking while you are thinking. If you are silent for a long time we will remind you to keep talking. We would like you to talk aloud throughout this period apart from when you are about to move the club backwards to hit the putt or shot. As soon as you have finished hitting the putt OR shot we would like you to continue thinking aloud.

We want you to think those thoughts out loud as they occur to you. Where you can try and elaborate and explain your thoughts. For example, why you are going to select a 9 iron, or why you are aiming at the right edge of the hole or the green. Just say what you are thinking – even if this doesn't always seem grammatical or you're afraid it won't make sense!

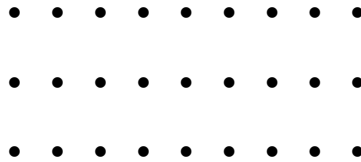
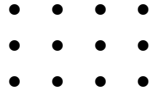
It is important that you keep talking.

We will record your thoughts.

Do you understand what we want you to do?

We will begin with a practice trial. Please think aloud while you generate your answer. We are going to show you a dot grid and ask you to tell us how many dots there are in the grid.

THINK ALOUD WARM UP SHEET FOR PARTICIPANTS



$$74 + 36 =$$

$$3 + 4 + 8 + 2 + 3 =$$

APPENDIX F

STUDY 1 SCORE SHEET FOR BOTH PRE-PUTTING PERFORMANCE AND PUTTING PERFORMANCE

Pre putt scores	Putting Scores	Verbalisation Level	Skill Level
3.00	2.00	control	low
1.00	3.00	control	low
7.00	6.00	control	low
2.00	.00	control	low
6.00	13.00	control	low
2.00	3.00	control	low
3.00	2.00	control	low
1.00	4.00	control	low
3.00	3.00	control	low
2.00	1.00	control	low
7.00	14.00	level 2	low
3.00	.00	level 2	low
1.00	6.00	level 2	low
4.00	8.00	level 2	low
5.00	11.00	level 2	low
3.00	6.00	level 2	low
2.00	5.00	level 2	low
1.00	7.00	level 2	low
1.00	6.00	level 2	low
2.00	3.00	level 2	low
4.00	5.00	level 3	low
2.00	4.00	level 3	low
2.00	6.00	level 3	low
3.00	1.00	level 3	low
7.00	14.00	level 3	low
1.00	8.00	level 3	low
4.00	7.00	level 3	low
5.00	12.00	level 3	low
2.00	8.00	level 3	low
2.00	8.00	level 3	low
2.00	9.00	control	high
7.00	3.00	control	high
6.00	12.00	control	high
9.00	12.00	control	high
1.00	14.00	control	high
1.00	7.00	control	high
4.00	12.00	control	high
5.00	7.00	control	high
4.00	9.00	control	high
9.00	9.00	control	high
3.00	14.00	level 2	high
7.00	5.00	level 2	high
6.00	19.00	level 2	high
7.00	16.00	level 2	high
4.00	14.00	level 2	high

5.00	17.00	level 2	high
5.00	5.00	level 2	high
2.00	9.00	level 2	high
3.00	9.00	level 2	high
6.00	15.00	level 2	high
5.00	9.00	level 3	high
7.00	9.00	level 3	high
6.00	17.00	level 3	high
5.00	13.00	level 3	high
8.00	2.00	level 3	high
2.00	19.00	level 3	high
5.00	8.00	level 3	high
3.00	4.00	level 3	high
6.00	12.00	level 3	high
2.00	19.00	level 3	high

APPENDIX G

EXAMPLE OF LEVEL 2 THINK ALOUD TRANSCRIPTS FROM STUDY 1

Right, don't know what I'm doing here.

Like this grip.

Missed that one.

Make sure my hands are in front of my body.

A bit right need to slow it down.

Do you want to hit it any softer you absolute knob!

This is a stupid green, I hate it.

Missed that left.

Let's make two in a row shall we get something going here.

Three in a row.

Ahh maybe next time.

That went in, I can't believe you're a one handicap this is not good.

That was a sweet strike, that's why it went into the hole.

Yes good strike.

I wonder what's for dinner I'm starving.

This is making me tired.

Energy levels are getting better. Yes maybe just a little bit.

Maybe I should concentrate on what I'm doing at the moment.

A reason I am not speaking now is because I am getting tired of this.

Is that 5 in a row?

Ok let's get 7 in a row.

Ahhhh I'm starving.

This to win the open. Told you I was a failure!

APPENDIX H

EXAMPLE OF LEVEL 3 THINK ALOUD PUTTING TRANSCRIPT FROM STUDY 1

Ok so this I think is going left to right and I'm going to aim over that side slightly.

Ahhh there's a ridge that's gone wide.

Need to get a bit more pace as well, need to follow the left to right line a bit better.

Yes good putt there,

Ok want to repeat that, left to right, keep the pace.

Ok think I got a bit excited there and hit it too hard.

Ok so follow the line again remember hands forward feet set, pre shot routine.

Yes nice one. I just need to keep repeating this.

Ok so I am aiming slightly to the right of the hole, more or less the same place as ive been putting it.

Ahh just lipped out that, I think it's because I'm not going too far right I need to keep it slightly left and I'm being a bit too heavy handed.

Pulled it there, about 4 foot past the hole, tried to force that.

Relax Dave, That was poor, it was to the left a bit, I dont think I'm really concentrating that's why it went to far.

Come on aim at the right edge. That was a bit off a push, get it backnow come on.

Relax. That one just lipped out the left edge, but it was quite a decent put just a bit off centre and too much pace.

The ridge on the right side is causing it to trickle off, so I'm going to keep it more left towards the hole to give it a better chance of going in.

Yep that went in, great.

Focusing on getting it over that ridge and more towards the left. Need to keep it towards the left side. Remember pre performance routine. Relax and hands forward.

Yes good putt.

Same again just relax and aim towards the left.

Too heavy handed today, I think it's because I'm a little tired and not used to this.

That went in yes good one. Just on the right side of the hole straight it.

There wasn't much bend on that one i just need to repeat that.

Come on Dave, relax pre-shot routine.

Yep nice one. Not putting too bad today especially when I actually concentrate.

Ok, hands, feet, pace, relax.

Ahhh again too hard, I keep trying to force it, I just need to relax. That's about three foot past the hole!!!

Idiot. Right last one come on..

Yes.

APPENDIX I

STUDY 2 INFORMATION SHEET

Amy Whitehead
E-mail –AWhitehead1@uclan.ac.uk
Phd Sport Psychology Student
School of Psychology
University of Central Lancashire, Preston
Supervisor: Dr Jamie Taylor
E-mail - JATaylor2@uclan.ac.uk

Dear Golfer,

My name is Amy Whitehead and I am a PhD student at the University of Central Lancashire. I am conducting my second study for my PhD, supervised by Dr Jamie Taylor and Professor Remco Polman, which is investigating the consistencies between think aloud level 3 verbalisation and retrospective recall straight after the performance and at 48 hours. If you chose to participate in this study you will be performing 6 holes of golf. During the 6 holes you will be asked to verbalise and provide explanations of your thoughts of each shot and provide an explanation of why you performed the golf shot in the way that you did (level 3 Think Aloud verbalisation). Following this you will be asked to answer a set of semi structured questions after completing the 6 holes and 48 hours after your performance. Participation in the study is voluntary, and if you choose to participate you are free to withdraw at any time up until the end of the study. If you do choose to withdraw, your data will be destroyed. You will remain anonymous throughout the study and your name and email given on the signup sheet will only be used to organise time slots for your participation and after you have participated in the study your name and email will not be used as you name will be replaced with a number. During the study when your name and details will be provided, this information will be stored securely in a locked filing cabinet. Furthermore you will not be named in any academic reports. Any quotations from interviews may be reported in articles and presentations but these will be anonymised by using pseudonyms or participant codes/numbers. Please indicate verbally whether or not you would like to participate in this study. If you have any further questions please feel free to contact me at the above address.

Kindest Regards,

Amy Whitehead

APPENDIX J

STUDY 2 RETROSPECTIVE INTERVIEW GUIDE

Retrospective Semi-Structured interviews

Firstly a set of question will be asked to build rapport between the interviewer and the interviewee.

- What is your age?
- What is your handicap?
- How many years have you been playing golf?

Questions will then be asked about the decisions that were made at each hole and shot. This will depend on how many shots were taken at each hole. For each hole a pattern of questions will be asked:

- What club did you use?
- What kind of shot did you play and why?
- Were there any environmental factors that you had to consider when playing your shot?
- Is there anything else going through your mind when you hit this shot?
- Would you like to add any further information about this shot?

APPENDIX K

EXAMPLE OF A THINK ALOUD TRANSCRIPT FROM STUDY 2 OF GOLF PERFORMANCE OVER SIX HOLES

Hole 1

Shot 1

Hole 1, I've got a driver in my hand and my main aim is to hit the big oak tree at the back, and to just to get it long for the first shot. Hit the shot. I pulled that a little it's on the left side of the fair way, we've got a good day for it.

Shot 2

Coming up to my next shot, I can see my ball is left of the fair way, and when I get there I will know how many yards I have to the centre of the green so when I get there I will be ready to hit the ball, there's a 150 marker, normally I have my gps system and if not I pace it to approximately where it is, there it is.

For this shot it's about 90 yards and I'm just slightly, and I can't see the flag from where I am so I'm going to stand in the middle of the fairway to gauge where the flag is its approx in the middle of the green towards the right side, and the main aim of this shot it just to get it as close to the pin as possible without taking much risk, so just take a couple of practice swings just to gauge how far I'm going to hit it with a sand wedge and ill just pick a target in the distance and hope for the best. I hit that a bit heavy it's going to be short on the green, you find out when you can't see a target you don't feel as comfortable hitting the ball, that's why you miss it hit quite a lot when you don't have an open target to aim at. So I've come up about 8 yards short of the green.

Shot 3

I'm around about 10 yards short of the green and vie got another 10 yards to the hole, so it's a pretty simple shot I've chose a putter to get the ball rolling to the hole, it's a low risk shot really, just a matter of feel. Just take a couple of practice strokes just to gauge the distance and what I want to try and hit it with. That's gone on about 4 or 5 foot, I'm quite happy with that.

Shot 4

Just give the ball a bit of a clean, I always like the ball with a line pointing towards the hole just to make it easier to line up. Yeah that's gone in I'm happy with a 4 there, slightly bad tee shot.

Hole 2,

Shot 1

It's strange that you're always thinking these thoughts but you never actually voice them, you have so many thoughts its best just to get them all out.

Here on the second hole, it's a par 3, its about 130 yards to the middle of the green, there's a blue flag so that dictates where the flag is, it's on the back portion of the green, I'm going to hit a 8 iron and try

to hit the green, my main aim is not to be short of the green because it's quite a difficult chip, just going to hit this 8 iron not as full and have a bit more control over it. I've hit that and I think its gone past the pin and I think I've hit a bit too much club and think it's a bit too far that.

Shot 2 and 3

Right I've approached the green and its finished up on the green and its about 25 foot away from the pin so I'm pretty satisfied as its on the putting surface so all I have to do it par the hole with 2 putts or maybe one putt for a birdie. For this particular putt its right to left and slightly down hill and the wind is helping right to left so I don't have to worry about the pace too much just try and pick a line and stick with it, again I will just clean the ball up and use this line as the gage. For longer putts I tend to look from behind to get a second opinion just to make sure, I want this about half a foot outside the hole and it should break right to left, couple of practice strokes to get the feel of the putt, yep just a simple tap in now for a par 3. *Tapped in.*

Hole 3

Shot 1

On the 14th hole there's a road on the right so I don't really want to go there and there's a mound on the left, it's quite a tough driving hole, wind left to right, again I'm using a driver to try and get as far up the fairway as possible, I'm going to tee up left side of the tee box to give me more room to aim for, there's three bunkers in the far distance I'm going to aim for the middle one, should I haul the shot it should still stay on the fairway and if I cut it should still be in the light rough. I did my best, it should be all right, I just pulled it slightly, it didn't feel quite comfortable over that shot, it's one of the harder holes on the course this. I hit one on the road last Saturday so that's why when your here your thoughts come back to you, and it's always a worry as you can get into trouble. It is quite a dangerous part of road.

Shot 2

What I need to do for my next shot it is just to plan it in mind so I'm not stuck over the ball too long when I get there. I'm in the light rough here it's about 130 yards to the pin. The pins at the front with the yellow flag, its more than likely going to be a 9 iron pretty simple shot really, I'm just going to try and aim this about 10 foot left of the pin because the winds left to right and hopefully the wind should knock it down and straight towards the pin, I'm going to hit a firm 9 iron, *HIT*, yeah just pushed it slightly it should be pin high on the right, you should come more often (laughs). It's actually quite good this when you voice it out it gives you clarity of mind, sometimes when you're playing in a competition it's all inside you and you don't want to tell everyone.

Shot 3 and 4

Right, ive seen the ball its pretty good it's about 15-20 foot again, a genuine birdie chance, just mark the ball, pick it up and have a walk round the hole and have a look at the line, this putts downhill. It's left, like the last putt don't really have to worry about the pace too much, just going to try and pick a line and keep with it, just going to mark the ball with a line just to gage where the ball's going, just a few practice strokes whilst looking at the hole just a to get a feel of the putt, pooh just a bit too firm, caught the left edge, not too disappointed could of gone it, nice tap in for a par again.

Hole 4

Shot 1

Right I'm on the 15th here the hole plays round about 310 yards, oh they've put a new bunker in there, there's a big church tower in front on me that's going to be my line, and I'm going to hit a driver as far up there as possible just to give myself a good chance for a birdie. There's a bit of risk in this shot but if it comes off it should be worth it. Where's the wind blowing now, its right to left I think I can't really tell, yes if there's any wind it's going to be right to left. I'm teeing up on the right side of the tee to aim at the church steeple and just try and hit it as smoothly as possible. Yes that was a good swing exactly where I want it I'm very happy with that. It's not a bad idea this is it? Talking about loud, sometimes when I'm playing in comps and you hit a bad shot, talking aloud gives you clarity and you just do it.

Shot 2

I should have brought my GPS then I would have known my yardages. Right I'm approaching my shot which I'm quite happy with in the middle of the fairway I have about 70 yards to the pin and its tucked to the left hand side of the green, for a big green its about 26 yards wide, I'm just going to play a simple pitch shot onto the green, going to try and get it as close as possible I'm going to use a sand wedge for this keeping it low, hopefully it should be quite close. I'm just going to aim about 5 foot right of the pin because if I do pull it I still have the left hand side of the green to work with. The balls on a slight down slope which should help my shot really, it's just come off a bit lower, yes exactly how I played it has come off perfect, it is about 8 foot behind the hole. That came off exactly how I wanted it to.

Shot 3

It's about 10 foot away behind the hole, it's a pretty straight putt really, if anything it's going to be downhill towards the hole again so smooth strokes should get me there, not too much break in this, I quite fancy this one. Creating a line towards the hole again, a couple of practice strokes looking at the hole just to get the feel of it, yep that's gone in , well played hole that. You should come on a comp day (laughs).

Hole 5

Shot 1

On the 16th it plays a 160 yards to the middle of the green, the flags yellow so it's slightly towards the front so it's probably playing around 150. There's not too much breeze around, if anything its helping slightly, a birdie on the previous hole it's just all about consolidating that birdie and trying not to make a mistake here, I don't want to give one back to the course. Teeing off to the right side, think between a 7 and an 8 iron, I'm going to hit a 7 iron, should just move the 7 iron. Just going to aim about 10 foot right of the pin and try and work it right to left. Yeah that's drawn in towards the pin quite nice I think it's gone past the pin, I'm quite happy with that started online and good contact with the ball, there's not much to explain when you're hitting the ball like that.

Shot 2

Because ive hit a half decent shot here thinking I'm in for a birdie I'm trying to walk abet slower to try and slow the process down. Yeah I think I could have hit an 8 iron there but I weren't to know, it's finished about 25 foot behind the hole. This putt is left to right its about 25 foot its back into the breeze a little, it's a pretty flat putt if anything it moves from right to left but not much. Same theory using this line on the ball to line where I want to putt the ball, just going to aim right side, right lip of, just a few practice strokes look at the hole to get the feel of the green, it should break right to left, oh, ive hit that a bit too hard and its gone through the break, time for a little tester 3 foot.

Shot 3 and 4

Trying to be positive, ahhh god, that's a 3 foot bogie that's disappointing really, just a bit too firm on the first putt and a bit too much work to do for the return putt, see that's what I mean about keeping everything in sync, just rushed the first putt by there and it went on a bit too far. They are the hardest bodies to accept when you've gone on the green and you take 3 putts.

Hole 6

Shot 1

We're here on the 17th tee, it's a 480 yard par 5, and if you hit a good drive here you can go for the green in 2 but that's if you hit a good handle and you can often find a downhill lie and then you can't really get over the trees so it's really a 3 shotter. Bit of trouble on the left a couple of mounds and the trees are reachable from this tee, so I'm going to aim on the right hand side of the fairway and see if I can move the ball from right to left and it should be alright. Aww a bit quick that not a good shot that it should be ok should be on a mound, the rhythm wasn't as good then.

Shot 2

Yeah ive got a bit lucky there I'm about 20 yards short of the trees so I can advance it up the fairway and I can get about 120 yards out of this shot using a pitching wedge to make sure I can get over these trees the lies not the best but. It's just a bit sat down, my main aim here is to keep right side of the fairway so I have a better chance of a shot to the green with it being a par 5 I can still and try and par the hole or even birdie it, here I'm just going to aim at the right side, ive got this tree to aim at, if I put a smooth swing on it I should be ok, about 110 yards. Ahhh just caught that a bit heavy it's made the fairway should be ok.

Shot 3

Looks like ive got around 140 just in front of the 150 mark, to a yellow flag pin. I'm in the middle of the fairway, there's some trees in front of me the branches should be ok should be far enough back, the main aim of this shot is just to get it on the green, it's quite a narrow green, it's the bank on the left, ive got around about 135 yards, going to hit a 9 iron with slightly down wind, going to aim for the middle of the green and just nothing too fancy, having a practice swing just to get the rhythm back. Ive pulled that slightly I could be lucky I think ive found the back end of the green, it was a good strike but ive pulled it. I think with the downwind the 9 iron was a bit too much, yeah the balls finished on the back end of the green, I could have hit one less iron.

Shot 4

It's quite warm today. The balls around 35 foot away it's just going to be try and 2 putt par, I'll take that after a bad tee shot really. Just going to look behind the flag to where the ball is and have a gage where the break is in the green. There's going to be about 35 foot. After that last hole with 3 putts I don't really want to be doing the same thing here so I'm trying to line this putt up to the hole, pretty flat putt if anything it runs away from the hole at the end, just going to try and aim this ball about 6 inches left of the hole which should break back, then again a few practice strokes looking at the hole just to get a feel of the putt. I've missed that by a bit too firm putt, left a good 6 foot for a par putt not what I wanted. The line was good just a bit too firm.

Shot 5 and 6

This is going to be an inside right lip nice and firm, practice strokes, ahhh just pulled that putt a little and another 3 putt bogie, not a good way to finish.

APPENDIX L

EXAMPLE OF INTERVIEW TRANSCRIPT FROM STUDY 2 IMMEDIATELY (10 MINUTES) AFTER PERFORMANCE

We are going to look at holes 2 and 16, second and fifth holes that you played.

Can you please describe hole 2 in general

Hole 2 with it being of a forward tee today it made it a bit easier because your hitting less club, if you miss the green its quite hard to get back up and down because there's quite steep banking's on each side, it's an island green so it's about trying to hit the green so your putting and it's easier to get your par, and today wasn't too windy so the shot wasn't too difficult.

Shot 1

So when you were standing at the tee what were your thoughts?

My thoughts were to just to get the ball onto the green with no difficulty and just try not to miss on either side or even short, as it would be quite difficult to get up and down.

What club did you use?

I used an 8 iron because the club was slightly into and I could have hit a 9 iron really but just to be on the safe side I hit an easy 8 iron just to get it up.

Where there any environmental factors that affected your performance?

Not then as it was still quite early in the round

Shot 2

So the second shot you hit, please can you tell me what you were thinking?

I was, god I can't remember now, I think I was, yes that's it I think I was about 20 foot behind the hole and the putt was right to left downhill and the wind was helping it slightly so I didn't have to worry about the pace of the putt, it had about 6 inches of break on and I managed to do that safely and tapped it in for a par.

Where there any environmental factors that affected that shot?

No not really I was pretty comfortable.

Shot 3

What were your thought's at the third which was a putt?

It was just a subconscious putt really, just be safe, just go through a similar routine, just be comfortable before I put the ball in the whole.

Any environmental factors effecting you?

No not really

Ok, so now we're going to talk about the 16th hole which was your 5th hole, when you were standing at the tee, what were your thought?

Shot 1

As I said before on the course, I just birdied the 15th, the main aim of this hole was not to drop a shot, in the event I did but it wasn't due to my shot making it was due to the 3 putt, what did I get now? I hit a 7 iron onto that hole it was 155yards.

So on the first shot?

On the first shot I clubbed too much I could of hit an 8 iron so if I did and I had the same direction I would have been close to the hole and the probability that I would of 3 putt bogey.

Where there any environmental factors?

No not really, no.

Shot 2

SO the second shot?

The putt was quite a long putt, about 25-30 putt, I wanted to be very cautious and try to get it as close to the hole as possible to try and make the next shot as easy as possible but I didn't do that and I think it went about 3 to 4 foot and I didn't hit the putt as convincingly as I should.

Why were you being cautious?

Because I birdied the hole previously and I was being a bit too protective of the score, I shouldn't think like that but it's difficult not to.

Shot 3

And the next putt?

The third putt, I thought it was a simple 3 foot putt and I just aimed it there and I just pulled it slightly and hit it to the left.

Why?

Because I think it was the shock of being so far past really because I should have been a lot closer and I think was a bit too anxious that I dropped a shot.

Shot 4

And then the final putt?

That was an easy one just a tap in, I was really disappointed with that 3 putt.

APPENDIX M

EXAMPLE OF INTERVIEW TRANSCRIPT FROM STUDY 2 24 HOURS AFTER PERFORMANCE

Interview 2 24 Hours after Performance

If you could just describe hole 1 in general

The first hole is quite a simple hole, about 350 yards, eh god I can't remember, there's a bunker on the right that does really come into play and the green is pretty easy and there's only 2 mounds, there's one on the right hand side that shouldn't be a problem.

If you could describe the first shot you played.

Shot 1

EHh the first shot, I tried to just hit it down the middle with the driver and I just pulled it slightly and it went left and in the event it was ok, but I couldn't see the green in the second shot

Were there any environmental factors that affected your shot?

Probably you really, probably just hindered the first shot really.

Any others?

No not really?

Shot 2

Ok and the second shot, please can you describe that?

Yes I remember that I couldn't see the flag, so it was a touch more difficult, I caught it heavy and it came off about 10 yards short of the green.

What thoughts were going through your mind?

I remember just wanting just to hit the green but it didn't happen but there was no panic button.

Were there any environmental factors that affected your shot?

Just that I couldn't see the flag really that's all.

Shot 3

Ok and the third shot you played?

The third shot I chose a putter because it's quite early in the round and you don't want to lose any shots and the grass was fairly short on the fringe and I think I managed to putt it to about 2 or 3 foot I think.

And how did you feel about that?

Yes I felt like I got the hole back with that shot.

Any environmental factors?

Maybe just that the ball was dirty but that's about it.

Shot 4

Ok and the last one?

It was quite a simple putt into the hole, with a curve, and I was confident with it.

And were you pleased with the hole in general?

Yes to par the hole is more than satisfactory.

Ok so Hole 15.

Hole 15, can you briefly describe the hole in general,

On the 15th its ehhh, let me think, there's more danger to the left and right of the fair way, and there's a bunker in the middle of the fairway, and the greens slightly to the right a bit its quite a small green, there's trouble of the left. That's about.

So when you were playing your first shot what were your thoughts?

Shot 1

I wanted to play the hole more confidently so I chose the driver, I wanted to get about 80 yards, there's a big church steeple in the distance of play and I managed to hit a really good shot.

Ok how did you feel about this shot?

Yes I felt really good.

Were there any environmental factors that affected your shot?

No not really, as I said before maybe just yourself.

Shot 2

And then the second shot that you played?

There was a bit of caution with this shot, I aimed to hit a little bit to the right, it was a round about a 20 yards shot, the main aim was not to pull the shot as it would of been quite difficult to get up and down, I think I hit it about 10 foot behind the hole.

How did you feel?

It was quite good.

Shot 3

Then the 3rd shot?

It was 10 foot putt from behind the hole I just needed to be confident, and I think the putt was pretty straight and I rolled it in for a birdie 3

Was there any environmental factors that affected your putt?

No not really no.

Ok in general how did you feel about that hole?

Yes I felt good.

APPENDIX N

EXAMPLE OF INTERVIEW TRANSCRIPT FROM STUDY 2 48 HOURS AFTER PERFORMANCE

Interview 3,

Can you talk me through 14 in general?

Hole 14 is one of the harder holes on the course, there's trouble on the right, some trees on the right and if you go further there's a busy road, and on the left there's a mound and trees and bushes and if you go further left you can actually hit the club house, so its total danger really. But if you hit a good shot onto the fairway the hole can be a lot easier.

Shot 1

OK can you just talk me through the first shot you played on 14?

The first shot I played on hole 14, eeehh (pause), oh yeah, I remember saying that there's 3 bunkers in the distance and I was aiming for the middle one, the wind was slightly left the right and I tried to hit it straight towards the middle bunker and then I hit it slightly left but I hit it ok, I finished on the left side of the light rough.

What club did you use?

I used a driver.

Were you happy with the shot?

I was happy with the outcome not with the shot

Shot 2

Ok, and then the second shot you played, what were your thoughts?

It was quite a simple shot really I think it was an 8 iron or a 9 iron, the wind was just a little bit left to right, I hit it just to the front of the green I think I just needed to aim to the front of the pin and I actually did.

Were you happy with this?

Yes I think it was about 15 foot from the pin

Shot 3

Then the third shot?

Pause, I think was a about 10 or 15 foot putt, and it was (pause) a little bit left to right and I can't remember, yeah I hit it past the hole about 3 foot, it was an attempt at birdie.

Shot 4

And finally the last putt?

I had to be a little bit more careful, it was from about 3 foot and I just stroked it in for a par.

And how did you feel about that?

Yeah I was happy, not bad really.

The last hole 17, can you describe this hole in general.

The 17th is a par 5 and it's about 480 yards, and there's trouble on the left with some mounds and the rough and further down the left hand side there's some trees. And there's houses and trees on the right hand side.

Shot 1

So the first shot you played what club did you use and what were your thoughts?

I used a driver and remember saying that I just wanted to get it on the fairway and the left hand sides quite troublesome, and I pulled it but was lucky as I could have been in the trees on the left.

What kind of shot did you play?

I pulled it slightly and in the event I was a little bit fortunate that I found the ball.

Shot 2

Then the second shot you played?

This was when I found the ball, there was huge branches over hanging but I was far enough back to hit a pitching wedge over the trees back onto the fairway so I could have a 3rd shot into the green and I managed to do that even though I didn't hit the ball as well as I should of.

Were there any environmental factors that affected your shot?

Just the trees and the rough that I was in.

How did you feel about that?

Just happy to get it back in play

Shot 3

Can you tell me about your thoughts and feeling around your third shot?

My thoughts were, there were trees on the left but weren't really in play but if it wasn't a good shot I could of hit them, but it had to be weary I didn't pull the shot, I was trying to hit it cautiously but I played it quite well

Where did it land?

I think it finished, back left of the green it was quite a distance away from the hole.

Shot 4

Ok then the fourth?

The fourth shot, I think it was about 30 foot away all I was trying to do was line it up to the hole and try and par the hole.

What was the result?

The result was that I think I hit it a bit too firm and it went past about 5 or 6 foot,

And how did you feel about that?

Not too good it was quite a tough par putt for the next putt,

Shot 5

Ok so the next shot?

The next shot was about 5 or 6 foot, it was quite a straight putt I tried be a bit cautious and I ended up missing.

How did you feel about that?

Not too good, I already dropped a shot.

Shot 6

The last one?

This was a tap in for a bogie?

How did you feel about the end result?

Not to good really, because id managed to get a bit of fortune and still walk off with a bogie it's a bit disappointing.

APPENDIX O

STUDY 3 INFORMATION SHEET

Comparison of the decision making process between high and low level golfers using Think Aloud level 3 verbalisation

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Dear Golfer,

My name is Amy Whitehead and I am a PhD student at the University of Central Lancashire. I am conducting my third study for my PhD, supervised by Dr Jamie Taylor and Professor Remco Polman, which is investigating the difference between decision making between high and lower level golfers.

Purpose of the study

The purpose of my research is to investigate whether higher level golfers who play off a handicap of 2 or below think differently to lower level golfers who play of 10 or above. The comparisons that will be made are based on the decisions that the golfers make before they take each shot.

What participation involves

If you chose to participate in this study you will be performing 6 holes of golf. During the 6 holes you will be asked to verbalise and provide explanations of your thoughts of each shot and provide an explanation of why you performed the golf shot in the way that you did. For example, "I'm using a 7 iron because I'm hitting 70 yards, and I want to hit it high over that small hill". You will have a small tie microphone attached to you at all times which will be recording your verbalisations.

Confidentiality

You will remain anonymous throughout the study and your name and email given on the signup sheet will only be used to organise time slots for your participation and after you have participated in the study your name and email will not be used as you name will be replaced with a number. During the study when your name and details will be provided, this information will be stored securely in a locked filing cabinet. Furthermore you will not be named in any academic reports. Any quotations from interviews may be reported in articles and presentations but these will be anonymised by using pseudonyms or participant codes/numbers.

Withdrawal

Participation in the study is voluntary, and if you choose to participate you are free to withdraw at any time. If you do choose to withdraw, your data will be destroyed. If you wish to withdraw at any time during the performance of your 6 holes please do so verbally, however once the data has been recorded withdrawal from the study is no longer possible.

Please indicate verbally whether or not you would like to participate in this study. Also could you please sign the consent form provided with this letter which indicates that you would like to participate in this study.

If you have any further questions please feel free to contact me at the above address.

Kindest Regards,

Amy Whitehead

APPENDIX P

EXAMPLE OF A HIGH SKILLED PERFORMERS THINK ALOUD TRANSCRIPT FROM STUDY 3

Hole 1

Shot 1

Put my glove on ok. Right lets go. Ok first hole par 5 up the hill, focus point is the path up the right hand side that will be a good line, hit in to the flag as well. Left hand of the tee box to give myself the best angle, ok. Go through my pre-shot routine. Concentrate on what I have been working on.

Right ok.

It's kind of not a bad shot down the right a little, first shot in a while I'll take that.

It's actually nice to get out on my out, it's nice to get out and work on my own game and hitting the golf ball for a while.

The course is soaking wet, just starting to drizzle but it's very mild so its fine.

Can't quite see my ball but hoping it's on the right side of the fairway or at worst in the semi rough.

Shot 2

Here we are, not too bad just on the right hand side, just missed the fairway by 2 or 3 yards.

Ok, lying nicely, pretty good. Slight upslope as well just going to take the yardage using my range finder. Ok I've got 168, that can't be right. 200 to the middle from the fairway I can see there that pin on the temporary is short so yeah 168 to the flag but uphill. God it looks further than that. 168 for me normally that would be a good 6 iron, but being uphill and cold and wet I'm going to go with a 5 iron, ok. Starting behind, starting my pre shot routine, keep the tension out of my hands. One more practice swing. Giving my club a quick clean. Ok fully commit.

Hooked it. A little heavy, short and left, the divot was pointing quite a long way right and the ball has gone left that would make sense. That wasn't what I rehearsed. It's amazing how my old habits always come out when I'm on the golf course, got to exaggerate it even more until it feels radical and extreme. You can tell this is a coach and not a player. Always chasing the technical ghost.

Shot 3

Come on you can get this up and down, start off with a Birdie.

That last swing felt I rushed the downswing. Ok. About 10 yards short of the flag high and about 25 yards left of the pin. Pretty straight forward situation. Because it's on the fairway I could putt this but I'm going to hit a little chip shot. My instinct says a little 7 iron just bump and run, I'm just finding my landing spot, I want to land this about 30% of the way slightly uphill. Lie is pretty good, let's do some rehearsals. That's it, ok let's go.

Just pulled up about 8 foot short, just didn't give it enough but that's to be expected haven't chipped and puttied for about 3 months.

Shot 4,

Just take the flag out, marking my ball now; ok the ground is definitely higher to the left of me so it's going to be a left to right putt. Just lining my line up on the ball to where I want to start the putt. Ok that's pretty good. About 3 inches left. Ok just go through my routine. Practice routine, one look and go.

Just overpowered that missed on the left.

Shot 5

Just tapping that in for a 5.

Ok a bit disappointing considering I only had 168 to the flag. Got a long way to go. Just heading up towards the second now.

Hole 2

Shot 1

It's pretty flat and calm out here, slightly breezy but not a lot. Maybe I should of puttied that ball on the last. First hole. And not take a chip shot maybe the putt was a better option if I was going for a scoring point of view. I wanted to try the chip shot as I have been thinking about my chipping even though I haven't been practising it.

Right second tee, up on the proper tee here. Again on a temporary green short of the proper green normally 284 yards but the flag is playing as a par 3. Got to back it 218 down there. Slightly downhill slightly down breeze. The pin is on the left side of the fairway with rough to the left of that so left would not be good. That's why I am going to tee up on the left side of the tee box because I don't want to go left and I'm hitting away from the trouble. Going to aim for the tree which is 5 or 6 yards to the right of the flag, because I tend to hit a little draw. Ok down this wind, I think a good 4 iron is the right number here for me. Ok that's a better feel. Come on make sure you keep rotating. That's it ok. Pick my spot just ahead of me to line my club face up with, aim my club face take my stance that's it, and ok mini rehearsal.

Just a little right of my target made sure I didn't hook that one, definitely a reaction to the last shot; neutral just went a tiny bit right. Not exactly at the flag bit 20 yards right of it.

Shot 2

Let's see if I can get this one down in 2. The flag is further on than I thought it was. Yes maybe again wrong club selection, 20 yards short of the flag. 218 is not a 4 iron I think my 4 iron is 200. For some reason because it's downhill with a raised tee I thought it was the right club. If I had hit it perfectly I think it would have been the right club.

I sound like one of them high handicappers who hits a 7 iron 150 every time.

Ok so I am actually 25 yards short of the flag. Tricky little chip here downhill. Quite a slopey fairway quite a lot of hills and hollows on the run up. The ball is best served on the ground as if I try to fly it could have a bad bounce. So again either a putt or a chip. My ball has a big lump of mud on so I'm going to give myself a slightly better lie. Going to go with a 7 iron and see if I can get my own back on it. Ok just visualising the shot, where I want to land it. That's it. Just going to have a little wander up, like a fish out of water on the golf course here. Still quite a long way to go from that landing spot, just pitch this a little further. Get it bouncing down there. Ok just doing some practice swings to get a feel for the right strike, ok let's just do it.

Wow that moves a long way right off the slope, wasn't the best execution in the world it went left on me which was good job as it moved a long way right. Strike was pretty good. Leaves me a little 9 footer across the slope.

Shot 3

Ok, just marking my ball going to look from the side as well to get a different perspective. This is literally like putting off the edge of a cliff face, it's very very steep left to right and downhill so can't be too aggressive with this putt. Ok I'm going to pick my starting line and aim this about 15 inches left of the hole. Line my line up with my ball. Come on John just stick to the line let the slope do the rest don't try and guide it in. doing some practice strokes. One look. Go.

Just over borrowed again. It's ran to two and a half foot past.

Shot 4

Pretty straight forward this one, a couple of practice strokes.

Back of the cup. Poor, feels like a dropped shot as it feels like a par 3. Poor course management. The wrong club selection.

Hole 3

Shot 1

Walking on to the third, I like this hole. Shortish par 4, if I hit a really good one I can get within 30-40 yards of this, ok, I can see the flag top of the hill. My line is going to be the pole in the distance coming out the top of the trees, come on really focus. That's feeling good, just keep turning. Ok let's commit. All the way.

What was that? Bit of a block to the right. Didn't quite find the slot of the way down, went short and right still in play I can still make 3 from there.

Pretty rusty which is to be expected. I think half the problem as a coach who used to play a lot is the expectations are still very high but you don't put any work into your game so you can't expect much you are better going out with no expectations purely enjoy it. Looking forward to this afternoon, my sons got a little gee on a school and has a few words to say so looking forward to watching him. It's a quarter to three. Just didn't get through that last drive probably because I wasn't in the right spot on the back swing. Old habits die hard.

Shot 2

Ok I can see it. I missed the fairway by about 10 yards, just into the second cut of rough. Lying well though no real damage done, I can get this up and down. 65 yards to the flag, don't want to pitch it at the flag, want to pitch it about 57 yards 56 yards, because it will skid the grounds a bit damp. Going to go with my 54 degree. And just try to take my wrists out of this and keep pivoting to the target. Ok just got to keep pivoting.

That's a good shot. Sit. Yep that is exactly how I visualised it. Yep happy with that one. Historically half wedge shots haven't been a strong point of mine but that was better. Nice strike pitched it exactly the right spot, a bit of a bounce left but a 6 or 7 footer for a birdie.

Shot 3

Really should play more golf. I really enjoy it when I am out but its time and pressure of families and everything else.

Right come on this is a pretty straight putt as well you can make this. Lining my line up with the ball, the left half of the cup. Ok just walking into it. Remember you are putting on the fairway here, that feels good. One look.

Ahhh pulled it pulled the arse off it. What was that??

Shot 4

Just tidied up. Ahh that's the new stroke you have been working at. Feels great in practice but not ideal on the course it's going to take a lot more practice to make that more comfortable. Opportunity missed. Come on. Let's get a good drive away on the next

Hole 4

This talk aloud is making me concentrate more and become more absorbed in what I'm doing which is never me on the golf course, I was always distracted as my school report would always say.

Letting the members tee off. Those guys play in any weather.

Shot 1

Ok fourth hole long par 4. Need a good tee shot here. Feels better ok let's pick my spot, aim to that tree that conifer down the left hand side, pick my spot right in front of the ball and let's go.

Pretty good that, that's better.

I need people to watch more often that was a better swing, just felt a left that club a fraction more behind me on the back swing which gave me chance to really turn on the power through the ball. Convinced it's a grip pressure issue that my whole game revolves around, again you can tell this is a

coach playing not a player, always looking for a technical answer. Performance is often down to course management, but that felt really good.

Shot 2

Come on. Pretty long to. I can see it down there. Yes I definitely enjoyed that one. Surprisingly hitting shot with little practice in front of members I didn't feel nervous. Completely different to how I would of 5 or 6 years ago, too worried about what people think, certainly don't feel that as much now. I have a bit more confidence in what I'm doing.

Ok so just crept about an inch off the fairway in the middle of winter conditions not going to make much difference. Lying pretty good hitting to a temporary green anyway. Actually let me make sure this is still working. Just check the machine is still going, yes it is 43 minutes I have been switched on now. Right lets laser the flag, ok I have 98 yards to the flag. Wind, slightly down but not a lot to speak of. Probably overall pretty level, slightly downhill, so actually playing about 95 yards, good sand iron is a 100 yards, so I'm going to go with a sand iron and pitch it about 90 and I'm going to choke down on a sand iron about half an inch and commit to that shot there. That's it. Ok. Clear the blade make sure that's ready, starting behind as usual choke down a little bit, going to aim for that tree trunk which is a yard left of the flag as the ball is slightly below my feet., walking in fully commit stay with it.

A fraction left. Probably finished about 5 yards left of the flag. Divot is slightly right. Felt as though I recovered on the way down and I didn't make the best backswing in the world. Come up a little short as well but the strike was alright, it's still on the green but 10-15 foot left and short.

Not good but a chance.

Shot 3

Come on you can knock this in. putting has always been my strong shot. Not sure why I'm dabbling with my style when I've always putted well. #

Ok I have a big lump pf mud on my ball. Just going to mark it and clean it with my towel. Ok take the flag out, probably got about 5 paces to the hole think end of 20 feet, downhill, I think it will come right to left, I have over borrowed on every putt so farm, going to aim this at the right half. Ok. One last look. Picture that ball going in the hole, starting my ritual now, now I'm over it, it looks more right to left, stick to your plan. One to one two one two one two, left foot right foot, over it look back.

Aww just missed on the left, better stroke, talking through my routine helps.

Shot 4

Left myself 3 and half foot up the hill pretty straight forward. Start my ritual again. One two one two, left foot right foot right foot over it, look back, one two, one two.

There we go much happier with that. Much better.

Hole 5

Shot 1

Going to really exaggerate my feelings on this shot to see if I can hit a really good iron shot.

Ok on the proper tee on to a temporary green uphill par 3. 166 to the flag, uphill. Probably plating 170-172. Wind slightly into if anything, let's say 175 shot, if not 180 considering its middle of winter and the ball is not flying far. Thinking a 5 or 6 here. Come on just a good 6. This does vary depending on the day, I'm teeing up on the left side of the tee box, I'm going one less, need a good swing here. That's it. Cover it and keep going. See that shot, lining up.

Better strike, turned it over a little bit, right club, just turned it over a little bit. 10 yards right of the flag, better swing. Not really a makeable birdie, I'm probably 35 feet of the flag but just got to stay patient and give every shot 110%. If at the end of the round I can say that

Shot 2

Slowing walking down, was starting to go a bit quick.

Ok so I am 4 yards short of the flag high, got about a 35 footer up the hill, going to putt this, just tidying mowed fairway just moving a few leaves and twigs off the line there. The green keeper has a wicked sense of humour with these winter greens, they all seem to be perched on the side of mountains. Good things about this putt is I'm slightly uphill so I can be a bit more positive wouldn't like to be past that flag. Ok going to go a foot left. And uphill line my line up. Going to need a bit extra as its up just standing a long side it go through my ritual ok, ok one two one two one two, left foot right foot over it look back, one two one two.

Not enough, what was that, come on John just think, thinking of your ritual too much now.

Shot 3

Ok. Come on the hole is a bucket. One two one two. One two one two.

That's gone straight over the left edge not the best

Shot 4

Nice three putt.

Come on concentrate. Did everything but forgot to hit the first putt and rushed the second one. Give it my full attention, come on that's frustrating.

Hole 6

Come on onto the next hole, forget it its gone. One shot at a time give it 110% all I can do. Technically I am one over.

Shot 1

This tee is a long way forward here, I am going to try and hit one like I did on the fourth. Feel quite irritated by the last green. Lack of concentration more than anything else. Put it behind you. Nothing you can do about it now. Its middle of winter you are just getting an idea of where your game is.

Ok par 5, short one today. That flag is round the corner. Going to aim at the right edge of the club house, the flag on the 18th green in a perfect line in the distance, I definitely don't want to go left of that so I'm going to make sure I keep turning so if anything it will fade slightly to the right, come on. That's it come on. Pick your target, see the shot. That's it.

A bit toey, but straight down the middle, it wasn't the best strike. Don't know if I will ever get that right shoulder in front of me on the way down, habit of the life time. Think I'm so used to hitting a ball on the driving range, and if I hit a shot I'm not happy with I can hit another shot straight away, that why I'm rushing to my next shot, this is that ball beating mentality that I'm always trying to get my students out of. Maybe lost 5 yards off that tee shot but its right down the middle so mission accomplished in terms of fairway hit. Can't believe the course is on temporary greens its damp but not that bad. Here's me an expert green keeper.

Shot 2

What a lovely day. I fancy carrying on after this. Can't get more in the middle of the fairway than that one. Unfortunately the ball is a long way below my feet which being 6'4" is going to make life difficult. The ball has literally pitched and stopped within 3 feet of where its landed. A huge lump of mud on the ball so going to clean that. Gives me a chance to give myself a decent lie. Ok so to that pin there I have got, 167 hardly a breath of wind to speak of just damp conditions, no real trouble, the only thing I have to contend with is the ball below my feet. It's probably 4 inches below my feet. 167 I'm going to go with a 6 iron. Ok. Let's just find a slope similar so I can get a feel for what I'm doing here, got to really stay down. That's it let the weight of the club do the job for you. Ok pick my line the ball below my feet it should fade but I tend to pull when its below my feet to over compensate. I'm going to aim this just a couple of feet or 2 yards left of the flag. Make sure it doesn't go left on me. Ok that's good. No it's not right. It didn't feel comfortable so I'm stepping off it, pick my spot again go through the routine. Club face setting my stance nice and stable.

A bit skinny but it's all over the flag. That's about 10-15 foot from the flag, came out alright, not the best Strike. That was a pretty neutral shot and didn't go left which is what my pattern has been; I release my right hand of the club in the follow through. Come on lets finish with a birdie.

Shot 3

A bit of causal water on the edge of the temporary green. Going to take a little drop and find a dry spot here. Ok going to give the ball a little bit of a clean as well. Going to take the flag out there. Its full of water. Ok what have we got, this isn't the best temporary green it looks a bit longer. It's so wet. Going to play to the left half of the hole. Probably one of the most sensible temporary greens.

Come on give it enough, just starting my ritual, one two one two one two left foot right foot, over it look, go. Aww I've made one, nice 3 to finish with. That makes up for the last. If it was like this all the time I could play more often, it's hard to stay motivated when it's freezing cold.

APPENDIX Q

EXAMPLE OF A LOW SKILLED PERFORMERS THINK ALOUD TRANSCRIPT FROM STUDY 3

Hole 1

Shot 1

Okay the course is a bit windy and I think I'm going to play on 8 iron

That was better than expected. He'd tell me not to hit it left so I didn't hit it left

Shot 2

It a better position from my first shots but a bit windy

It's very windy trying to get this over the ridge and had there

Not too bad

Shot 3

Taylor made right off the green at the back I probably would've been better to chip it

The greens seem quite fast I might even be able to use my putter from here I'm going to try

30 feet

A bit short

Shot 4

shot 5

Short of the pin there

Shot 6

and in

Hole 2 (par 4)

Shot 1

That last hole didn't go according to plan

Where does this hole go?

Okay very windy again trying to keep the club out in front

That was terrible

Shot 2

Right, there's a wall there and a little raised platform. There is a wall between me and the green.

Ok not totally sure how far this is. 4 iron.

Not too bad of a result, went a little bit to the right.

Shot 3

Wind interruption

Using a wedge

I'm on the green with 4 or 6 feet that's got to be a good result

Shot 4

It's pretty tricky down there

7 or 8 foot putt

About 8 feet, pretty flat I can't see any movement on it, going to leave it short, which I tend to do

Good line, ohhh nearly

Shot 5

About 4 feet

Hole 3

Shot 1

380 yards par 4

Poor tee shot again, but its straight-ish

Shot 2

Oh no, hit down on the ball there

Ahh come on, never mind im on the fairway, work in progress.

Shot 3

Hit that about 150 yards so this must be about 100 yards.. ish.

I'll go with a pitching wedge try and avoid that bunker on the right.

Decent shot, to the left of the green.

Shot 4

Short of the green really, oh well better than I expected actually.

Trying to land this so it hits the edge of the green and rolls towards to pin.

Shot 5

Hole 4

Shot 1

A big hit but it's gone a bit right, its not out of bounds. On the fairway decent strike.

Shot 2

Try and lay it up short in front of the green.

Shot 3

Try a little chip here,

Shot 4

Looks about 7 feet to the flag. Lining up the putt 6 or 7 feet, leave it short.

Ohhh in and out

Shot 5

That was dead straight all the way, lipped out.

Hole 5

Shot 1

I'm out of the wind here, so again, last few tee shots haven't been very good. Just trying to make this one a bit better.

Aww that one was terrible as well, terrible.

Shot 2

I've ended up in the rough here, there's a good chance it's in a bad lie. Oh no its ok. There's a surprise.

On the left hand side there.

Shot 3

So, not sure the distance to the pin, about 104

I think that's just short of the green, unless there's something in the way.

Shot 4

I need to give it a bit more and land it further onto the green and give it enough to get onto the green.

Left myself about 12 foot.

Shot 5

Missed left of the hole

Shot 6

APPENDIX R
STUDY 4 INFORMATION SHEET

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Preston, PR1 2HE

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Dear golfer,

My name is Amy Whitehead and I am PhD student from the School of Psychology at the University of Central Lancashire. I am conducting a study which is looking at what golfers think about during performance. Should you wish to take part in this study you will be asked to verbalise your thoughts throughout the performance of 6 holes during two different time periods. The first time you will perform six holes of golf whilst thinking aloud will be during a practice round. One week later you will be thinking aloud during a competition (stroke play), where you will be performing six holes against 9 other golfers. Your verbalisations will be recorded with a tie mic which you will wear throughout the performance. There will be a prize of £100 golf voucher for your pro shop for the winner of the competition, £70 voucher for second place and £30 voucher for third. Furthermore there will be a formal presentation event where trophies will be awarded.

Participation in the study is voluntary, and if you choose to participate you are free to withdraw up until the point where you leave the data collection session (the end of 6 holes of golf) but not afterwards. If you do choose to withdraw, your data will be shredded and deleted from any electronic device. You will remain anonymous throughout the study and your name will be replaced with a number. During the study when your name and details will be provided, this information will be stored securely in a locked filing cabinet, furthermore you will not be named in any academic reports. The recordings that are produced will only be listened to by myself and my director of studies Jamie Taylor and some of your quotations may be used when writing up the results. Following the transcription of your recordings a copy of your transcription will be emailed to you. Please indicate whether or not you would like to participate in this study by emailing Amy Whitehead at the above email address. Before you begin the study I will also ask you to sign the consent form that is accompanied with this letter and I will collect this from you in person on the day of data collection. If you have any further questions please feel free to contact me at the above address.

Thank you for your participation, Kindest Regards,

Amy Whitehead

APPENDIX S

THE MOVEMENT SPECIFIC REINVESTMENT SCALE © Masters, Eves & Maxwell (2005) USED IN STUDY 4

1

THE MOVEMENT SPECIFIC REINVESTMENT SCALE

© Masters, Eves & Maxwell (2005)

Name: _____ Date: _____ Age: _____ Hand: L / R

DIRECTIONS: Below are a number of statements about your movements. The possible answers go from 'strongly disagree' to 'strongly agree'. There are no right or wrong answers so circle the answer that best describes how you feel for each question.

1 I rarely forget the times when my movements have failed me.

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree
----------------------	------------------------	--------------------	-----------------	---------------------	-------------------

2 I am always trying to figure out why my actions failed.

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree
----------------------	------------------------	--------------------	-----------------	---------------------	-------------------

3 I reflect about my movement a lot.

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree
----------------------	------------------------	--------------------	-----------------	---------------------	-------------------

4 I am always trying to think about my movements when I carry them out.

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree
----------------------	------------------------	--------------------	-----------------	---------------------	-------------------

5 I am self conscious about the way I look when I am moving.

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree
----------------------	------------------------	--------------------	-----------------	---------------------	-------------------

6 I sometimes have the feeling that I am watching myself move.

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree
----------------------	------------------------	--------------------	-----------------	---------------------	-------------------

7 I am aware of the way my body works when I am carrying out a movement.

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree
----------------------	------------------------	--------------------	-----------------	---------------------	-------------------

8 I am concerned about my style of moving.

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree
----------------------	------------------------	--------------------	-----------------	---------------------	-------------------

9 If I see my reflection in a shop window, I will examine my movements.

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree
----------------------	------------------------	--------------------	-----------------	---------------------	-------------------

10 I am concerned about what people think about me when I am moving.

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree
----------------------	------------------------	--------------------	-----------------	---------------------	-------------------

APPENDIX T

The Decision-Specific Reinvestment Scale USED IN STUDY 4

Name _____ Mobile/Contact Number _____ Age _____ M/F

Please answer the following questions about yourself by circling the appropriate number. For each of the statements, indicate how much each statement is like you by using the following scale:

Extremely Uncharacteristic	Uncharacteristic	Neutral	Characteristic	Extremely Characteristic
0	1	2	3	4

Try to think of situations in which you have to make decisions. Please be as honest as you can throughout, and try not to let your responses to one question influence your response to other questions. There are no right or wrong answers.

- | | | | | | | |
|-----------|--|----------|----------|----------|----------|----------|
| 1 | I'm always trying to figure out how I make decisions. | 0 | 1 | 2 | 3 | 4 |
| 2 | I'm concerned about my style of decision making. | 0 | 1 | 2 | 3 | 4 |
| 3 | I remember poor decisions I make for a long time afterwards. | 0 | 1 | 2 | 3 | 4 |
| 4 | I'm constantly examining the reasons for my decisions. | 0 | 1 | 2 | 3 | 4 |
| 5 | I get "worked up" just thinking about poor decisions I have made in the past. | 0 | 1 | 2 | 3 | 4 |
| 6 | I sometimes have the feeling that I'm observing my decision-making process. | 0 | 1 | 2 | 3 | 4 |
| 7 | I often find myself thinking over and over about poor decisions that I have made in the past. | 0 | 1 | 2 | 3 | 4 |
| 8 | I think about better decisions I could have made long after the event has happened. | 0 | 1 | 2 | 3 | 4 |
| 9 | I am alert to changes in how much thought I give to my decisions. | 0 | 1 | 2 | 3 | 4 |
| 10 | I'm aware of the way my mind works when I make a decision. | 0 | 1 | 2 | 3 | 4 |
| 11 | I rarely forget the times when I have made a bad decision, even about the minor things. | 0 | 1 | 2 | 3 | 4 |
| 12 | When I am reminded about poor decisions I have made in the past, I feel as if they are happening all over again. | 0 | 1 | 2 | 3 | 4 |
| 13 | I'm concerned about what other people think of the decisions I make. | 0 | 1 | 2 | 3 | 4 |

Scoring: Decision Reinvestment = Items 1, 2, 4, 6, 9, 10
 Decision Rumination = Items 3, 5, 7, 8, 11, 12,

APPENDIX U

EXAMPLE OF AN INTERMEDIATE SKILLED PERFORMERS THINK ALOUD TRANSCRIPT FROM STUDY 4 DURING THE PRACTICE CONDITION

Hole 1:

Tee shot:

I genuinely don't know what to hit

I want 8

I want 8.

Light breeze of the left

It's going to be causing a little bit of a fade, and pull possibly, it's going to make it 120

Raining, don't like rain

So I'm going to hit a 3/4 8 iron tee it back a bit

Line tree just right of the flag

Ok it can go over there

Kind of done all my talking to the ball before but, kind of didn't do what I wanted it to do

Putt 1:

Balls on the green maybe 5 ft away

It's dead weight to the pin

OK

Can see this coming of the right about a foot

So staring at the point I want to hit it too, so that's a foot right of the hole, concentrating on a point a foot right of the hole

Stayed pretty straight turned more towards the end, finished about 8 inches away

Hole 2:

Tee Shot:

202 to the pin

Leaning slightly into the wind, there's a cross on the last hole

Can I play it 210?

210 flags on the back

Ball will travel through the back

..10, I was going to hit a high but it will probably come up short but, better than being too long because that's where all the trouble is

Just going to tee it down

So going to hit it 10 yards left of the flag

Oh

Pulled it a bit, it's in the bunker probably, yep

Bunker shot:

In the bunker am I? ooh hello

brilliant, I am in a huge footprint

I will genuinely do well to get this out, I've got like, 8, 9, 10 yards to get it out the bunker and it's in a hole practically

have to have quite a steep swing on this

this could genuinely go anywhere

it's in like, it's in a really big footprint it's horrible, genuinely don't know how I'm going to get it out left, maybe try going a bit right

well I got it out
it's quite a good shot actually; it's finished about 4 foot from the flag

Putt 1:

seeing, looking of the left by about an inch and a half 2 inches, seeing a white line turning into the hole

aimed an inch and a half left it's got to be hit go approximately 2 foot past, foot past going on that line getting over the ball, looks to be an inch, going to aim it an inch left

hit it too hard, right line just hit it through the break

Hole 3:

Tee shot:

so, I know I want to be hitting it up the left hybrid, just to get them playing middle of the fairway wind slightly behind

go lower because I've just skyed the last one

left edge of the bunker on the left

going to work on getting it on the inside

OK

it's gone exactly where I wanted it too, didn't feel like the best of swings
but it's worked

thinking technical a little bit
which I know I shouldn't be doing

Shot 2:

so, it wasn't a good swing but I'm happy where it's finished up where I wanted it too didn't feel nice but, there's no pictures on the card

97 yards to the flag

slightly into the wind

in-between clubs

97 yards usually hitting wedge 100ish

9 iron 115, 110 so bushing to the front of the bunker is 90 yards

should be able to carry that with a wedge although it's into the wind

just going to be aiming left of the flag, only just, though with a tiny bit of fade that I may be hitting

doesn't feel like a good strike needs to go

oh but it's got there

there's a pitch in high just past the flag

head winds getting up a bit

think,

walking down to the green you can feel that the winds a lot stronger than initially anticipated, so quite surprised that wedge has got there considering it didn't feel like a good strike I didn't thin it or

anything like that it was like, a norm, like a good strike really like it come of the toe a little bit and

had a tiny bit of fade so expect those to reduce distance but it's past the flag by about 15 foot so not a bad shot

Putt 1:

whilst tom is putting I'm just going to get down and see it comes of the right

it's going to die a lot more when it comes to the hole because it's going to be travelling little bit slower because its downhill, don't want to be racing it so I see this about 4 inches right although I'm going to give it 6 inches though I might change my mind when I get over the ball
let's have a look, the balls down, it's obviously about 4 inches right, there's a little patch of dirt 4 inches right

it broke, aww

a lot more than I initially anticipated but I've seen the read going past so should be able to get the return

Putt 2:

seen this like an inch left about 5 foot putt

so I started par, bogey, par, not a bad start

Hole 4:

Tee Shot:

started to rain a little bit, the power lines above me I can hear the rain hitting the power lines, not really going to hear that during my golf swing thought, don't really hear or see anything other than the golf ball when I'm, like before I've walked to the ball and this tee's kind of like a contact lens it's cut round and it's kind of domes at the top and there's a little rabbit hole and where ever you put the ball on this tee going to be hitting of a downslope so looking at possibly teeing it back a bit because it's a bit flatter if you go to, to the left hand side of the tee box? little bit flatter only problem is going to be above you so, going to tee up to the right hand side just behind the right hand marker, that's only about 2 foot in front of me but that's not really going to bother me

it's got like the flattest part of the ground there; I'm just going to be aiming this over the dip in the trees

straight at the flag practically

foots on a slight hill but there's nothing we can do about it

hit it left but its slicing, back to the middle of the fairway, felt as though I come across that quite a bit it's fine

Shot 2:

so that, slice, about 15 yard slice has left me a little bit of distance but no problem it's not a long hole so, walking up to my ball, although it's sliced 15,20 yards it's still a decent way up here, swing felt a bit over the top

but, it's not really a lot you can do about that now

winds behind slightly 51 yards to the flag its more coming of the right

51 yards, just going to get a 60 degree out, want to be pitching it at about 44 yards 45 yards, it just wants to be a half, through make that 3/4

going to iron this about 5 yards right of the flag allowing for the wind to take it, little bit

oh and I like, thinned it

it felt really dodgy, focusing too much technically

Shot 3:

back of the green its gone slightly downhill

greens downhill sloping right to left

got a 9 iron out just intend to kind of run this up to the hole side aiming a couple yards right slightly back in the stance, weight more forward hands slightly forward, landing zone

pitched it perfect, it's a bit low trajectory though, to be expected on the downhill lie

Putt 1:

I seen running down, ran, aiming it right round to the left but that's because there's a slope up there so, coming from this side it's going to come just of the right, not a lot but it will come just of the right by about half an inch right

it was a bit indecisive and it broke a bit more

Putt 2:

there's a lot of chemicals on the green
got like a 2 and a half foot putt, just going in the middle of the pole pop it in
middle of the hole, line middle of the hole

that's a poor effort, 51 yards coming of a bogey

Hole 5:

Tee shot:

approach shot in cost me should've had a different shot that I should have played
so, my, not from the tee, brolly

106

it feels a lot later on in the day now because I've been here, feels about 3 or 4 o'clock in the afternoon
so, not off the usual tees, but I'm usually here with my drive, usually 100 yards out

I'll move my ball

going to aim at the bush on the right of the flag
ensuring clubs there ensuring feet are there

pulled it left again

I know that's just something tactical I've got to work on

so walking up I thought I hit it up just left of the green, fortunately 12 foot from the flag, you can
already see walking up I'm going to have a downhill left to right putt
always try and get my putts past the hole, can't go in if they're short
so walking up now I can see it's a bit further past than 12 or 14 foot

Putt 1:

about 18 foot away and now it's going to break of the left going to give it a bit more anticipated
probably about 3 or 4 inches of the left going to be missing this left if I can
got to get over the ball
going to give it a bit more, I think, about 5 inches

go, go, go

I missed it left it's about an inch past

Putt 2:

good putt

good par good putt, did what I wanted to missed it left could never have gone in on the low side

so thinking about take away, my take away felt really disconnected from the first tee
just going to rehearse it then forget about it and address the ball to swing

Hole 6:

Tee shot:

So, two bogeys rest pars, not bad

no

yes, 2 bogeys rest pars, but one of them shouldn't have been a bogey though
so I played this this morning, same flew 105 but I know it's a bit more than that, flags on the back
teeing it back a bit

got a 9 iron just going to hit a 3/4 shot with this

going to go straight at the flag with this

clubs going at the flag

I'm going just left of the flag that's fine

I hit it just left and its drawn a bit

swing still doesn't feel brilliant but it's working so

I'll...range a bit later

ball set of just left where body was aiming, just faded a bit not bad only a yard or 2, not bad couple of
foot from the flag about 80 foot walking up

Putt 1:

Looking to hole this putt hopefully its good birdie chance although if it doesn't drop it doesn't drop
not going to be racing it 5 or 6 foot past it'll be 2, 3 foot past should be holing the return

so walking up, you can see that

we're about 10 12 foot away

trying to find a marker don't know where it's gone

somehow managed to put it in the other pocket usually put my marker on my tee peg in my right hand
pocket but forgotten mic in the had to put them all on the left

so, looking at this putt comes of the right, slightly downhill it's going to be quite quick after it gets
past the hole

what're we going to hit?

2 inches left

approximately an inch left

I fancy this

stroked it down, just didn't hit it hard enough

died towards the end otherwise it was in

APPENDIX V

EXAMPLE OF AN INTERMEDIATE SKILLED PERFORMERS THINK ALOUD TRANSCRIPT FROM STUDY 4 DURING THE COMPETITION CONDITION

Hole 1:

Tee shot:

I'm just going to do the same thing
same club 8 iron
going to do the same thing, tee it up the club back, a little bit back, take me right down
aim at that tree
try and aim at the tree this time
feels good

I've got it a bit heavy

it's a bit short

Putt 1:

just coming of the right, by about an inch not a lot of break in it

missed it on the low side disappointing only because it wasn't hard enough

Hole 2:

Tee Shot:

so every time I've played this hole I sky it and I hit it left
so I'm not going to hit this ball until I feel comfortable hitting a good shot
it quite a tough follow you can expect a bogey at 200 yards

hit it, couple of yards left of the flag so a couple of yards not a lot
feet lined up that's the most important thing

got it heavy again ah, why would I do that

it's really annoying that I've done that

Shot 2:

so out of the rough just going to play a 9 iron kind of chip and run
just going to try chipping it just slightly left of the flag, trying to pitch it one bounce and then on

pulled it left
not what I wanted to do

it's at the back of the green that's fine, I'll get up and down from there

Putt 1:

I can use the putter, get the percentage
so, think I'm just of the left couple of inches slightly downhill, slightly across

woo

so just holed that from just of the green

thought I was missing it miles left and it went in
bonus

so, levels of 2, 4 holes left

Hole 3:

Tee shot:

tee'd up on.. the side, quite low again
right hand edge of the bunker, left hand bunker

oh that was really bad go, yep thought so, that was bad
kind of like duff pulled that brilliant, it's in the bunker

oh that was not good

Bunker shot:

I should be able to get to this green
it's not bad
should be able to get a 9 iron
over that
be needing 8 to get to the green can I get an 8 above that
no I'm going to hit a 9 iron hoping I get it a bit closer
aim just right

not what I wanted to do
got it kind of heavy which is fine

hit it out a little bit of the way so it's fine
got a lot shorter of a shot left of the flag now anyway

Shot 3:

got a little pitch in
it's getting kind of hot
54 yards over a bunker
from behind we're pitching it

or you can go left that's fine

distance wasn't bad just direction
break of the left

Putt 1:

couple of foot of the left going to swing it more towards the end

didn't hit it, need to be hit a little bit harder

an extra couple of foot and it would have held it's line, line wasn't bad after the tee shot

Hole 4:

Tee shot:

OK so, to the fourth tee contact lens tee, know exactly where I want to tee it, know exactly what I
want to do

it's a bit warm
going to have to take these waterproofs of in a bit, I am boiling

contact lens tee, where's the wind, slightly behind
straight at the flag again

oh really dodgy, mm

Shot 2:

got 51 yards last time, it's changed what 60 into the wind
60 yards, wind, just going to do 3/4 par 3/4 54
just right of the flag
and I'm going slightly left

and it's gone left its where I felt it was going and it went that way

Putt 1:

distance isn't bad
hope the distance, 2 off the green fancy holing these sort of shots, really like these shots

this is just going to run slightly to the right maybe, it's not really a lot in it
leans a bit left then a bit right so got to hit it left lip

mm, didn't hit it left lip
outside left

Putt 2:

at that line actually that I should have hit it on, probably should of been in, had I have hit it a little bit
less would have 4, 5 foot past
so it's coming back down just of the right maybe, straight just of the right
see a couple of white lines, see one an inch outside right, it's got to be hit pretty dead weight for it to
drop on that line
yeah I'll hold

Hole 5:

Need to mark the card haven't marked it past couple of holes

Tee shot:

106, , that looks good
it's going to be half the shot thought, 3/4 wedge is what it's probably going to be

that bush on the right again

went even further left, that's not going to come in from there

up and down is

have to bring the old up and down
should be able too

into the wind at 106 hit a 3/4 wedge, where have you gone

Shot 2:

it's in the thick stuff

going to play 54

considering that was laying down I am so happy with that
that was sitting in such a hole

Putt 1:

find the hole, 6 feet to the hole, 3, 2,

7, 3, good up and down seeing as it was in the rough lying down

Hole 6:

Tee shot:

par 3/4 9 iron back up but
wind seems to have dropped a little bit
its 110 going to be 9 iron not a full one
tee back up a little bit

to the left of the flag

or you can hit miles behind it that's fine, ohh that was really bad

so how I have just hit that is beyond me
should be a good up and down

not a bad bunker shot

Bunker shot:

sands really soft, really soft

Putt 1:

er, it's an inch, however much of the left, it's definitely going to break

APPENDIX W

EXAMPLE OF A HIGHER SKILLED PERFORMERS THINK ALOUD TRANSCRIPT FROM STUDY 4 DURING THE PRACTICE CONDITION

Hole 1:

Tee shot:

122, er 122, no wind, 122, 122 no wind, hat you hitting little bit of rain, just a 3/4 9, 3/4 9 all day
smooth swing
just a smooth swing

perfect, perfect

Putt 1:

about 20 feet

20 foot

left to right, putting through the Himalayas

be a bit slow with this water on top

just about 3 inches outside the left

confident, confident stroke come on

ooh, you girl hit it

Hole 2:

Tee shot:

21? (221) 220 bloody hell, ok, 221 er, I have no idea I'm just going to hit 4 I think, 4
if I can find a 2 peg, yeah

just a 4 iron

keep the pin 3/4 at back no wind

just try and hit a little fade, little fade of the left edge of the green

come on

stay committed

perfect, absolutely perfect, mm a bit short, little bit short

Shot 2:

hmm need a cannon to get it there

(counting)

57, 57 foot, 57 uphill got to get up that step, get it up that step middle of the green come on

leave anything inside 4 foot, anything inside 4 foot is good

all about pace

ahh batted it, sit down, shit, shit

fuck

mmm, smashed it a good 10 foot past, well done

ah that was horrible, touch of a baby elephant you dick

Putt 1:

slightly of the left, probably the same as the first, couple of inches outside left

ah, little dick, fucking miles away absolutely miles away

Putt 2:

clubs through wack
got loads of crap on my ball

Hole 3:

Tee shot:

(singing)

right got to try and leave yourself 80 yards
just take it up over that bunker, take over the bunker little bit of a draw

fly, fly, fly, nearly missed the club face

Shot 2:

easy enough, easy enough what we got, oh 9 yards out, 89
89, erm, going to hit a semi, wet grass is it going to fly, are we going to get a flyer, I don't know
makes itself, just probably a half, little bit more than a half 52, just left of the flag come on, just hit it,
left of the flag, 10 foot left come on, 10 foot left of the flag, little 3/4 52

eugh, pinned it damn, sit, oh dear, that was not very good
you bloody fool
not very good

Shot 3:

see if we can get it up and down, shouldn't be too difficult
I like making it interesting bloody hell
it's easy what 20 yards, 22 yards
sat down a little bit possibly going to affect the way it comes out
try and bump it a little 52 try and get a top spin on it
bump it out just let it roll towards the hole

give it too much, dick head

that was not very good
heavy handed

Putt 1:

come on try and save par
couple of inches outside the left all about pace, no pace is going to drop of left keep the pace keep the
pace come on

no pace, fuck

fucking sick of all this shit on the ball

Putt 2:

another tap in bogey well done, sick of it, rubbish on my hands now from all this crap on the green

Hole 4:

I'm going for it Tom, I'm going for big dog, sick of playing rubbish
(singing)

Tee shot:

I'm just warming up, just warming up
(singing) tempo, tempos out, smooth with the tempo
try hit a little fade, little fade over those trees

that was not a little fade that was a dirty pull
dust some cobwebs of you see, what happens if you don't play

Shot 2:

77 from the world's worst lie, shit, no green to work with, tight flag thick ruff 77 yards, got to hack at it to get it out really, hack at it, just make sure you get it there,
not too bad if you go big just don't flirt with short
try and hit it big so you go go longer, come on, anything, bigs better than short just hit it
make sure you get decent contact lets go

oh that heavy contact short all day
although it's not that bad, heavy heavy contact
but I'll take it

Putt 1:

tell you what, fancy chipping this in, I fancy chipping this in
perfect set up nice, just going to bump it, little 58, just going to get a little bit of release out of it
hopefully it'll drop in front door

go on then go on then turn turn, it was good, it was good

Putt 2:

tap if fours, somewhat of a victory today

Hole 5:

Tee shot:

what you got 90 95? (6) 106? ok
106, just love the rain 106 just a little half pitching wedge isn't it, need to go right of the flag, slightly right, little bush 10 foot right, half pitching wedge nice and smooth

it's pretty good if it's length, go, little bit short, hmm

Putt 1:

that's pretty good I'll take that one there, about 18 foot
18 feet, (counting) 18 foot away looks like it's going to swing a little bit from the right
I would say about a cut from the right but again it's all about the pace but greens been slow today
make sure you get it there

stay up stay up, oo, better effort
just the wrong line, fucking crap all over my pants

Putt 2:

left

if..went straight inside the hole,

easy

Hole 6:

Tee shot:

121, 1, 2

121 winds picking up now, going to be then same, no stick with this, stick with the wedge, stick with the wedge, just hit it

121 3/4 wedge bit left of the flag, the wind take it

oh, find the bottom grove again

get all the bad shots out my system, Jesus, Jesus

Shot 2:

...weight transfer what so ever, absolutely no weight transfer, they're all sticking in the left hand side fucking get of the left hand side you dick

another 20 yard chip, not going to be too difficult

58, 58 degree loft it up on the green, well that sounds pretty hard under there, sounds good though all about strike come on

oh he played one, oh, almost

almost a good strike, just didn't release that much (singing)

Putt 1:

another tester for par

(singing)

got to be on the inside of the right edge, keep the pace, so it doesn't fall of the low side, keep the pace, keep the pace inside right edge come on

ah, and it dropped across the front, jokey

APPENDIX X

EXAMPLE OF A HIGHER SKILLED PERFORMERS THINK ALOUD TRANSCRIPT FROM STUDY 4 DURING THE COMPETITION CONDITION

Hole 1:

alright let's see if you can find the middle of the clubface
let's see if you can find the middle of the club face come on head on now head on head on head on lets
go

6 holes, competition, game on come on
screw on

Tee shot:

122
right
122, little bit of wind, stick with the same club
stick with a little wedge, 3/4 9
wack it, wack it
stick to it
feel, feel that wedge
watch the strike watch the strike, keep the spine and go, come on, keep the spine and go

oh sit down. down. down
that was better

Putt 1:

that was a better shot, that was a better shot lee Roy

about 8 foot away, perfect, drop that in the front door
8 foot, surely from this side there's no break, I don't think so anyway, I don't think there's any break
because you kept the spine angle lee Roy, keep the spine angle, and its exactly what you did, good
yeah no break
inside the hole, inside the hole on the left side no break
come on open your count

no
oh, right, that was not very good, lapse in concentration
leads to fucking 3 putt, dick
dick

fuck sake

well done lee well done, 3 putt 4

Hole 2:

Tee shot:

come on, just find it little fade again just to hit, try and find the middle of the clubface, just keep that
spine angle open
keep the spine angle come on

fly fly
fuck

(singing)

come on lee, come on lee Roy keep going, good strike that keep the club short, humped that though,
absolutely humped it

never mind it's good that it's on the green, make a 2 putt
2 putt par and get off

Putt 1:

little bit closer than last time, only just
stopped dead absolutely humped that and stopped dead

come on see if you can do a better job this round lee
keep the, little bit closer, little bit easier
come on

uphill again ever so slightly left to right, about the pace, give yourself and tap and par come on

hurry, hurry, hurry, hurry
its ok, that's ok

Putt 2:

tap in, tap it in
there we go, 1 better than last time, 1 better than last time

Hole 3:

Tee shot:

come on the same as last time, little 4 iron
little 4 iron over the bunker, nice and easy, try and leave yourself 80 yards

nope oh dear that's in trouble, ah it'll be alright, it'll be alright
oh dear that was a pull, pulled it from top of the swing
no spine angle

Shot 2:

I'm chopping out of the rough here

let see if we can find it, I hit it pretty well to be fair just pulled it, it was always turning over

not sat very well though, just about got a shot

67

67 yards, from the heavy rough

ok, that's got to be like a 3/4 58

try and get it on the green from here if you can

sit down short, stay short stay short, oh he's in the water fuck of lee,
eh? did it get over? fucking hell no way, lovely

showcasing every amount of skill you've got today, well done

fucking putting the fairway, fucking make it hard for yourself. Don't make it hard for yourself

Putt 1:

not a lot of green to work with, I put it up in the air
see if we can get this one close

sat pretty good fancy this come on, let's get it going close

it's come out quite nicely, that'll do
that'll do donkey that'll do

Putt 2:
(singing)

inside left, left edge
left edge, nice bit of pace left edge nice bit of pace

well done good block, good block, good 5, dick, dick

way to make a bogey

Hole 4:
hey 2 over par for a 3 fucking hell
I'm going to finish birdie birdie birdie though
like a boss

Tee shot:
just over the trees little bit of a draw, come on, just a little bit
you get that spine angle, keep that spine angle

better, bit better

Shot 2:
53 same angle as last time not a great deal of room
wet grass see if you can get it out of this onto the green come on
keep your spine angle nice firm 58

just like that, be good, be good, sit
that's better, that's better

Putt 1:
maybe not 8 foot maybe 1 foot actually
10 feet for birdie, I'm going to hole it, I'm going to hole you

come on 10 feet
should move a little bit from the left if anything at the hole
I'm going straight hit it straight drop it in the front door

fucking hell fucking hell lee hit it, hit it harder that's horrendous man, its fucking 8 foot past
fuck sake, what are you doing

Putt 2:
For 5 footer into the middle, just be confident

good putt well done, more work than I would've liked

take it, I'll take it

Hole 8:

Tee shot:

OK 106 winds got up a little bit now
yeah couple of birdies to finish I think
couple of birdies, come on, good shot here 106
it's a little half pitching wedge again
nice smooth half pitching wedge,
go flag hunting

down, down, sit

that was OK, that looked ok

Putt 1:

tell you what that's pretty close think I'd like the one that's near the hole obviously but I would say I'd want the one that's got a right to left putt as opposed to left to righter

which one you taking lee Roy, which on you taking
I'm on the fucking back of the fucking green
(singing)

come on slightly downhill, left to right
I'll hit a good cup outside the left I'd say
good hole outside the left
have something to drop

go on drop, drop, ah

too much work to do, nearly, nearly, too much break really