An Exploratory Study of Collaboration In Built Environment Design Teams

A Social Psychology Perspective

by

Jennifer Barrett

VOLUME TWO

A thesis submitted in partial fulfilment for the requirements for the degree of Doctor of Philosophy at the University of Central Lancashire

February, 2018

VOLUME TWO: CONTENTS

APPENDIX 1: Industry survey questions with associated thematic codes

APPENDIX 2: Survey data statistical analysis

APPENDIX 3: Physical and verbal indicators prescribed by the SPAFF method

APPENDIX 4: Summative AEC-specific thematic content/literature framework

APPENDIX 5: Published material

APPENDIX 1

Industry survey questions with associated thematic codes

Question codes associated with thematic codes attributed in Tables 5.1-3:

Theme M: Motivation and reward

M1 Intrinsic motivation
M2 Extrinsic barriers
M3 Rewards structures
M4 Motivational factors
M5 Co-operation and competition

Theme R: Risk Attitudes

R1 Shared risk tolerance
R2 Shared risk responsibility
R3 Risky shifts
R4 Familiarity theory
R5 Pluralistic-ignorance theory
R6 Relevant argument theory
R7 Leader-confidence theory

Theme C: Social Climate

C1 Test for cohesiveness (task cohesion)
C2 Test for cohesiveness (social cohesion)
C3 Test for cohesiveness (attraction to the group)
C4 Effects of cohesiveness
C5 Effects of groupthink
C6 Psychological safety
C7 Effects of conflict
C8 Effects of team climate
C9 Innovation as a team value
C10 The influence of cultural norms
C11 Social tuning
C12 Social comparison

DEMOGRAPHICS

DEM1	Discipline of respondent
DEM2	Organisation type
DEM3	Organisation md/sd
DEM4	Project Size
DEM5	Disciplinarity of team
DEM6	Long term professional relationships
DEM7	Meeting frequency
DEM8	Leadership
DEM8A	Leadership discipline

Industry survey questions

Thematic code (where appropriate)	Question number	Question (with selection of answers, where appropriate e.g. Likert scale/drop-down menu)
	Q1	I have read the information above
	Q1_1	Yes
	Q1_2	Other
	Q1_Other	Other
	Q2	I consent to my voluntary participation in this study
	Q2_1	Yes
	Q2_2	Other
	Q2_Other	Other
	Q3	I am at least 18 years of age
	Q3_1	Yes
	Q3_2	Other
	Q3_Other	Other
DEM1	Q4	What is your main discipline or profession

	1	Architect
	2	Architectural technician
	3	Building services engineer
	4	Building surveyor
	5	Civil engineer
	6	Construction project manager
	7	Design/Project manager
	8	Ecologist
	9	Highways engineer
	10	Landscape architect
	11	Mechanical & electrical engineer
	12	Property developer
	13	Quantity surveyor
	14	Structural engineer
	15	Town planner
	16	Urban designer
	17	Other
DEM2	Q5	What type of organisation do you work for?
	1	I'm a sole practitioner
	2	A small, private practice (fewer than 10 employees)
	3	A medium-sized, private practice (between 10 & 50 employees)
	4	A large company (more than 50 employees)

	5	A public sector organisation e.g. council, government office
	6	A building contracting company
	7	A commercial property development company
	8	Other
DEM2A	Q6	Does your organisation employ other professions/disciplines?
	1	No, we are all generally from the same profession
	2	Yes, it's a multidisciplinary organisation
	3	Other
DEM3	Q7	What is the ''estimated'' total construction budget (i.e. excluding professional fees)?
	1	Less than £100,000
	2	£100,000 - £1 million
	3	£1 million - £10 million
	4	£10 million - £100 million
	5	£100 million - £500 million
	6	More than £500 million
	7	Other
M3	Q8	How does the client remunerate your professional services?
M5	1	Each consultant has their own separate fee agreement with the client.
	2	The lead consultant liaises with the client and then apportions the fee to subconsultants.
	3	The fee agreement is with the team and remuneration is then apportioned amongst us.

	4	Don't know.
	5	Other
M3	Q9	Apart from monetary payment, which factor 'most' influenced you or your company to work on this project?
M4	1	The high profile nature of the project
	2	An opportunity to expand our client network
	3	An opportunity to develop my/the company's experience and knowledge
	4	To maintain our profile in this sector of the industry
	5	It was simply an income opportunity
	6	Other
	Q10	Can you briefly describe your role in this project e.g. project engineer, lead consultant, fire safety specialist?
DEM5	Q11	Thinking about the ''design team'' on this project, which professions and disciplines are present in the team besides you? ''Please select all that apply''
	Q11_1	Architect
	Q11_2	Architectural technician
	Q11_3	Building services engineer
	Q11_4	Building surveyor
	Q11_5	Civil engineer
	Q11_6	Construction project manager
	Q11_7	Design/Project manager

	Q11_8	Ecologist
	Q11_9	Highways engineer
	Q11_10	Landscape architect
	Q11_11	Mechanical & electrical engineer
	Q11_12	Property developer
	Q11_13	Quantity surveyor
	Q11_14	Structural engineer
	Q11_15	Town planner
	Q11_16	Urban designer
	Q11_17	Other
	Q11_Other	Other
DEM6	Q12	Do you work with any of these people on other projects?
	1	Yes
	2	No
	3	Other
DEM7	Q13	On average, how frequently do you meet face-to-face with the design team on this project?
	1	Never
	2	We only meet in a virtual environment, never face-to-face
	3	Daily
	4	Weekly
	5	Fortnightly

	6	Monthly
	7	Every two months
	8	Every three months
	9	Other
DEM7a	Q13_a	If you '''only''' meet in a virtual environment (''such as via BIM, email, intranet''), how frequent are these interactions?
	1	Daily
	2	Weekly
	3	Fortnightly
	4	Monthly
	5	Every two months
	6	Every three months
	7	Other
DEM8	Q14	Does this design team have a leader or lead consultant?
	1	Yes
	2	No
	3	Other
DEM8A	Q14_a	If yes, what is their profession/discipline?
	1	Architect
	2	Architectural technician
	3	Building services engineer

	4	Building surveyor
	5	Civil engineer
	6	Construction project manager
	7	Design/Project manager
	8	Ecologist
	9	Highways engineer
	10	Landscape architect
	11	Mechanical & electrical engineer
	12	Property developer
	13	Quantity surveyor
	14	Structural engineer
	15	Town planner
	16	Urban designer
	17	Other
	Q15	Please rate how strongly you agree or disagree with each of the following statements.
R3	Q15_a	The whole point of design is to create something new and different
	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other

M5	Q15_b	It is important that the building design reflects my personal ethos and approach
	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
R4	Q15_c	Working alone is not conducive to creativity
R5	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
M5	Q15_d	On the design team, everyone is equal
	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree

	6	Other
M3	Q15_e	Personally, I'm not the kind of person who likes to take risks
	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C9	Q15_f	I don't think the terms ''innovation'' or ''creativity'' are relevant to this kind of project
C11	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
R3	Q15_g	The point of design is to eliminate all risks
	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree

	5	Strongly disagree
	6	Other
	Q16	Please rate how strongly you agree or disagree with each of the following statements.
C1	Q16_a	The design team feels a shared ownership of this project
C8	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
R2	Q16_b	Liabilities for defects/failures will be shared amongst the group
	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C10	Q16_c	The group has a very clear set of norms and values
	1	Strongly agree
	2	Agree

	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C2	Q16_d	I sometimes meet with team members outside work hours
M1	1	Strongly agree
M4	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
R1	Q16_e	We embrace risk - it's a fundamental part of design!
	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
	Q17	Please rate how strongly you agree or disagree with each of the following statements.
C10	Q17_a	The group shares the same views regarding the ethical issues in design

	1	Strongly Agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly Disagree
	6	Other
R3	Q17_b	There are some people who are prepared to take big risks in this team
	1	Strongly Agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly Disagree
	6	Other
C12	Q17_c	There is a member of this team who inspires me to be more creative and innovative
M4	1	Strongly Agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly Disagree
	6	Other

C6	Q17_d	I feel that I can learn something from my colleagues in this team
C12	1	Strongly Agree
M1	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly Disagree
	6	Other
C3	Q17_e	I look forward to participating in design team meetings
C4	1	Strongly Agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly Disagree
	6	Other
	Q18	Please rate how strongly you agree or disagree with each of the following statements.
C2	Q18_a	We celebrate our successes as a project team
	1	Strongly Agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly Disagree

	6	Other
C2	Q18_b	I celebrate project successes with colleagues in my own organisation
	1	Strongly Agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly Disagree
	6	Other
R6	Q18_c	The project leader likes to take a risk
R7	1	Strongly Agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly Disagree
	6	Other
C1	Q18_d	I am often unclear about what role or task I need to perform
	1	Strongly Agree
	2	Agree
	3	Don't know
	4	Disagree

	5	Strongly Disagree
	6	Other
	Q19	How important are the following values to your '''team'''? Please allocate a number to each value below, where 1 is the value which is ''extremely important'' to the team and 8 is of ''no concern''.
	Q19_a	Satisfying the client's requirements -- ''1 is extremely important - 8 is of no concern''
	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8
	9	Other
	Q19_b	Satisfying planning or other regulatory issues -- ''1 is extremely important - 8 is of no concern''
	1	1
	2	2
	3	3
	4	4
	5	5
	6	6

	7	7
	8	8
	9	Other
	Q19_c	Minimising the time spent in meetings -- ''1 is extremely important - 8 is of no concern''
	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8
	9	Other
C9	Q19_d	Seeking new ideas and innovations -- ''1 is extremely important - 8 is of no concern''
	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7

	8	8
	9	Other
	Q19_e	Meeting deadlines -- ''1 is extremely important - 8 is of no concern''
	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8
	9	Other
	Q19_f	Keeping the project within budget -- ''1 is extremely important - 8 is of no concern''
	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8

	9	Other
	Q19_g	Maintaining positive professional relationships -- ''1 is extremely important - 8 is of no concern''
	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8
	9	Other
	Q19_h	Other (''please specify below'') -- ''1 is extremely important - 8 is of no concern''
	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8
	9	Other

	Q20	If you answered ""'Other"" to '''question 19,''' please identify this team value.
	Q21	Please describe ''one'' innovative aspect of this project.
	Q22	Please can you also briefly describe the creative process that led to this particular innovation?
	Q23	Please rate how strongly you agree or disagree with each of the following statements.
C1	Q23_a	Our team is united in reaching project goals
C4	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C6	Q23_b	I feel happy and comfortable during design team meetings
C8	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other

M5	Q23_c	It is important that all members of the team are in consensus before agreeing to design changes
	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C6	Q23_d	I feel comfortable to offer my solutions to design problems
R1	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C2	Q23_e	I would say that some of the team members are my personal friends
C3	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other

	Q24	Please rate how strongly you agree or disagree with each of the following statements.
R4	Q24_a	The more we talk about the project, the easier it is to develop new ideas
R5	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
M5	Q24_b	I don't mind if the design team reject my ideas if they think it enhances the overall design
	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
R2	Q24_c	I'm happy to take a risk, if that's the consensus of the group
R3	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree

	5	Strongly disagree
	6	Other
R1	Q24_d	When someone comes up with an idea, we discuss it as a group before accepting or rejecting it
R2	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C5	Q24_e	I often feel that the team have not fully explored the design alternatives
C9	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
	Q25	Please rate how strongly you agree or disagree with each of the following statements.
M5	Q25_a	There are some individuals in the design team whose egos dominate the design discussion
	1	Strongly agree
	2	Agree

	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C7	Q25_b	I have often felt angry or unduly stressed during design team meetings
M2	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C5	Q25_c	I often feel that I agreed to go with a solution that I wasn't entirely comfortable with
C6	1	Strongly agree
C11	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C6	Q25_d	Design team meetings are characterised by conflict and argument
C7	1	Strongly agree

C11	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C1	Q25_e	Our team members have conflicting ideas about the design brief
C7	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
C1	Q25_f	Our team members have conflicting ideas about how the project should be designed
C7	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
M1	Q25_g	My fellow team members recognise and appreciate my efforts on this project

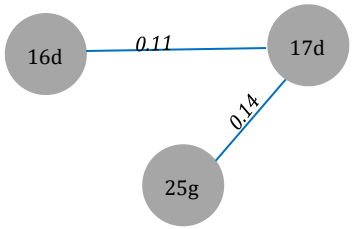
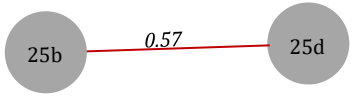
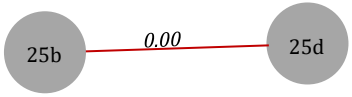
M3	1	Strongly agree
	2	Agree
	3	Don't know
	4	Disagree
	5	Strongly disagree
	6	Other
	Q26	Is there anything else that you think characterises this design team? Is there any aspect of the collaboration that you think presents particular issues or opportunities for design?
	Q27	If you would like to receive a summary analysis of the survey results, please enter your email address below.
	Q28	Following the initial survey, the research project will be developed by observing design teams in action to see how the social dynamics might influence design outcomes. If you are interested in participating in this stage of the research, please enter your email address below. Please note that this does not represent any commitment to participate and confidentiality will be respected in all stages of the research.

APPENDIX 2

Survey data statistical analysis

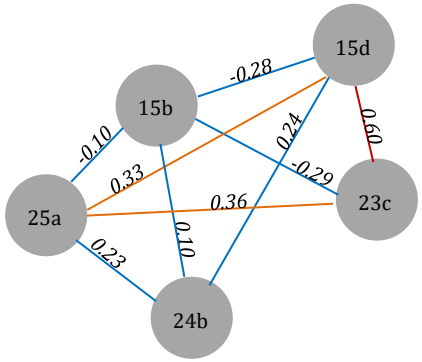
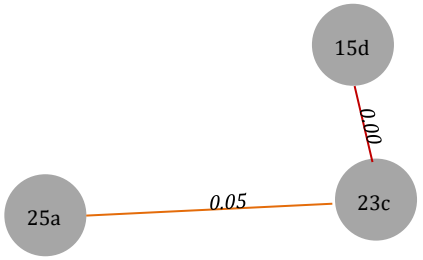
The following pages document the statistical analysis of responses for each thematic code. Thematic codes are described in Tables 5.1-3 and also in Appendix 1. Statistical analysis includes calculations of correlative relationships between question responses investigating each thematic code and significantly correlated responses, to describe the internal validity of the results and associated inference. Descriptive statistics are also included. Statistical analysis is presented according to anchor theme, beginning with motivation and reward, and followed by risk attitudes, and social climate.

(1) MOTIVATION AND REWARD

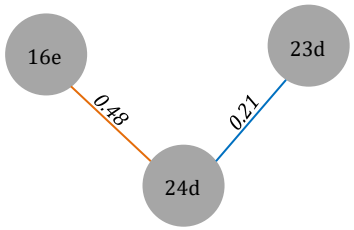
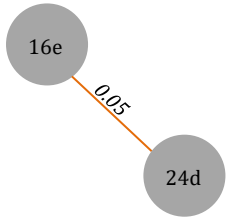
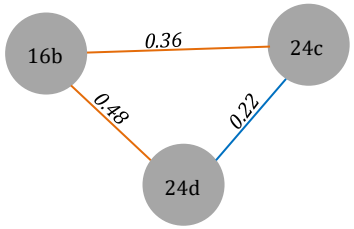
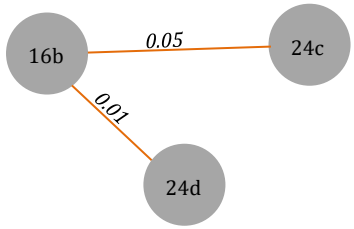
Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
M1	Intrinsic motivation		*No significant correlations* *(16d/17d; p=0.52)* *(17d/25g; p=0.46)*	*Q16d* n=39 Mean Statistic =2.59 Std. Deviation=0.91 *Q17d* n=41 Mean Statistic=1.93 Std. Deviation=0.47 *Q25g* n=31 Mean Statistic=1.90 Std. Deviation=0.30
M2	Extrinsic barriers			n=38 Mean Statistic =3.14 Std. Deviation=0.53

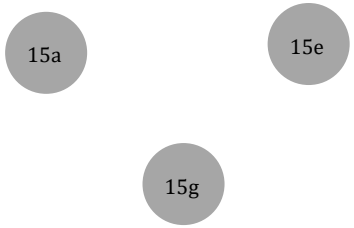
Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
M3	Reward structures	*Questions in this subgroup are not tested for correlation as each are regarded as individual and separate factors.*	*Q8 Remuneration* n=41 95.1% are remunerated individually 4.9% are remunerated as a team *Q9 Reward (excepting remuneration)* n=41 High profile project=24.4% Expand client network=9.8% Experience & knowledge=14.6% Maintain profile=17.1% Solely income related=17.1% Other=17.1% Q25g Appreciation of effort within project team n=34 100% of respondents consider their efforts to be appreciated.	

Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
M4	Motivational factors	*Questions in this subgroup are not tested for correlation as each are regarded as individual and separate factors.*	*Q8 Remuneration* n=41 95.1% are remunerated individually 4.9% are remunerated as a team *Q9 Reward (excepting remuneration)* n=41 High profile project=24.4% Expand client network=9.8% Experience & knowledge=14.6% Maintain profile=17.1% Solely income related=17.1% Other=17.1% Q25g Appreciation of effort within project team n=34 100% of respondents consider their efforts to be appreciated.	*Q9 Reward (excepting remuneration)* n=41 High profile project=24.4% Expand client network=9.8% Experience & knowledge=14.6% Maintain profile=17.1% Solely income related=17.1% Other=17.1% *Q16d Social motivation* n=39 Mean Statistic=2.59 Std. Deviation=0.91 *Q17c Inspiration* n=35 Mean Statistic=2.60 Std. Deviation=0.60

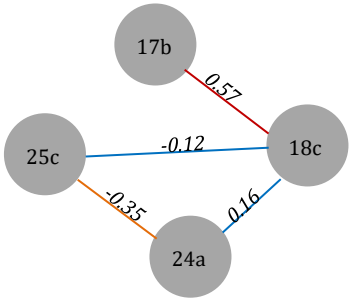
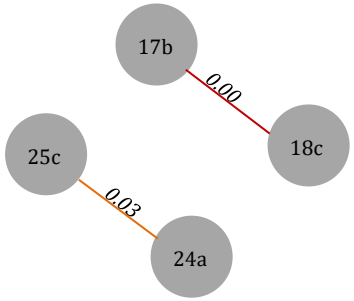
Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
M5	Co-operation & competition			*Q8 Remuneration* n=41 95.1% are remunerated individually 4.9% are remunerated as a team *Q15b* n=41 Mean Statistic=2.85 Std. Deviation=0.69 *Q15d* n=38 Mean Statistic=2.50 Std. Deviation=0.86 *Q23c* n=33 Mean Statistic=2.70 Std. Deviation=0.68 *Q24b* n=36 Mean Statistic=3.19 Std. Deviation=0.47 *Q25a* n=36 Mean Statistic=2.56 Std. Deviation=0.69

(2) RISK ATTITUDES

Code	Construct	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
R1	Shared risk tolerance			n=40 Mean Statistic = 2.29 Std. Deviation=0.49
R2	Shared risk responsibility			n=41 Mean Statistic =2.28 Std. Deviation=0.52

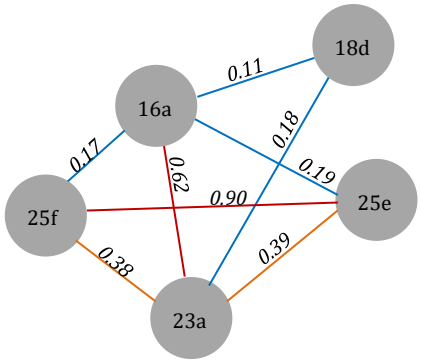
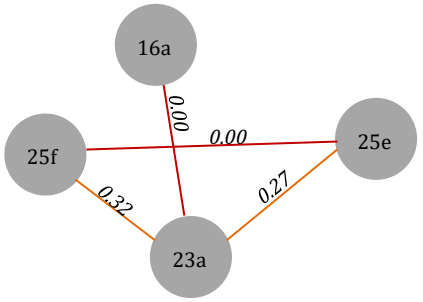
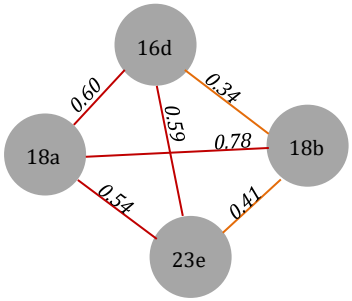
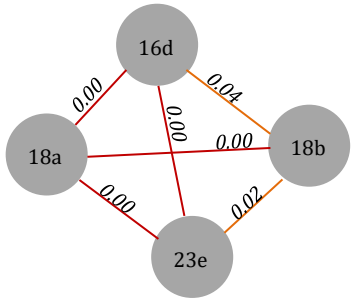
Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
R3	Risky shifts		*No significant correlations* *(15a/15e; p=0.72)* *(15a/15g; p=0.60)* *(15e/15g; p=0.93)* 27% (n=11) of respondents consider that they are not the kind of person to take risks. (Q15e) Of these, 2 respondents are in a group where members perceived as risk takers are present. (Q17b) Both of these respondents will, however, take a risk if the group consensus requires it. (Q24c) All other respondents who do not identify themselves as risk takers are not in groups where other risk takers are perceived to be present. 85% of all respondents will take a risk if the group consensus requires it.	*Q15a* n=40 Mean Statistic=2.75 Std. Deviation=0.78 *Q15e* n=36 Mean Statistic=2.14 Std. Deviation=0.76 *Q15g* n=37 Mean Statistic=2.16 Std. Deviation=0.65

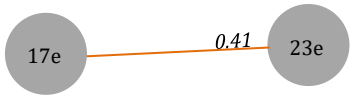
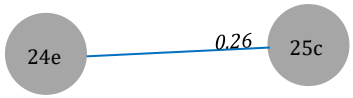
Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
R4	Familiarity theory		*No significant correlation (p=0.92)*	*Q15c* n=34 Mean Statistic=2.01 Std. Deviation=0.85 *Q24a* n=39 Mean Statistic=2.06 Std. Deviation=0.50
R5	Pluralistic-ignorance theory	*Examination of links between survey questions and meta-study were subsequently judged to be tenuous and omitted from analysis, pending further development in Stage 3.*		

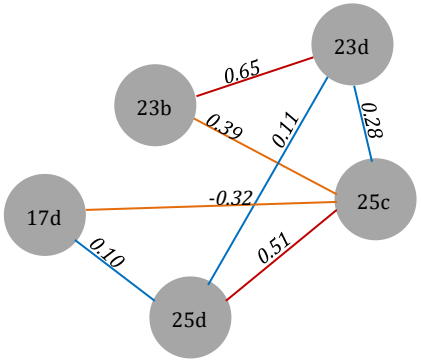
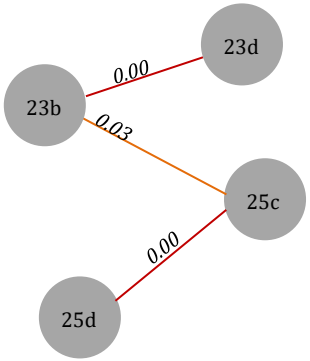
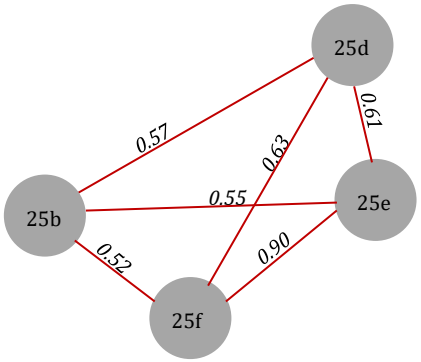
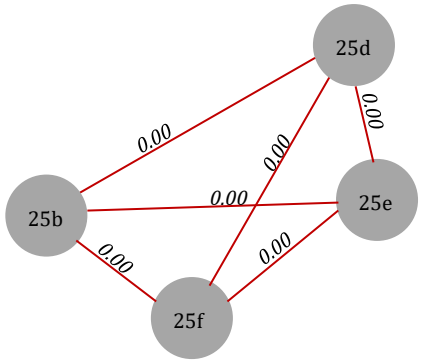
Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
R6	Relevant argument theory		 Correlation occurs between the predominance of risk takers within the group and its leadership. Correlation also occurs between the level of discussion of ideas and whether an individual's comfort with the solution consensus. Whilst this suggests that certain social phenomena influences design decision-making, further observation is required to be able to identify the presence of Relevant Argument Theory.	*Q17b* n=37 Mean Statistic =2.62 Std. Deviation=0.64 *Q18c* n=33 Mean Statistic=2.67 Std. Deviation=0.74 *Q24a* n=39 Mean Statistic=1.90 Std. Deviation=0.50 Q25c n=36 Mean Statistic=2.06 Std. Deviation=0.67

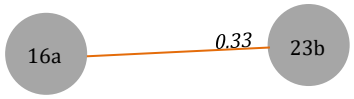
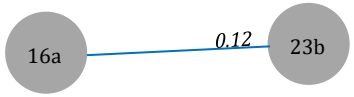
Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
R7	Leader confidence theory	*Examination of links between survey questions and meta-study were subsequently judged to be tenuous and omitted from analysis, pending further development in Stage 3.*		

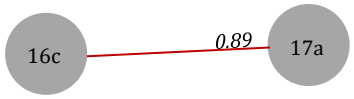
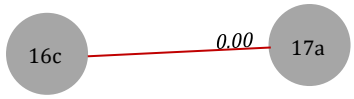
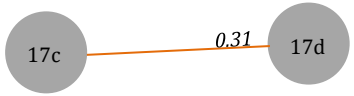
(3) SOCIAL CLIMATE

Code	Construct	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
C1	Group cohesiveness (task)			n=41 Mean Statistic = 2.14 Std. Deviation: 0.49
C2	Group cohesiveness (social)			n=41 Mean Statistic =2.51 Std. Deviation:=0.43

Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
C3	Group cohesiveness (attraction to group)			n=41 Mean Statistic=2.15 Std. Deviation=0.46
C4	Effects of cohesiveness			n=40 Mean Statistic=1.99 Std. Deviation=0.42
C5	Effects of groupthink		*No significant correlation (p=0.18)*	*Q24e* n=30 Mean Statistic=2.30 Std. Deviation=0.70 Q25c n=36 Mean Statistic=2.94 Std. Deviation=0.67

Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
C6	Psychological safety			N=40 Mean Statistic=1.81 Std. Deviation=0.43
C7	Effects of conflict			n=39 Mean Statistic = 2.94 Std. Deviation=0.54

Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
C8	Effects of team climate		*No significant correlation (p=0.06)*	*Q16a* n=36 Mean Statistic =2.08 Std. Deviation=0.60 *Q23b* n=36 Mean Statistic=1.83 Std. Deviation=0.51
C9	Innovation as a team value		*No significant correlation (p=0.55)*	*Q15f* n=37 Mean Statistic=1.78 Std. Deviation=0.58 *Q24e* n=30 Mean Statistic=2.7 Std. Deviation=0.70 *Q19 ranked values:* 75% of respondents identify innovation as a team value

Code	**Construct**	**Pearson's (r) correlation of question responses** *r values shown where Cohen's (1988) scale of magnitude of effect size applies:* *small (>0.10) = blue* *medium (>0.30) = orange* *large (>0.50) = red*	**Significantly correlated question responses** *p values shown where p<0.05 (2 tailed)*	**Descriptives** Values relate to Likert Scale (as recoded – '*don't know*' removed): 1= *Strongly Agree*; 2=*Agree*; 3=*Disagree*; 4=*Strongly Disagree*
C10	Influence of cultural norms			n=32 Mean Statistic=2.31 Std. Deviation=0.61
C11	Social tuning	*Examination of links between survey questions and meta-study were subsequently judged to be tenuous and omitted from analysis, pending further development in Stage 3.*		
C12	Social comparison		*No significant correlation (p=0.07)*	*Q17c* n=35 Mean Statistic=2.60 Std. Deviation=0.60 *Q17d* n=41 Mean Statistic=1.93 Std. Deviation=0.47

APPENDIX 3

Physical and verbal indicators prescribed by the SPAFF method

The coding method used for attributing affect within the thematic codes was derived from the Specific Affect Coding System (SPAFF) (Coan & Gottman 2007). The current codes of the SPAFF, indicators, physical cues and counterindicators are listed below, taken directly from Coan & Gottman's paper.

Affection

Function

Affection expresses genuine caring and concern and offers comfort. Often the voice slows and becomes quieter or lower. Its function is to facilitate closeness and bonding.

Indicators

1. *Reminiscing*. The speaker shares warm memories of something she and the receiver enjoyed together.
2. *Caring statements*. Direct statements of affection or concern, such as "I love you," "I care about you," "I worry about you," and so forth.
3. *Compliments*. Statements that communicate pride in or admiration of one's partner (e.g., "you are so smart!" or "you did such a great job with the . . .").
4. *Empathy*. Empathizing individuals mirror the affect of their partners. Such mirroring need not be verbal, but however it is expressed, it should be obvious that the intent of the mirroring is to express an understanding of the partner's feelings. Importantly, empathy does more than simply validate the partner's thoughts and feelings—by mirroring the affect of the partner at the same time, it conveys a level of care that surpasses validation per se.
5. *The common cause*. An important indicator of Affection, similar to empathy, is the common cause, whereby individuals engage in virtually any affective behavior together as a form of building trust, closeness, consensus, or bonding. This indicator can sometimes be confusing. Insults, such as remarking that "Bob is a jerk," can be coded Affection if intended to express obvious agreement. A shared anger, a shared fear, a shared and vocalized political opinion—all of these things could be coded Affection.
6. *Flirting*. When individuals flirt, they are communicating desire for their partners. The verbal expression would be "I want you," but flirting needn't be verbal. Flirting can be playful, sweet, warm, intense, or all of the these.

Physical Cues

There are no particular AUs that indicate affection, but AUs 6 + 12 will commonly be seen.

Counterindicators

• Defensive affection. Occasionally, a speaker will insist that he loves the receiver as a defensive maneuver. The indicators of defensiveness (discussed later) will usually give this away. Watch for defensive voice tone, a defensive context, and a lack of warm, positive feeling underlying the affectionate message.

Anger

Function

In the SPAFF, anger functions to respond to perceived violations of the speaker's rights to autonomy and respect. It serves as a kind of "affective underlining" of displeasure and complaint, indicating that an interpersonal boundary has been transgressed. Some SPAFF coders have called the SPAFF code of Anger "angry affect without belligerence, contempt, defensiveness, disgust or attempts to dominate." This is largely true.

Indicators

1. *Frustration*. A relatively low intensity form of Anger, here facial expressions of anger become apparent at low levels and the voice may lower in pitch and tempo. The anger will appear constrained or out of the obvious awareness of the speaker. Otherwise, the person may not express anger verbally at all.
2. *Angry "I-statements."* These are verbal statements that express personal feelings, as in "I am so angry!" or "I am so frustrated right now!"
3. *Angry questions*. Questions asked with angry affect and usually with sharp exhalations, as in "Why?!"
4. *Commands*. Commands are not attempts to dominate but rather are strong, affectively intense attempts to stop a recent or ongoing violation of the speaker's autonomy or dignity. Sharp exhalations and strong angry affect frequently

accompany commands. Examples include “Stop!” or “Don’t speak to me like I’m a child!”

Physical Cues

AUs 4, 5, 7, 4+5, 4+5+7, 23, 24. The lips will frequently thin, with the red of the upper lip disappearing or the lips pressed together; the teeth will clench; and the muscles of the jaw and neck will tighten. The voice may suddenly increase in pitch, amplitude, and tempo and may include a kind of “growl” as when yelling.

Counterindicators

• Blends with other codes. Angry affect is frequently observed during moments in which indicators of other negative codes are present. In these instances, Anger is never coded.

Belligerence

Function

The function of Belligerence is to “get a rise” out of the receiver through provocation of anger. The belligerent speaker is, in a sense, looking for a fight.

Indicators

1. *Taunting questions*. These are questions whose function is to irritate or confuse the receiver. An example might include the frequent and irritating use of the question “Why?” in the context of a serious discussion. Frequently the belligerent speaker is seen struggling to suppress a smirk while asking taunting questions as the receiver becomes increasingly enraged.
2. *Unreciprocated humor*. Sometimes, the belligerent speaker appears to actually believe he or she is being funny, even though the receiver is obviously annoyed. Such moments of unreciprocated humor are neither playful, fun, and shared (as in humor) nor sarcastic, mocking, and insulting (as in contempt). Belligerent speakers do not appear to get the message that the humor is not universally funny, or the fact that

the jokes are annoying the receiver may increase the level of humor experienced by the speaker.

3. *Interpersonal terrorism*. Here, the belligerent speaker is posing direct challenges to the agreed-on rules or boundaries of the relationship. Frequently, such behavior takes the form of a dare, as in "What would you do if I did?" or "What are you going to do about it?" It can also be accompanied by a kind of emotional "strutting," whereby the belligerent person will make use of loud commands such as "Don't interrupt me!" as a means of demonstrating his or her power. This is often seen in violent men as a vestigial reminder of how dangerous they can be.

Physical Cues

AUs 1 or 2. Jaw thrust forward.

Counterindicators

1. *Good-natured teasing*. Good-natured "jabs" at the receiver's foibles are not coded as belligerence, especially if the humor or the teasing appears to be shared.

2. *Hostile humor*. Unreciprocated humor that is obviously hostile, mocking, belittling, or insulting is coded Contempt.

Contempt

Function

The function of Contemptuous behavior is to belittle, hurt, or humiliate. Contempt can be any statement made from a superior position to the partner, such as correcting an angry person's grammar. Such behavior deliberately and forthrightly communicates an icy lack of respect, often cruelty. On theoretical and empirical grounds, we regard this behavior as extremely detrimental to interpersonal relationships (Coan et al., 1997; Gottman, 1993a; Gottman et al., 1998; Gottman & Levenson, 1992), and so the SPAFF gives it precedence over most other behaviors.

Indicators

1. Sarcasm. Sarcasm in conversation frequently precedes derisive laughter at the receiver's expense or manifests as a ridiculing comment regarding something the receiver has said. Frequent examples include the ironic use of such statements as "sure!" or "I'll bet you did!"

2. *Mockery*. When speakers mock, they repeat something the receiver has said while exaggeratedly imitating the receiver's manner of speech or emotional state for the purpose of making the receiver look ridiculous or stupid.

3. *Insults*. Insults are active and straightforward forms of contempt—they are shows of disrespect for the receiver through obvious verbal cruelty.

4. *Hostile humor*. Often, the contemptuous speaker uses a form of unshared humor that, though an apparent joke, utilizes sarcasm, mocking, or insults to achieve the aim of contempt. By delivering such messages as a "joke," the speaker may be attempting to leave him- or herself an "out" (as in, "hey, I was only joking"). Hostile humor can be momentarily confusing for coders and receivers alike. The contemptuous speaker may laugh heartily, and sometimes the receiver will briefly and reflexively laugh along. Such moments are not coded as Humor.

Physical Cues

AU 14 (uni- or bilateral). Note: Eye rolls are nearly always coded as contempt.

Counterindicators

Good-natured teasing. Good-natured "jabs" at the receiver's foibles are not coded as contempt. A good indication that contempt is not occurring is that the context of the conversation appears to contradict contemptuous intentions or that the speaker and receiver appear to both experience laughter and joy as a result of the teasing.

Criticism

Function

Criticism functions as an attack on someone's character or personality in a way that is not obviously insulting, as in Contempt. It is a complaint that suggests that the partner's personality is defective. It is often accompanied by blame and is quite distinct from complaining. Complaints refer to specific instances of behavior, whereas Criticisms are characterized by negative global assessments of a person's abilities or value as a person. Complaints accompanied by "you always" or "you never" statements are considered criticisms. Criticism may or may not make reference to a specific event.

Indicators

1. Blaming. In blaming, one individual assigns fault to another, along with a personal attack or global accusation, as in "the reason the engine blew up is that you never put oil in it."

2. *Character attacks*. Often expressed as "you never/you always" generalizations, character attacks are critical of a person's personality or abilities in very general ways. Examples include statements such as "you don't care," "you always put yourself first," and so forth.

3. *Kitchen sinking*. This is essentially a long list of complaints. Even though any particular item on the list may not fit criteria for Criticism per se, a long list functions to illustrate the incompetence or personality defects of the person on the receiving end. For example, an individual might "kitchen sink" using complaints and "I" statements, such as, "I don't feel listened to by you, and you don't touch me very often, and I asked you to do certain chores, but you didn't, and we don't do very many fun things together lately."

4. *Betrayal statements*. Similar to blaming, betrayal statements specifically reference trust and commitment, implying that the person on the receiving end is either not committed, untrustworthy, or both. "How could you?" is a question frequently indicative of Criticism.

5. *Negative mind reading*. Generally speaking, mindreading statements express

attributions about another's feelings, behaviors, or motives. They indicate Criticism when negative or accompanied by negative affect. An example of negative mind reading would be "you just don't like Tom because he smokes."

Physical Cues

There are no particular AUs that indicate Criticism.

Counterindicators

• Insults. Critical statements designed to inflict gratuitous emotional pain (e.g., "you're an idiot") are coded contempt

Defensiveness

Function

Defensiveness functions to deflect responsibility or blame. It communicates a kind of innocent victimhood or righteous indignation (e.g., as a counterattack) on the part of the speaker, implying that whatever bad thing being discussed is not the speaker's fault. Defensive speakers can engage in defending themselves or friends and loved ones who may be under attack by their partners.

Indicators

1. The "yes-but." SPAFF coders refer to statements that start off as momentary agreements but very quickly end in disagreements as "yes-buts." They are common indicators of defensiveness.

2. *Cross-complaining.* This behavior involves meeting one complaint with an immediate countercomplaint. In this way, complaints are simply not responded to—cross-complaints deflect them by leading the conversation into a suddenly new direction.

3. *Minimization*. Defensive speakers will frequently try to minimize a complaint by asserting that the problem they are potentially responsible for was scarcely a problem in the first place. A minimizing speaker might say, for example, "You're right,

I did forget to put the garbage out, but there was hardly any garbage anyway, so it really isn't a problem. It can wait until next week."

4. *Excuses*. Excuses are attempts to locate responsibility or blame in something other than the speaker, as in, "well, traffic was all backed up, there was nothing I could do."

5. *Aggressive defenses.* Oftentimes a speaker will aggressively assert things, for example, "I did not!" These are vehement denials of responsibility that come across as childish, as in "did not/did too" interactions.

Physical Cues

AUs 1, 2, 1 + 2, arms folded across chest. The voice will increase in pitch and amplitude.

Counterindicators

• Invalidations. Statements designed to directly contradict the receiver (e.g., "you are wrong" or "that's simply untrue"), spoken in a lower pitched voice tone, are more properly coded Domineering.

Disgust

Function

Disgust is a relatively involuntary verbal or nonverbal reaction to a stimulus that is perceived to be noxious. Harmful substances (e.g., feces, rotted food) reliably elicit disgust, but disgust can also occur for moral or symbolic reasons (Rozin, Lowery, & Ebert, 1994).

Indicators

1. Involuntary revulsion. Here the object of disgust is some obvious image of, or reference to, an aversive, noxious stimulus, as in momentary descriptions of a gruesome physical injury.

2. *Moral objection.* Here the object of disgust is an action or idea that the speaker

finds repulsive for moral or other symbolic reasons, as in responses to undesirable sexual practices or even political positions.

Physical Cues

The physical cues of Disgust are robust and specific. AUs 9, 10, 4, 15, and 17 can sometimes be seen, either singly or in any combination. The tongue will sometimes protrude, and the head will sometimes turn to one side as if avoiding the noxious stimulus.

Counterindicators

1. *Mockery, insults, or belittlement*. If the function of a disgust response, whether verbal or nonverbal, appears to be to communicate obvious disrespect of the receiver, it is more properly coded as Contempt. This includes instances in which the speaker appears to be disgusted by the behavior of the receiver.
2. *Disapproval without Disgust affect.* Disapproval, absent other obvious signs of disgust, can be coded Neutral (when lacking in obvious affective tone), Domineering (when spoken in a patronizing tone), or Anger (with angry affect).

Domineering

Function

The function of Domineering behavior is to exert and demonstrate control over one's partner or a conversation. Domineering behaviors attempt to impose compliance on the receiver's responses or behaviors.

Indicators

1. Invalidation. Invalidation deliberately and forcefully contradicts the validity of the receiver's point of view (e.g., "that's just wrong") or expressed feelings (e.g., "oh, you are not afraid, quit exaggerating").
2. *Lecturing and patronizing.* This indicator identifies attempts to belittle or disempower a person or a person's arguments. Many "subindicators" suggest the

presence of lecturing and patronizing, including pointing or wagging a finger while talking, citing authorities (e.g., "well, Dr. Phil says . . ."), speaking in platitudes and clichés, appealing to an ambiguous "everyone" (as in "everyone knows"), and so forth. A distinctly patronizing quality often accompanies these behaviors. Look for finger pointing used for emphasis.

3. *Low balling.* Low balling expresses itself in the form of questions that have predetermined answers. The questions are not merely rhetorical but also have a manipulative quality, such as, "You want me to be happy, don't you?" Low-balling behaviors are similar to sales ploys that seek to force unwary customers to answer "yes" to very simple questions (e.g., "Do you want your children to achieve their potential?") in order to manipulate them into purchasing a product.

4. *Incessant speech.* By using incessant speech, domineering persons can ensure that the receiver is not allowed an opportunity to respond. It is a form of forcibly maintaining the floor in a conversation at all times. Incessant speech often has a repetitious, steady, almost rhythmic quality in the voice. When speaking incessantly, domineering persons often repeat or summarize their point of view while paying very little attention to the verbal content of things said by the people with whom they are speaking. Look for finger pointing used for emphasis.

5. *Glowering*. Glowering is really a kind of steady gaze, often characterized by the head tilted forward with the chin down, and the outer portions of the eyebrows raised—an eyebrow configuration we refer to as "the horns" because, when configured in this way, the eyebrows do indeed resemble horns. Thus, when glowering, the "horns" are emphasized, and the person may be leaning the head, body, or both forward. Physical Cues AU 2 ("the horns"), head forward, body forward, finger pointing, head cocked to one side.

Counterindicators

• Contemptuous patronizing. Whenever the content of patronizing becomes blatantly insulting, it should be coded Contempt.

Enthusiasm (Formerly Joy)

Function

The function of enthusiasm is to express a passionate interest in a person or activity, as well as a positive valence associated with that interest. Enthusiasm is infectious and often sudden, loud, boisterous, and energetic. Nonverbal behaviors prominently accompany verbal expressions of eagerness and joy.

Indicators

1. Anticipation. Anticipatory behaviors are hopeful, future-oriented, and often childlike. They may be accompanied by fidgeting and distraction.
2. *Positive surprise.* This is an emphatically happy reaction to some unanticipated event or remark. Prominent smiles and loud verbalizations characterize this indicator (e.g., AU 1+2+6+12+24, accompanied by "Really!?")
3. *Positive excitement.* Similar to positive surprise, positive excitement includes expressions of joy and anticipation at very high levels of intensity.
4. *Joy*. Joyful moments reflect high levels of often suddenly felt happiness, similar to positive surprise but less intense. Joy will frequently follow receipt of a compliment and will often be accompanied by broad, warm smiles and bright, alert, positive facial expressions.
5. *Expansiveness*. Expansive individuals feel creative, motivated, and inspired and convey an effervescent and elated affect. Physical Cues AUs 1+2, 5, 6+12, 23, 24, 25–27 will commonly be seen. Individuals will sometimes sit up or forward in their chairs, and their voices will increase in pitch and volume.

Counterindicators

• *Interest indicators*. Enthusiasm can sometimes look like Interest and vice versa. Interested questions are accompanied by positive affect but of a lower intensity than those coded Enthusiasm.
• *Negative Surprise.* Surprise reactions are not unequivocally positive, and it is important to be watchful for surprise reactions that contain either a lack of positive affect or the presence of negative affect.

Fear/Tension

Function

Fear/Tension communicates, usually involuntarily, fear, worry, anxiety, nervous anticipation, or dread.

Indicators

1. *Speech disturbances.* Fearful or tense speakers will often have a difficult time expressing or even knowing what they want to say. This will manifest as incomplete or unfinished statements, stuttering, or frequent and rapid "uhs" and "ahs." Watch also for shallow, rapid breathing. (Note that the occasional use of "ah, "er," or "umm" can simply reflect attempts to keep the floor or turn at speech.)
2. *Shifts in fundamental frequency.* In studies of vocal quality, chest register refers to a lower pitch characterized by vibratory sensations felt in the sternum and trachea, and head register refers to a higher pitch characterized by vibratory sensations felt in the head. Either of these states can characterize a fundamental frequency, or the lowest frequency, of sound waves characterizing a person's speech. In fear/tension, one can often detect a shift in fundamental frequency that moves from a chest register to a head register.
3. *Fidgeting*. Fearful or tense individuals will fidget, repeatedly shifting their position in their chairs (as if in the "hot seat"), plucking at clothes or hands, rubbing their faces (especially the temple, mouth, and chin), or biting the lips or inside of their mouths.
4. *Nervous laughter*. Unshared laughter or giggling that doesn't appear to fit in the conversation and likely is a response to nervous tension (e.g., no jokes or humorous moments have occurred). Often, the fearful or tense individual will seem unable to stop. The smile will often appear "pasted on" (see "Physical Cues").
5. *Nervous gestures.* Certain gestures of the arms and face can indicate fear/tension, such as arms akimbo (folded across the chest) and hands frequently touching the face. Physical Cues AUs 1, 2, 4, 12, 20, 1+2+4, 1+2+4+5. Watch for frequent eye movements, frequent gulping, biting of lips and inside of mouth, and the "unfelt smile," a smile without AU6 that has been associated with neurophysiological

patterns suggestive of behavioral withdrawal (Ekman & Davidson, 1993; Ekman, Davidson, & Friesen, 1990).

Counterindicators

1. *Away behaviors.* Away behaviors, such as paying attention to trivial objects in the room, looking at one's own hands or nails, and so forth, when unaccompanied by anxious affect and when in the context of high negative affect, are more properly coded as Stonewalling.
2. *Foreign object.* Sometimes individuals will become occupied with picking their teeth or removing something from their eye in the midst of a conversation. Such behaviors may be associated with increased anxiety but are more likely simply Neutral.
3. *Shared nervous laughter.* Nervous laughter that is shared among two or more individuals can quickly escalate into a shared moment of positive affect that is more properly coded as Humor.

Humor

Function

The function of humor is to share in mutual amusement and joy following a mutually recognized moment of absurdity or fun. Humor is relatively unique within the SPAFF in that it cannot be coded in isolation. The humor code requires a moment of shared amusement.

Indicators

1. Good-natured teasing. When an individual teases, she highlights qualities or behaviors in her partner that both agree are somewhat ridiculous, cute, or otherwise funny.
2. *Wit and silliness.* Wit is expressed as an apt or clever observation that is considered

by both individuals to be humorous. This could manifest as a funny observation or the straightforward telling of a joke.

3. *Private jokes.* Private jokes can include moments of shared laughter and obvious amusement that derive from coded messages or moments of sudden mutually recognized humor that are opaque to all but the two individuals who are communicating.

4. *Fun and exaggeration.* A very playful form of humor; here individuals share active, animated, and exaggerated play or imitation behavior. High energy and a deeper form of laughter often accompanies this indicator.

5. *Nervous giggling.* Occasionally, individuals will begin to chuckle with each other for no apparent reason. This could result from a private joke or may indicate a brief release of nervous tension given the experimental context. The affect underlying the giggling should be obviously positive and shared, unlike a similar form of giggling associated with the Fear/Tension code.

Physical Cues

AUs include 1, 2, 6, 12, 6 + 12, and 25–27.

Counterindicators

1. Unshared humor. Laughter or amusement that is not shared is never coded Humor.

2. *Tense humor.* Humor that is obviously both a nervous reaction to a high level of tension in the conversation and either lacking in any positive energy or unshared.

3. *Affectionate humor.* Sometimes a joke will be coupled with affectionate messages. Such moments are more properly coded affection.

4. *Belligerent humor*. A form of unshared humor, one individual makes jokes that are intended to “get a rise” out of the other or make the other angry.

5. *Contemptuous humor.* Jokes that are intended to be hurtful or insulting and that are unshared. This is sometimes confused with teasing. A good rule for distinguishing contemptuous humor from goodnatured teasing is to attend closely to the degree to which both individuals are amused.

Interest

Function

The function of this behavior is to communicate genuine interest in one's partner through active elaboration or clarification seeking. As used in the SPAFF, Interest is characterized as a positively valenced behavior that emphasizes information gathering about the partner as opposed to minor or trivial factual information.

Indicators

1. Nonverbal attention with positive affect. Interested persons will frequently attempt to actively communicate their interest through nonverbal behaviors, such as leaning forward in their chairs, affecting a warm tone of voice, and making steady eye contact. The interested person will communicate focused, respectful, and active engagement with what his or her partner is saying. If cues associated with Fear/Tension are not present, the interested person will sometimes communicate low levels of excitement (not to be confused with Enthusiasm) that communicates a desire to hear more.

2. *Elaboration and clarification seeking.* Interested individuals will often ask specific questions in order to gather additional information. Frequently, such questions will be accompanied by nonverbal behaviors such as those described in indicator 1. It is important that questions that serve to elicit more information are not accompanied by nonverbal negative affect, as such affect can indicate other affective agendas. Elaboration and clarification-seeking questions can include questions about a partner's opinions and questions that serve to paraphrase what a partner has been saying. Paraphrasing questions are easy to confuse with paraphrasing statements that are coded as Validation (discussed later).

3. *Open-ended questions.* Almost any question that does not require a "yes" or "no" response and that allows the partner to express him- or herself in greater detail.

Physical Cues

AUs 1+2, 6, 12, 6+12, leaning forward, positive valence.

Counterindicators

1. Lack of eye contact. Eye contact is not absolutely essential for coding interest, but a lack of eye contact can indicate that interest is feigned or that questions are serving some other affective function.

2. *No pauses following questions.* When questions are frequent and no opportunity is provided for a partner to respond to them, it is unlikely that genuine interest is being observed. Relentless question asking, especially if it appears to be leading the partner to a very specific series of answers, can be a sign of Domineering behavior.

3. *Low-balling questions*. Similar to counterindicator 2, low-balling questions are those to which there is only one rational answer. An example would be, "Don't you want me to be happy?" Such a question is properly coded Domineering.

4. *Exchange of general factual information*. It is important, though sometimes difficult, to distinguish between questions that communicate an interest in the partner and those that communicate an interest in settling some minor factual issue. An example of a noninterested (per SPAFF) question might be "What time is it?"

Neutral

Function

The Neutral code represents a sort of "dividing line" between positive and negative SPAFF codes. It is relatively nonaffective and is associated with the exchange of unvalenced information. The voice will have a relaxed quality, with an even pitch and volume. It is important to become familiar with an individual's neutral behavior early on in a coding session, as facial morphology and other characterological mannerisms that are actually neutral for a given person can often seem affective to coders unfamiliar with them.

Indicators

1. Information exchanges.

2. *Noncodable moments.* Sometimes it will be unclear whether a behavior is affective or what a particular affective behavior represents. In the SPAFF, such moments are coded Neutral.

Physical Cues

The neutral face is apparent, though care must be taken to avoid coding baseline facial morphologies as affective facial behavior.

Counterindicators

1. Loaded issue. It is possible that a moment of behavior that seems to be a neutral exchange of information actually makes reference to an issue that has emotional relevance to the speaker, the receiver, or both. Such moments are not properly coded Neutral.

2. *Any codable affect*

Sadness

Function

In the SPAFF, the Sadness code refers to behaviors that communicate loss, resignation, helplessness, pessimism, hopelessness, or a plaintive or poignant quiescence.

Indicators

1. Sighing. Sighs, especially deep sighs, very frequently occur in the context of Sadness. Thus sighing is nearly always considered an indication of sad feelings (note, however, "relief" as a counterindicators).

2. *Pouting/Sulking.* Sadness physical cues in the context of being rebuffed, ignored, or not getting one's way. Pouting may cause the sad person to appear to withdraw from the conversation.

3. *Resignation*. Sad individuals will frequently behave as if resigned or hopeless. This

behavior is communicated through a pattern of very low energy, slouching, long pauses between words, and so forth. In the resigned person, nearly all movement appears to require extra effort.

4. *Crying*. Nearly all instances of crying indicate sadness (but see "happy tears" as a counterindicators.) Sometimes individuals can be observed "choking back tears," or trying not to cry. Physical cues and tears welling up in the eyes will give them away.

5. *Hurt feelings*. In response to moments of high negativity, such as belligerence, contempt, or anger, individuals will sometimes report or appear to have hurt feelings. Such moments are coded as Sadness.

Physical Cues

AUs 1, 6, 15, 17, 1+6, 1+15, 1+6+15, 1+6+15+17. Shoulders may droop, and individuals may hang their heads or look down. The lips and the chin may tremble. The voice may quaver in terms of pitch and amplitude and may occasionally break.

Counterindicators

1. No back channels. A lack of responding that is attributable to the deliberate attempt to communicate lack of interest is not a form of pouting and is more properly coded Stonewalling.

2. *Relief*. Individuals who display a sudden decrease in energy as a result of the diffusion of tension or an escape from responsibility may be showing evidence of relief, which may be coded as Neutral.

3. *Happy tears*. Happy tears are here intended to mean one of two things. First, tears can sometimes result from intense laughter. Second, tears can sometimes result from sudden moments of shared intimacy, compliments, accomplishments, and so forth. These instances of tears are more properly coded as Humor, Enthusiasm, or Affection.

Stonewalling

Function

Stonewalling functions to communicate an unwillingness to listen or respond to the receiver.

Indicators

1. Active away behavior. The speaker focuses on some trivial object in order to avoid contact with the receiver. Such away behavior frequently entails the use of "automanipulation," a behavior characterized by playing with hair or hands (e.g., cleaning fingernails or looking at split ends). This behavior is "active" in Stonewalling in that it is not a function of idleness but rather purposefully communicates an unwillingness to pay attention, especially during conversational moments characterized by high levels of negative affect. The "speaker" (i.e., the contemptuous person) is communicating the message, "I'd rather not be here right now, and I don't want to listen to you."

2. *No back channels.* The stonewalling person offers no vocal or nonvocal back channels such as one would find in Validation. There are no head nods, the neck is rigid, there are no vocal or verbal assents (as in "ummhmmm," "yeah," "uh-huh," etc.), and no other verbal responses. There is little if any facial movement and certainly no facial mirroring or eye contact. The "noback-channeling" behavior may occur very abruptly, as if intended to suddenly put up an obvious, though technically invisible, wall between the speaker and the receiver.

3. *Monitoring gaze.* Within the context of "no back channels," stonewalling individuals will occasionally steal glances at their partners, as if to remind their partners to notice their lack of listening behavior. This can appear as a intermittent glance in the partner's direction, as if the partner is an annoyance that must be endured, much as one might occasionally glance over at a noisy person in a library.

Physical Cues

In Stonewalling, the face will typically appear stiff or frozen. The jaw may be clenched, and the muscles of the neck may be obviously flexed. Other times, the face will show no obvious signs of emotion at all, deliberately arranged to appear neutral.

Counterindicators

1. Boredom. Individuals can sometimes become bored or otherwise run out of things to say to each other. Sometimes, this will cause them to sit quietly without interacting for seemingly long periods of time. Away behavior can characterize these moments, but they should not be confused with Stonewalling behavior. Stonewalling does not result from idleness or boredom but is rather a form of active and aggressive communication, most frequently observed during heated moments.
2. *Sleepiness*. If an individual stops offering back channels but also appears to be very sleepy (as sometimes happens), his or her behavior is more properly coded as Neutral.
3. *Resignation*. Sometimes individuals will become sad or defeated during an intense conversation. During such moments, they can appear to be Stonewalling for want of back-channeling behavior. It is important to recognize when this is occurring and to code accordingly. Most often, resigned behaviors such as these are coded as Sadness.

Threats

Function

Threats are a particularly hostile form of domineering behavior in that their function is to control the behavior of the receiver by setting explicit conditions under which the receiver will be punished for behaving in ways the speaker finds undesirable.

Indicators

1. Bans. These are direct "if/then" statements that forbid certain behaviors and threaten to impose punitive (sometimes violent) consequences if those behaviors occur. An example might be "if you ever speak to me like that again, I'll. . . ."
2. *Ultimatums*. Ultimatums reflect demands for change within some defined context

or time period. An example might include "if you don't start doing your share around here by next month, I'm moving out."

Physical Cues

AU 1, 2 ("the horns"), 1+2, 1+2+5, head forward, body forward, finger pointing, head cocked to one side.

Counterindicators

• Good-natured teasing. Good-natured "jabs" at the receiver's foibles and those that include humorous threats (as in, "ooh, I'm going to get you for that!") are coded as Humor.

Validation

Function

The function of validation is to communicate sincere understanding and acceptance of one's partner or of one's partner's views and opinions. In the SPAFF, Validation is considered to be a positively valenced behavior.

Indicators

1. Back channels. Back channels are behaviors that indicate attentive and affirmative listening through the use of paralinguistic and physical cues, such as head nods and "uh-huhs" or other physical and vocal assenting behaviors. Usually, back channels are accompanied by eye contact.

2. *Direct expressions of understanding.* Direct expressions of understanding include explicit expressions of respect or agreement (e.g., "I agree," or "that's a very good point").

3. *Paraphrasing*. In this behavior, individuals repeat back what their partners have told them, usually verbatim, but sometimes in a slightly altered style.

4. *Apologies*.

5. *Sentence finishing*. In this behavior, individuals will place endings on the sentences

their partners have begun. This behavior lets partners know that both individuals are "on the same page." Importantly, sentence finishing is an indicator of validation only if it is delivered in a package of positive affect (see "Physical Cues").

Physical Cues

AUs 1+2, 6, 12, 6+12. Head nod, eye contact, nonconfrontational voice tone.

Counterindicators

1. Lack of eye contact. A lack of eye contact can mean that the back channels being offered are insincere, as in humoring. Back channels without eye contact can also be associated with sarcastic behavior.

2. *Bobbing heads.* "Bobbing heads" are head nods that appear so automatic and repetitive that they essentially become meaningless. Bobbing heads can also be a sign of exasperation—a kind of nonverbal request to "shut up."

3. *Affect mirroring*. Sometimes, the various indicators of validation occur in the context of strong mirroring of affect, as when an individual says, "I understand how you're feeling" while expressing facial signs of sadness in response to their crying partners. The SPAFF considers such expressions to be signs of empathy, and such signs are properly coded Affection.

4. *Interrupting*. Sentence finishing can be an important indicator of Validation, but if the sentence finishing is abrupt or is delivered with negative affect, it is likely nothing more than an interruption related to Domineering, Defensiveness, or other negative affective behaviors.

Whining

Function

Whining functions to make what might otherwise be an ordinary complaint into a plaintive or pleading form of emotional protest. Whining suggests an innocent victim stance, communicating something like "What are you picking on me for?" or "What about all the good I do?"

Indicators

• *Whiny protest*. Whining is really characterized by a quality of voice paired with a complaint or protest. This voice quality is high-pitched, nasal, “sing-songy,” or otherwise annoyingly plaintive. For example, the question “why” might be expressed in a high-pitched voice and drawn out with an exaggerated “eeee” sound at the end, as in “whyyyyeeee?”

Physical Cues

AUs 1, 1 + 2, 1 + 2 + 15.

Counterindicators

• Defensive whining. Sometimes defensive behaviors can be expressed in a whiny voice style. Such moments are more properly coded Defensive.

APPENDIX 4

Summative AEC-specific thematic content/literature framework

The tables included in the following pages modify and expand the socio-behavioural AEC literature framework produced in Table 2.1. The tables now include the themes and thematic content generated by the framework produced by the current research. The knowledge gaps that were highlighted in the original AEC literature review are maintained in this table (in grey) to demonstrate where the current research has provided directions for future research.

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Individual
Risk Management *ALSO: INNOVATION DISSEMINATION* *ALSO: INTRA-TEAM BEHAVIOUR* *ALSO: INNOVATION DRIVERS* *ALSO: FEEDBACK + RECOGNITION* *ALSO: INTERDISCIPLINARY KNOWLEDGE*	▪ Risk of potential profit loss by expansion of stakeholder engagement ▪ Risk of conflict with industry agencies ▪ Conflict between corporate risk management and innovation dissemination ▪ Risk relating to compromised intellectual ownership	▪ Role specialism as factor in ownership of specialist risk ▪ Establishing risk norms for risk sharing	Egbu et al., 1998 Lloyd-Walker et al., 2014	▪ Risk aversion prompts removal of innovation potential rather than problem solving ▪ Commercial privacy conflicts with innovation dissemination ▪ Risk ownership shared to mitigate effects of negative feedback ▪ Risk of negative feedback externally to team ▪ Reticence to share information outside the team in case of negative feedback ▪ Risk of being perceived as non-productive

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Individual
(continued from previous) *Risk Management* *ALSO: INNOVATION DISSEMINATION* *ALSO: INTRA-TEAM BEHAVIOUR* *ALSO: INNOVATION DRIVERS* *ALSO: FEEDBACK + RECOGNITION* *ALSO: INTERDISCIPLINARY KNOWLEDGE*				▪ Role specialism directed toward specialist risk ▪ Corporate information protection inhibits information sharing ▪ Risk adoption according to leader confidence ▪ Consensus as risk mitigation strategy ▪ Need to develop risk norms to be able to share risk ▪ Corporate information protection limits role clarity

	Levels of agency			
Emerging concepts	**Industry-wide**	**Organisation /Discipline**	**Team-based**	**Individual**
Project management *ALSO: TIME + WORKLOAD*	Groak, 1992 Kagioglou et al., 2000 den Otter and Prins, 2002 Austin et al., 2007 Cash et al., 2015 Poirier et al., 2016	Gann & Salter, 2000 Barrett & Sexton, 2006 Love et al., 2011a Cash et al., 2015 Poirier et al., 2016 ▪ Limitation of face to face meeting for cost purposes ▪ Company workload management systems influence individual's capacity for task completion	Bresnen & Marshall, 2000 Kagioglou et al., 2000 Koskela et al., 2002 Blayse & Manley, 2004 Barrett & Sexton, 2006 Tuuli & Rowlinson, 2009 Tuuli et al., 2010 Oyedele, 2013 Cash et al., 2015 Poirier et al., 2016	▪ Influence of time and workload on possibilities for face to face meeting ▪ Conflict under pressure relating to theory vs. delivery ▪ Project deadlines induce individual pressure ▪ Time pressures inhibit collective information sharing ▪ Intra-team co-operation of workload management leads to positive climate ▪ Consensus damaging when under pressure ▪ Conflict caused by request for changes that will cause delay

	▪ Levels of agency			
Emerging concepts	**Industry-wide**	**Organisation /Discipline**	**Team-based**	**Individual**
Client	Asad et al. , 2005 ▪ Client capabilities as influence on scope for innovation	▪ Client distance as barrier to collaboration ▪ Correlation of member dominance with proximity of client relationship	Wallace, 1987	▪ Influence of client views on personal motivation
Procurement mechanisms *ALSO: INTERDISCIPLINARY KNOWLEDGE*	Blayse & Manley, 2004 Ling, 2004 Asad et al., 2005 Barrett & Sexton, 2006 Mills & Glass, 2009 Aouad et al., 2010 ▪ Procurement processes inhibit innovation	▪ Timing of appointment as factor in ability to collaborate	Ankrah et al., 2009 Forgues & Koskela, 2009 Baiden & Price, 2011 Lloyd-Walker, 2014	▪ Dominant members act as filters to team membership ▪ Conflict caused by process constraints on appointment

	▪ Levels of agency			
Emerging concepts	**Industry-wide**	**Organisation /Discipline**	**Team-based**	**Individual**
Integration and cohesion *ALSO: INTRA-TEAM BEHAVIOUR*	Pryke, 2004 Asad et al., 2005 Pryke, 2012 ▪ Team identity created as brand within industry ▪ Team core value to improve industry ▪ Sharing of risk failure performed by group narrative ▪ Explicit 'no wrong answer' culture ▪ Team identity forged within industry ▪ Team pride in innovative venture	Den Otter & Prins, 2002 Baiden & Price, 2011 Oyedele, 2013 ▪ Fragmentation to conserve cohesiveness ▪ Reinforcement of team task focussed behaviour ▪ Limited face to face meeting to reduce cost to company	Austin et al., 2001b Macmillan et al., 2002 Baiden et al., 2003 Blayse & Manley, 2004 Morton et al., 2006 Emmitt & Gorse, 2007 Baiden & Price, 2011	▪ Subscribing to cohesion reaps rewards in focus and progress ▪ Role of 'banter' to determine individual identities ▪ Reticence to discuss personal life ▪ Sharing personal politics establishes norms and cohesion ▪ Dominant member creates false consensus ▪ Dominant members establish psychological safety ▪ Collective identity strengthened by shared adversity ▪ Call to focus on task rather than individual contribution

	▪ Levels of agency			
Emerging concepts	**Industry-wide**	**Organisation /Discipline**	**Team-based**	**Individual**
Incentive and reward *ALSO: PROFESSIONALISM VS. PROFIT* *ALSO: FEEDBACK + RECOGNITION* *ALSO: TIME + WORKLOAD* *ALSO: PROFESSIONAL IDENTITY* *ALSO: THE SOCIAL TEAM*	Steele & Murray, 2004 ▪ Conflict between professional ethic of industry improvement and profit-led goals. ▪ Impact of positive recognition from external funders on team motivation ▪ Promotion of stakeholder engagement to enhance external recognition ▪ Recognition of industry contribution as extrinsic reward ▪ Pro-team promotion vs. self-promotion	Akintoye & Main, 2007 Burtonshaw-Gunn & Ritchie, 2007 Oyedele, 2013 ▪ Motivation to impress professional body ▪ Corporate profit goal and process innovation goal conflict ▪ Company support of autonomous flexibility incentivises collaboration	Bresnen & Marshall, 2000 Love et al., 2011b Rose & Manley, 2011 Oyedele, 2013	▪ Time available for full compliance to standards ▪ Non-contribution by team members as barrier to motivation ▪ Motivation to maintain project momentum ▪ Motivation via documented progress ▪ Influence of absence of expertise within the group on delay ▪ Influence of company workload management systems on project engagement capacity

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Individual
(continued from previous) *Incentive and reward* *ALSO: PROFESSIONALISM VS. PROFIT* *ALSO: FEEDBACK + RECOGNITION* *ALSO: TIME + WORKLOAD* *ALSO: PROFESSIONAL IDENTITY* *ALSO: THE SOCIAL TEAM*	▪ Industry feedback as mechanism to foster team learning			▪ Influence of company support of autonomy on collaboration propensity ▪ Degree of individual company attachment as factor in project engagement ▪ Motivation derived from showcasing self to industry ▪ Motivation from positive external recognition ▪ Motivation from getting credit for work done ▪ Interest maintained via potential for future success

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Individual
(continued from previous) *Incentive and reward* *ALSO: PROFESSIONALISM VS. PROFIT* *ALSO: FEEDBACK + RECOGNITION* *ALSO: TIME + WORKLOAD* *ALSO: PROFESSIONAL IDENTITY* *ALSO: THE SOCIAL TEAM*				▪ Company lack of recognition for work done as barrier to motivation ▪ Individual motivation to impress professional body ▪ Intellectual ownership key to gaining deserved recognition ▪ Professional desire to improve industry processes ▪ Individual interest in the project ▪ Motivation derived from individual career development opportunities ▪ Career aspirations conflict with desire to improve industry ▪ Association with inspiring people

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Individual
(continued from previous) *Incentive and reward* *ALSO: PROFESSIONALISM VS. PROFIT* *ALSO: FEEDBACK + RECOGNITION* *ALSO: TIME + WORKLOAD* *ALSO: PROFESSIONAL IDENTITY* *ALSO: THE SOCIAL TEAM*				▪ The design team as a networking device

	Levels of agency			
Emerging concepts	**Industry-wide**	**Organisation /Discipline**	**Team-based**	**Individual**
Technology solutions and appropriateness *ALSO: INTRA-TEAM BEHAVIOUR* *ALSO: INNOVATION ADOPTION*	Garber, 2014 ▪ Communication tech adoption as collaboration facilitator	▪ Lack of knowledge overlap between technical providers and construction disciplines	den Otter & Prins, 2002 den Otter & Emmitt, 2007 Kocaturk, 2013 Adamu et al., 2015	
Managing adversarial relationships and group pressures *ALSO: INTRA-TEAM BEHAVIOUR*	▪ Member non-contribution as motivation limiting factor		Egbu et al., 1998 Austin et al., 2001b Spence et al., 2001 Emmitt & Gorse, 2003 Harris et al., 2003 Dainty et al., 2006 Russell et al., 2007 Love et al., 2011b Kleinsmann et al., 2013 Morrell, 2015	▪ Interpersonal tensions evident via concealed disparagement ▪ Dominant member creates false consensus ▪ Differing individual goals causes conflict

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Individual
(continued from previous) *Managing adversarial relationships and group pressures* *ALSO: INTRA-TEAM BEHAVIOUR*				▪ Change to team identity disturbs and distracts
Interdisciplinary relationships *ALSO: INTERDISCIPLINARY KNOWLEDGE*	▪ Priority of project delivery in relation to collective learning and success ▪ Disciplinary partitioning across industry ▪ Availability of non-construction expertise for construction innovation	den Otter & Prins, 2002 ▪ Timing of appointment as factor in ability to collaborate ▪ Reappraisal of team roles as key activity ▪ Interdisciplinary sharing towards innovation ▪ Discipline sector knowledge equates to member specialism ▪ Innovation from extra-discipline knowledge	Loosemore & Chin, 1999 Sebastian, 2004 Ankrah & Langford, 2005 Austin et al., 2007 Kocaturk, 2013	▪ Willingness to share information fosters team learning ▪ Motivation from mutual support of individual learning ▪ Team success derived from shared learning experience ▪ Positive climate generated by group supported learning

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Individual
(Continued from previous) Interdisciplinary relationships ALSO: INTERDISCIPLINARY KNOWLEDGE		▪ Disciplinary skills required from specific problem solving ▪ Innovation derived from interdisciplinary processes		
Communication methods and media ALSO: INTRA-TEAM BEHAVIOUR	▪ Communication tech adoption as collaboration facilitator		Egbu et al., 1998 Salter & Gann, 2003 Emmitt & Gorse, 2007 den Otter & Emmitt, 2007 den Otter & Emmitt, 2008 Gambatese & Hallowell, 2011	▪ Clarity of communication aids collaboration
Individual capabilities & empowerment ALSO: INNOVATION DRIVERS *ALSO TIME + WORKLOAD*	▪ Industry innovation driven by critical mass of individuals		Tuuli & Rowlinson, 2009 Tuuli et al., 2010	▪ Influence of company workload management systems on project engagement capacity ▪ Influence of company support of autonomy on collaboration propensity

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Individual
NEW: PRACTICE GUIDANCE	▪ Process complexity inhibits task definition ▪ Lack of prioritisation of compliance to standards ▪ ▪ Lack of model projects devolves innovation responsibilities ▪ Barrier to motivation via over complex and variable standards and protocols ▪ Compliance-reality dissonance ▪ Decision validity compromised by lack of clarity in guidance	▪ Conflicting guidance results in unclear output ▪ Role clarity determined by clarity of guidance ▪ Market deference as response to variable disciplinary interpretation ▪ Company project separation in compliance to guidance		▪ Company separate to project in terms of standard compliance ▪ Dissatisfaction with decisions taken in response to conflicting guidance ▪ Confusion caused by process complexity ▪ Conflict caused by dissonance between compliance and reality

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Individual
(continued from previous) *NEW: PRACTICE GUIDANCE*	▪ Validity of role definition compromised by lack of clarity in guidance			
NEW: FEEDBACK + RECOGNITION	▪ Negative industry response as influence on decisions ▪ Negative industry response as influence on innovation sharing ▪ Project output influenced by expected industry response ▪ Stakeholder engagement as mechanism for minimising industry conflict	▪ Motivation to impress professional body		▪ Motivation derived from external recognition ▪ Individual motivation to impress professional body ▪ Company lack of recognition for work done as barrier to motivation ▪ Intellectual ownership key to gaining deserved recognition ▪ Reticence to share information outside the team in case of negative feedback

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Individual
(continued from previous) *NEW: FEEDBACK + RECOGNITION*	▪ Importance of recognition for innovation via awards and publicity			▪ Risk of being perceived as non-productive ▪ Positive climate generated by positive external recognition ▪ External individuals keen to be part of the group
NEW: INNOVATION ADOPTION		▪ Dominance of individual rather than disciplinary preference in innovation adoption		▪ Innovation adoption individually led rather than company led

APPENDIX 5

Published material

Aspects of the research have been disseminated in conference presentation and publication.

Conference presentations

BE2Camp, Collaboration, October, 2015

International Association for Bridge and Structural Engineering (IABSE) Future of Design, April, 2016

Publication

Barrett et al., (2013) The Social Life of the Novel Idea: What did social psychologists ever do for us? in *Engineering, Construction and Architectural Management*, 20(3), p250-266.

The current issue and full text archive of this journal is available at
www.emeraldinsight.com/0969-9988.htm

The social life of the novel idea: what did social psychologists ever do for us?

Jennifer Barrett, Jack Goulding and Pamela Qualter
School of Built and Natural Environment, University of Central Lancashire, Preston, UK

Abstract

Purpose – The purpose of this paper is to present the extant literature relating to the social processes of innovation in built environment design teams. The paper connects the relevant and significant work in the field of social psychology and architecture, engineering and construction (AEC) to derive a theoretical framework which can be used to direct further research, towards development of the behavioural facet of design management.

Design/methodology/approach – First, the paper establishes which aspects of social processes of innovation are already present within the AEC field and examine concepts/ideas in social psychology that are likely to be important in understanding group processes within AEC, applying three emergent themes of social climate; risk attitudes and motivation and reward. Second, the paper identifies which elements of social psychology may be used to expand, consolidate and develop our understanding and identify gaps in AEC specific knowledge.

Findings – The paper suggests that whilst the AEC literature has supplanted some key elements of social psychology, this discipline offers a further and significant theoretical resource. However, whilst some aspects of social climate and motivation/reward are well-represented in the AEC field, these have not yet been fully explored. Furthermore, how collective attitudes to risk can influence design decision-making is identified as having a limited presence.

Originality/value – This paper is the first to bring together the two disciplines of AEC and social psychology to examine the social aspects of innovative design performance in built environment teams. The paper fulfils an identified need to examine the social processes that influence innovative design performance in construction

Keywords Innovation, Design, performance, Project teams, Group working, Social psychology

Paper type Literature Review

Introduction

This paper explores the social dynamics at work in the development of innovative designs within built environment design teams. It presents and summarises the existing body of literature in relation to innovative design in construction projects, and analyses literature in the field of social psychology which offers further expansion and consolidation of existing knowledge in the architecture, engineering and construction (AEC) field. Key themes explicit within the literature relating to the study of behaviour within small groups are explored: their applicability to the AEC sector as areas for future research are discussed, and the creation of methods which may manipulate social interaction to enhance opportunities for the production of innovative design work in construction project teams.

Engineering, Construction and Architectural Management
Vol. 20 No. 3, 2013
pp. 250-266

0969-9988
DOI 10.1108/09699981311323998

Theoretical background

The design of buildings is a multi and interdisciplinary design process. Whilst it requires a complex array of related skills and knowledge, simply asking architects and engineers to work alongside each other has often been considered insufficient. It is,

therefore, inappropriate to assume that such teams know how to collaborate towards a favourable or optimal solution, and simply putting creative people in the same room, does not necessarily yield creative results (Leonard and Swap, 1999). Moreover, it is advocated that the AEC disciplines must collaborate as a highly interdependent group.

In the latter part of the twentieth century, the catalogue of construction reports (Figure 1) observed that, within practice, such collaboration was fraught with challenges; the success of the constructed outcomes was considered to be highly dependent on the effective management of the social processes within the team environment (Murray and Langford, 2003). Despite this, many have noted that research into AEC collaborative performance improvements have centred upon operational improvements or technological advance, with scant attention paid to behavioural approaches (Dainty *et al.*, 2006; Shelbourn *et al.*, 2007; Kululunga, 2009; Gorse, 2009; Love *et al.*, 2011).

Whilst behavioural aspects have been explored widely in design and creative thinking, research in this field, historically, tends to be weighted towards exploration of design activity as an individual and cognitive process (MacKinnon, 1965; Goldschmidt, 1995; Goldschmidt and Badke-Schaub, 2010; Pour Rahimian and Ibrahim, 2011). More recently, design has been explored theoretically as a social and collaborative process too, notably in Pryke's (2004, 2005) mapping of social networks in construction projects and in Bucciarelli's (1994) description of design as a social process of interaction and

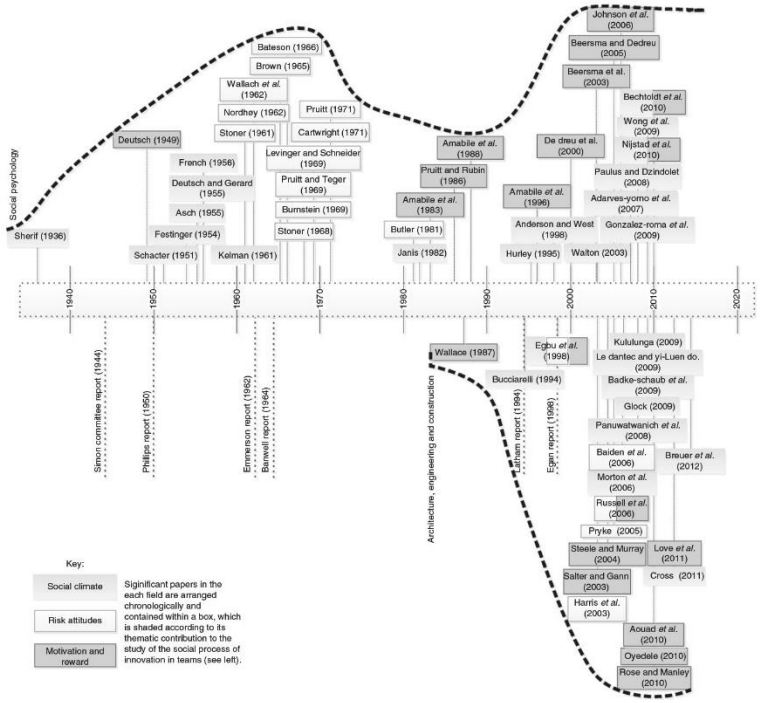


Figure 1.
Comparative (chronological and thematic) analysis diagram showing the extant literature of the two disciplines of social psychology and AEC in relation to the social process of innovation in small groups

negotiation. Further, it is considered as aspects of Cross's (2011) design thinking and in the outcomes of the recent Design Thinking Research Symposia (DTRS). Of particular interest within the DTRS7 proceedings (McDonnell and Lloyd, 2009) is Matthews's statement that which asserts that:

> The very identification of designers' normative orientations (e.g. to the local relevance of talk) is one important step towards the creation of formats of interaction that might be able to 'tamper' with social order, in similarly mild ways, so as to be more conducive to design objectives (Matthews, 2009).

This paper seeks to develop an understanding of how this "social order", at work in built environment design teams, influences their ability to produce innovative design ideas. It searches within the field of social psychology to see what it can offer in assistance towards the creation of formats for design, which may be more conducive and supportive of innovative performance.

Methodology

This paper is the first to bring together the existing theory relating to the social aspects of innovative design performance and to examine the literature in the AEC and social psychology fields in order to connect social interaction and innovative design performance and creative thinking in small groups. Literature is presented in the form of a comparative analysis between the two disciplines: first, aspects of social processes of innovation which are already present within the AEC field are established and concepts/ideas in social psychology that are likely to be important in understanding group processes within the field of AEC are examined; second, elements of social psychology which may be used to expand, consolidate and develop our understanding of built environment design teams, and identify gaps in AEC-specific knowledge are identified. Ultimately, then, key areas for future research are presented.

A thematic approach has been adopted in presentation of the literature. Three main themes from social psychology that are important for understanding small group social processes within AEC are considered: social climate, risk attitudes and motivation and reward. These three themes are important concepts within social psychology and help explain creative decision-making (social) processes in small groups. In the current paper, these ideas are applied to small groups within the AEC field. Social psychology theory also identifies a fourth heading, which relates to issues of leadership. Our decision to consider only three main themes with the omission of leadership is that the study of leadership deals with personality characteristics and attitudes and not the direct social processes within small groups (Davis *et al.*, 1976). Whilst there are many reasons to believe that team leaders can be important in creating a shared and task-adaptive understanding (van Ginkel and van Knippenberg, 2012), discussion of this large area of empirical study is beyond the scope of the current paper. The focus, instead, is on the social processing of information within small groups within AEC.

Innovation and ideas in the design team

The nature of innovation specific to the construction industry is described by Slaughter (1998) who distils a set of models of innovation which respond to sector activities. She identifies five types of innovation: incremental innovations, radical innovations, modular innovations, architectural innovations and system innovations.

These typologies are arranged on a scale of change as a way to enhance companies' awareness of innovation opportunities and the likely impacts of innovation on resources and outcomes (Slaughter, 1998). The applicability of this is relevant in a sectoral and organisational capacity, but requires further discussion in relation to the conception, presentation and adoption of the innovative idea within the multidisciplinary design environment. Whilst there is an increasing body of work which considers social influence as a driver or limiter of innovative design (Agars *et al.*, 2008; Runco, 2008; Wong *et al.*, 2009), this still to be transferred and applied extensively within the AEC research field (Kululunga, 2009).

The Construction Research and Innovation Strategic Panel (CRISP): Motivation Group (1997) offer a valuable definition of innovation as "the successful exploitation of new ideas where ideas are new to a particular enterprise, and are more than just technology related – new ideas can relate to process, market or management".

This definition offers a separation of the "new idea", which becomes an "innovation" when implemented successfully. This is further explained by Amabile *et al.* (1996), an influential writer in the field of social psychology and creativity. Amabile describes creativity as "the production of useful and novel ideas" and innovation as "the successful implementation of ideas". In light of this definition, when discussing the social aspects of innovation in the design team, this paper will focus upon the extent to whether social interaction can hinder or facilitate the presentation of the "novel idea" within the collaborative design space, to use the vocabulary of the co-evolution design model (Maher *et al.*, 1996; Dorst and Cross, 2001). This is supported by existing observational research which notes the generation of novel ideas being limited, or design direction being steered, as a symptom of implied and normative social interaction (Matthews, 2009; Barrett, 2010).

The social life of the novel idea

Research in the field of social psychology has expanded and gathered impact since the 1930s when Elton Mayo's Hawthorne studies linked the industrial performance of engineers to social issues within groups (Mayo, 1949). Social psychology as a field for scholarly exploration may be traced back to Aristotle and Plato who acknowledge the existence of group-level processes (Aristotle, 384-322 BC; Plato, ca. 380 BC), but it is the development and acceptance of a scientific approach to group research in the early twentieth century that enabled it to gather momentum and deliver insights into how the behaviour of one person might impact on that of another. More relevant here, is the application of these studies to work-based teams, which led to a large body of work linking social behaviours to productivity and performance. Such is the legacy of scholars at the Research Center for Group Dynamics at the Massachusetts Institute of Technology (Forsyth and Burnette, 2005).

Whilst studies in social psychology may not specifically consider their application to design process, it is assumed that the human condition remains constant and the social behaviours which influence creative performance also do so within the AEC sector. A number of studies, notably the recent analyses of the DTRS7 data set (McDonnell and Lloyd, 2009), seek to analyse communication (drawn, written, gestural or verbal) in the design process as a tangible representation of the mutual expectations and shared understandings of the design team (Cross and Clayburn Cross, 1996; Dong, 2007; Emmitt and Gorse, 2007; Matthews, 2009; Visser, 2009; Oak, 2011). These studies can provide us with some valuable knowledge about what happens during collaborative design and how it may be analysed, providing us with the foundations to

carry out further research which will address the behavioural themes presented in the social psychology literature and apply them to the resultant design outcomes – in this case, innovation in building design, performance and process. These include studies of "design moves" as in protocol analysis (Cross and Clayburn Cross, 1996) or studies in communication in construction teams which draw their methodology directly from the social psychology field, through Bales's (1950) interaction process analysis (Emmitt and Gorse, 2007). Deeper observation also acknowledges the relevance of informal talk and interaction between design team participants to establish role allocation and transfer of normative values which facilitate the ability of design team participants to gain a comprehensive understanding of the shared and "imagined" building and their ability to move and explore its innovative possibilities (Goldschmidt and Eshel, 2009; Lloyd, 2009; Luck, 2009).

The social climate

If the cliché, "thinking outside the box" describes a route to innovation by way of independent thought, then the social psychology literature presents to us a problem. Landmark experiments of the 1950s (Asch, 1955; Deutsch and Gerard, 1955; French, 1956) demonstrated the effects of social pressures on judgement and decision making. Findings showed that an individual will change his opinion when faced with a unanimous majority, even when he is correct. Hence, our ability to "think outside the box" and foster independent thought and offer clear judgement is compromised by the cultural norms (Kelman, 1961). This influences our future behaviour via our own senses of reward and failure, in that conformity to group norms promote feelings of self-esteem and self-approval whilst non-conformity causes feelings of anxiety and guilt (Deutsch and Gerard, 1955).

Further studies identify the effects of "group standards" which demonstrate a convergence of judgements to a cultural norm, developing towards group "cohesiveness". The degree of group cohesiveness is then a factor in influencing members to stay in the group or to conform to its normative values in their individual decision making or behaviour (Sherif, 1936; Schacter, 1951). In recent years, the AEC industry has embraced the creation of more cohesive teams through initiatives such as partnering contracts and partnerships with clients and throughout the supply chain. These less ephemeral alliances can take advantage of long-term familiarity by reaping the social benefits of continuous, collaborative learning and an environment of psychological safety as long as it promotes a team climate which is conducive to innovative performance. Indeed the positive effects of long-term relationships with cohesiveness as a key characteristic underpins Latham's (1994) proposals for industry reform through development of the "integrated team". Morton *et al.* (2006) observed that product development teams who are more familiar to each other are indeed more effective. This is developed in a design environment by Badke-Schaub *et al.* (2009) who acknowledge the relevance of social interaction in the development of a shared team mental model of the design. They note how this "sharedness" requires time to develop and how the shared mental model influences team performance depends upon group co-ordination of roles, cohesiveness and leadership.

Whilst cohesiveness may generally be considered conducive to performance, creative problem solving may also be hampered by "groupthink", the social phenomenon which occurs within cohesive groups with symptoms which include ignoring alternatives and hampering rational thought (Janis, 1982). Indeed, Egbu *et al.* (1998) note the impact of entrenched cultural norms as a barrier to construction

innovation and this is observed to be especially true for contracting organisations (Kululanga, 2009).

There is a tendency for individuals to seek social consensus or validation from the group and each team will have their own implicit values and validation of what constitutes their task. This concurs with the DTRS7 analysis (Badke-Schaub *et al.*, 2009) which describes cohesiveness as three communication acts – informal talk (non-task related); appreciation (explicit statements of liking) and confirmation (a shorter form of appreciation) – which allow the team to develop and shape their shared mental model of the building they are designing. The relevance of informal talk is also underlined as a way to allow interpretative flexibility and hence shaping and delimiting the shared mental model, but also as a way of building cohesiveness through the appeal to informal, social relationships (Bucciarelli, 1994; Glock, 2009; Cross, 2011).

The transfer and shaping of normative values in design teams have also been observed by Le Dantec and Yi-Luen Do (2009) in their study of the mechanics of transfer and sharing of ethical values through spoken interaction during design revision. However, embedded within the cohesiveness and "sharedness" of the team mental model of the design problem and solution, is a shared creation of its limits (Breuer *et al.*, 2012). If opportunities for innovation are omitted from these shared values or receive low priority, then a group norm will have developed in which innovation does not form part of the accepted focus or task effort. This is known as "social tuning" where group norms and values – which may either foster creativity/originality or convergence/conformity – evolve from intra-group validation and reinforcement (Adarves-Yorno *et al.*, 2007; Bechtoldt *et al.*, 2010). This is observed in a study of team climate in Australian architecture and engineering design teams where organisational culture and leadership were found to have a key role to play in fostering innovation in their ability induce a team climate that was supportive of and receptive to innovative performance (Panuwatwanich *et al.*, 2008).

The group norms may also influence the perception of what is to be deemed "creative" (Adarves-Yorno *et al.*, 2007). Furthermore, individuals may fear contradicting the norm which may inhibit presentation of potentially innovative solutions (Walton, 2003). A psychologically safe environment created by a more inclusive, socially cohesive group dynamic is more likely to promote creativity and this is supported by the findings of Morton *et al.* (2006) who observed that effectiveness in product design teams strongly correlates with the presence of trust, respect and loyalty. The positive mood from good social cohesion supports increased cognitive flexibility and hence, increased likelihood that creative or novel solutions will be found (Paulus and Dzindolet, 2008; Wong *et al.*, 2009).

Tensions held between consensus and conflict may characterise the life cycle of group decision making but in-group conflict can actually be caused by an individual or sub-group who present a creative or novel idea. The effect can be the strengthening of whole group attachments, thus making the creative people feel separate or part of an "outgroup". This is due to the creative proposition being counter group norms of creativity acceptance (Walton, 2003) and may be applied to the differing cognitive models of design between architects and engineers who navigate the solution search space differently resulting in different models of the "imagined building" resulting in the characteristic interdisciplinary tensions experienced in built environment design teams (Badke-Schaub *et al.*, 2009). This is given further clarity by "social comparison theory" (Festinger, 1954) that suggests that individuals tend to move in the direction of

a social comparison referent. Hence, whilst there is a convergence of values to a median referent, there will be an upward convergence in relation to ability (Paulus and Dzindolet, 2008). This would help to explain the differences in group norms in relation to the valuing of creativity and innovation as well as their abilities to deliver it.

Team climate is a distinct area of research in organisational psychology literature which explores the shared perceptions of organisational norms and values. Team climate may be explored via a number of perceptional facets, with one common facet of team climate study pertaining to innovation capacity (Anderson and West, 1998). This research area is developing to consider the relationship between team climate and team performance and task outcomes (Gonzalez-Roma *et al.*, 2009), necessarily moving beyond organisational-level research to that of work groups (Anderson and West, 1998). Epistemological wisdom suggests that when team climate is strongly supportive of innovation, performance in this domain can be enhanced with even small differences having significant effects (Hurley, 1995; Gonzalez-Roma *et al.*, 2009). In addition, there is some research which suggests that a positive team climate creates positive mood states which in turn encourages greater cognitive flexibility and hence, enhanced creative performance. Interestingly though, when a negative climate induces negative mood states which prompt an active response (e.g. anger, fear rather than sadness or depression), creative performance is enhanced through sheer persistence (Nijstad *et al.*, 2010). These aspects of work group climate for innovation are summarised in West's four factor theory which identifies predictors of innovativeness – vision, participative safety, task orientation and support for innovation (Anderson and West, 1998).

Risk attitudes

Decision making in built environment design and evaluation of innovative solutions frequently comprises a discussion of the relevant risks and trade off of those risks. Established within social psychology theory, project participants are more likely to take risks if they are part of a cohesive team which promotes psychological safety and adopts a shared value of risk acceptance. However, in an historically litigious industry (Latham, 1994), it would be expected that innovation struggles to exist within the risk averse and adversarial culture that this generates.

Where innovation thrives, it is attributed to the existence of a team which exhibits a willingness to share risk and, clear, potential rewards for subsequent innovation in the construction product or process (Russell *et al.*, 2006). As a result, Egbu *et al.* (1998) observe in four AEC organisations that innovation is more likely to occur when a risk tolerant climate is achieved. This is observed in teams which perform more effectively when a "no blame culture" is consciously employed (Baiden *et al.*, 2006) and exemplified in a number of architectural projects which are widely considered to be "innovative". For example, the success of the Downland Gridshell (Edward Cullinan Architects/Buro Happold) is attributed to the technical innovations applied to create the complex timber structure. This is documented as attributable to the risk tolerant, non-adversarial and positive team climate facilitated by the client and maintained in project team interaction (Harris *et al.*, 2003).

The field of social psychology offers further, significant and more detailed discussion that considers the valuation and acceptance of risk in collaborative decision making. In a study of the effects of group interaction on risk and caution in decision making, a significant Master's thesis study by Stoner in 1961 (Stoner, 1968; Cartwright, 1971; Pruitt, 1971) noted that greater risk taking occurs during social interaction than during individual evaluation and that the risk taken is collectively

higher than the individual average within that group. Wallach *et al.* (1962) later posits that this is due to a spreading of responsibility for risks across the group and the fact that individuals with a previous propensity for taking risks are more likely to become dominant within that group. Interestingly, Wallach also notes that group members are likely to maintain the higher level of risk taking for two to six weeks following the interaction. This "risky shift" (Stoner, 1968) initiated further study on the phenomenon of group convergence on risk as a value. Pruitt and Teger (1969) also note that there is a positive correlation between group cohesiveness and the size of the risky shift.

"Social comparison" theory (as aforementioned) is also relevant to the risk discussion (Brown, 1965). The way that the individual adjusts his own risk norm to the perceived group mean is also discussed in "pluralistic-ignorance" theory (Levinger and Schneider, 1969). Further theories are offered such as "familiarity theory" (Bateson, 1966) which suggests that group interaction reduces uncertainty which in turn reduces risk in decision making. The role and characteristics of group leaders are also found to be relevant in "leader-confidence theory" as leaders who are higher risk takers are likely to be more persuasive as a result of their assumed confidence (Burnstein, 1969) and conversely, it is confident leaders who are required to facilitate risk taking (Butler, 1981). The presence of high risk takers are also found to "release" individuals from their individual norms of cautious behaviour within a group setting (Pruitt, 1971) and "relevant arguments theory" suggests that they will use the group to elicit supportive arguments of higher risk strategies rather than to gain a balanced view of "pros" and "cons" (Nordhøy, 1962; Brown, 1965).

Motivation and reward

The work of Amabile (Amabile, 1983, 1988; Amabile *et al.*, 1996) explored the social environment as a driver of creative performance, with particular focus on the role of motivation. The wide internalisation of this work within the fields of business, government and education and its focus on creative performance suggests that it may also offer insight into how design team members' motivation may influence their innovative performance. The AEC sector considers the relevance of motivational theory and in Oyedele's (2010) study of architects and engineers in design firms, he identified four critical success factors for increased motivation. These were:

(1) favourable project working conditions (e.g. the psycho-social and organisational working environment);

(2) organisational support (e.g. commitment to employees' career development; appropriate evaluation and feedback mechanisms);

(3) design process efficacy (e.g. harmonious working relationship within the design team; good communication); and

(4) efforts recognition (e.g. appropriate reward, whether monetary or non-monetary).

The fourth is also supported by Egbu *et al.* (1998) who notes that innovative solutions are not fostered where there is a lack of motivational reward. If innovative performance is desired, the foresight to apply these critical success factors to the procurement and selection methods of design teams may be one option to ensure successful results.

Amabile (1983) also noted the dynamic relationship between intrinsic and extrinsic motivators. Whilst intrinsic motivators such as personal autonomy, intellectual

challenge and satisfaction in achievement enhance creativity, this can also be undermined by extrinsic pressures. Such pressures may include rigid organisational control or in-group strife (Amabile *et al.*, 1996). Alternatively, creativity may be fostered by a conducive social environment which further enhances intrinsic motivation within the individual. This may be achieved by encouraging collaborative idea flows and a shared commitment to creative thinking, for example (Amabile *et al.*, 1996).

The impact of motivation on innovative design performance is highlighted in their survey and interviews with built environment engineering designers at Arup. Here, Salter and Gann (2003) observe that those involved in non-routine design processes rely heavily on face-to-face conversations with other designers for solving problems and developing new, innovative ideas. When considering motivation as a key driver of innovation in design, intrinsic factors such as a sense of professionalism are cited, but also the extrinsic, organisational and project-based factors which allow opportunities for innovation are also considered significant. Other extrinsic motivators are found to include the simple act of creating a new structure, satisfying client needs and the social reward of working in a team. However, as predicted by Amabile *et al.* (1996), certain extrinsic barriers are also found to limit innovative thinking in the design process. These barriers include insufficient time, insufficient budgets and conflicting workloads. Interestingly, this research also concludes that it is the opportunities for face-to-face social interaction that are more significant in creating opportunities for innovation than the knowledge management tools which support information access and arguably it is the latter that have received more attention in recent research and practice.

With this in mind, design managers who wish to enhance innovative performance must therefore endeavour to establish a collaborative, face-to-face culture which fosters the intrinsic motivation to be creative and minimises the extrinsic barriers to idea generation and flow (Amabile *et al.*, 1996; Nijstad *et al.*, 2010). These principles must continue to be managed throughout design and delivery as Amabile's work is further echoed in construction literature by the suggestion that the failure of construction companies to adopt and diffuse the innovations presented may act as a demotivator to employees, becoming a barrier to innovative activity in the future (Steele and Murray, 2004).

Returning to the field of social psychology, an additional aspect of motivation explores the notion of reward as an influential factor in facilitating innovation. The theory of co-operation and competition (Deutsch, 1949) sets a foundation for exploring differences in the behaviour and performative potential of groups when individual motivation is either prosocial or proself (Pruitt and Rubin, 1986; Beersma and De Dreu, 2005; Bechtoldt *et al.*, 2010). In prosocial behaviour, individuals are working towards the collective success of the group, whilst in proself behaviour; the individual is seeking to "win" at the expense of group consensus or harmony. It is to be expected that in collaborative teams, collaborative behaviours such as information sharing, communication of goals and priorities as well as giving and making concessions will enhance performance. Indeed, more effective problem solving behaviour has been observed in prosocially motivated groups, with egoistic motivation driving out problem solving, inhibiting motivation to collect full information and overconfidence, all damaging to innovation capacity (De Dreu *et al.*, 2000).

Counter-intuitively, the presence of proself behaviour have been found to enhance collective results in the long run (Beersma and De Dreu, 2005). An individual's

attempts to create further value in a competitive environment are considered to be more conducive to divergent thought processes – those associated with brainstorming and idea generation. Hence, the group overall is more prolific in producing original ideas. However, when integrative behaviours are required such as during decision making and project execution, it is the convergent through processes that are needed as the usefulness of ideas is the goal, rather than number. Hence, it is asserted that a prosocial environment is required (Beersma and De Dreu, 2005) for delivery. Such a collaborative reward structure may have a negative effect on speed of project delivery and overall creative output (Beersma *et al.*, 2003; Johnson *et al.*, 2006). This has clear implications for the design process which requires both divergent and convergent thought processes, corresponding simplistically with the concept and implementation phases.

The nature of the reward structure as an aspect of motivation has clear applicability to issues of procurement in the construction industry and their influence on the innovative capacities of construction teams. The influence of the choice of procurement route on group performance has been investigated in the AEC field in a series of studies which analyse the effects of a variety of reward packages on team performance. However, it is noted that performance incentives are not usually an important feature of procurement routes in relation to the role of design consultants, except in prime contracting where consultants are incentivised through a shared savings scheme (Pryke, 2005). In a study of a range of procurement routes, Baiden *et al.* (2006) observe that the highest levels of integration are observed in the team procured through a design and build route and thus whilst innovation is not a specific measure in this study, their performance overall is acknowledged as higher than those procured by other routes. In another study, it was noted that the nature of the risk/reward package and the way that it is distributed amongst the design team did influence group behaviour through its perceived levels of equity and fairness, thus prompting varying levels of willingness to explore alternative design options or expend effort into modifications that would improve the design or add value (Love *et al.*, 2011). It is important to note the impact of the client's role here too, as perceptions of equity and fairness may derive from a design team understanding that they were selected fairly and on the basis of competence, past performance or capacity to add value, rather than under traditional price-focused criteria (Rose and Manley, 2010). This highlights the significance of the way in which the design team is procured as a driver of innovative performance, rather than as a by-product facilitated by in-project management (Russell *et al.*, 2006).

In summary, the significance of the pre-commission activities of the client is evident in his role in determining procurement method, selection criteria and payment/penalty structures. The industry has already taken steps to improve in this area by seeking to develop more cohesive teams in the form of new procurement mechanisms such as partnering arrangements or public private partnerships, which take advantage of longer term relationships to promote better collaboration towards value return (Aouad *et al.*, 2010). Similarly, during the design process, the effects of client-architect communication relating to cost limitation is significant in presenting a barrier or facilitator of creative performance (Wallace, 1987).

Discussion

By analysing the social psychology literature in parallel with the extant research from the AEC field, it is apparent that there has been a groundswell in the AEC literature

since the latter years of the twentieth century relating to social interaction and its influence on the innovative performance of AEC design.

However, it is evident from the analysis of literature from both fields, that the field of social psychology can offer a significant theoretical resource, with significant areas that remain under-explored, yet have clear relevance, for the AEC sector. Using the thematic approach gained from the social psychology literature, three areas emerge as having special and specific significance for built environment design teams: the social climate, attitudes to risk, and motivation/reward structure.

Figure 2 shows that, from the relevant theoretical framework within the social psychology field, the AEC sector has supplanted some key elements in its exploration of the innovative capacity of built environment design teams. There is clear evidence of discussion relating to effects of social climate, for example, and this focuses on the effects of cohesiveness and this is linked to the focus upon the definition and implementation of the "integrated team" in response to government direction. This cohesiveness is further explored through effects of conflict and "groupthink" and the need for psychological safety through trust, respect and loyalty on creating the appropriate environment for creative thinking and shared innovative response to the design problem.

Theories of motivation and reward are also well represented within the AEC field. These are explored particularly in relation to the intrinsic motivators, extrinsic barriers and reward structures which may limit or hinder the novel idea within the design environment and frequently in relation to procurement and selection methods.

Furthermore, a more quantitative analysis, expressed chronologically and thematically in Figure 1 shows that this research is a relatively recent phenomenon and, whilst these aspects of social psychology are present on our understanding of how AEC groups work towards innovation, there is still some significant work to do to embed these principles firmly within our understanding of the social process of design.

There are also further aspects of social climate and motivation and reward that still require consideration in terms of our own discipline. The influence of team climate, how teams support innovative thinking and the influence of cultural norms still require consideration. Similarly, the effects of social tuning and social comparison also remain unstudied in relation to AEC teams. Theories of motivation and reward also require further development, particularly in relation to the factors that motivate teams to innovate as well as an application of the theory of co-operation and competition within the design process and how this affects design outcomes.

Most notably, however, is the limited presence of research relating to the effects of shared risk attitudes in design teams. Whilst the construction industry has embraced risk as a critical element of management in design and construction, it would appear that the behavioural facet of this term has been neglected. It would also appear that the ability of design teams to take risks as a fundamental part of creative thinking is also limited within the AEC field. In particular, our understanding of design decision making would benefit from further exploration into how teams might share risk responsibility; the nature of the "risky shift" in design teams as well as the application of the theories of risk adjustment and acceptance in design interaction.

Conclusion

This paper has reviewed, connected and synthesised the relevant and significant work in the field of social psychology and AEC to derive a theoretical framework which can be used to direct further research towards development of the behavioural facet of

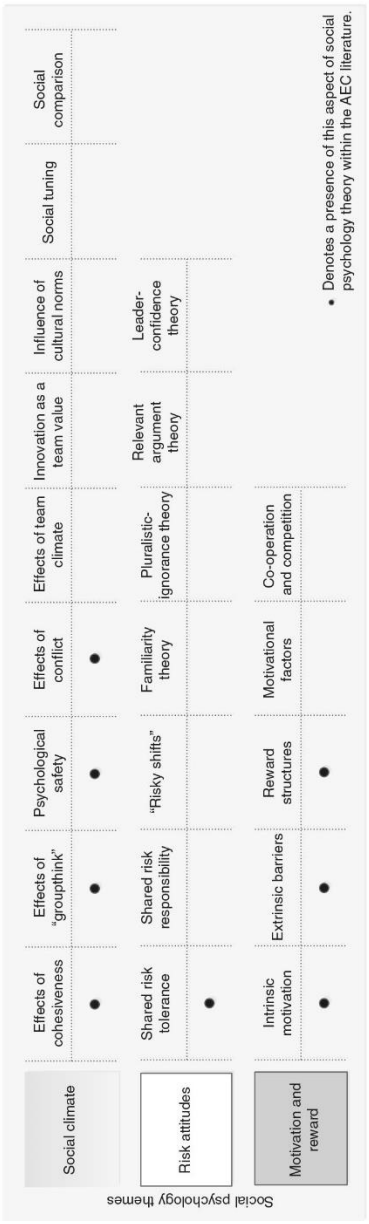


Figure 2.
Theoretical framework within the social psychology field relating to innovative performance in teams and its representation in the AEC field

design management. Whilst, some aspects of social processes are well represented in the AEC literature, the social life of the novel idea is not yet fully understood in the management of built environment design teams. The comparative analysis of the social psychology literature and that represented within the AEC has been invaluable in yielding some key areas which would benefit from further research. Development of these behavioural facets is imperative if we are to balance the operational improvements and technological advances already achieved in relation to building innovation. Development of these behavioural facets is also critical if we are to strengthen our understanding of how teams may be better designed and managed to capitalise on individual creative currency, and work towards a collaborative environment that allows innovative thinking to thrive.

References

Adarves-Yorno, I., Postmes, T. and Haslam, S.A. (2007), "Creative innovation or crazy irrelevance? The contribution of group norms and social identity to creative behaviour", *Journal of Experimental Social Psychology*, Vol. 43 No. 3, pp. 410-416.

Agars, M.D., Kaufman, J.C. and Locke, T.R. (2008), "Social influence and creativity in organisations: a multi-level lens for theory, research and practice", in Mumford, M.D., Hunter, S.T. and Avers-Bedell, K.E. (Eds), *Multi-level Issues in Creativity and Innovation*, Elsevier, Oxford, pp. 3-61.

Amabile, T. (1983), *The Social Psychology of Creativity*, Springer-Verlag, New York.

Amabile, T.M. (1988), "A model of creativity and innovation in organizations", *Research in Organizational Behaviour*, Vol. 10, pp. 123-167.

Amabile, T.M., Conti, R., Coon, H., Lazenby, J. and Herron, M. (1996), "Assessing the work environment for creativity", *Academy of Management Journal*, Vol. 39 No. 5, pp. 1154-1184.

Anderson, N.R. and West, M.A. (1998), "Measuring climate for work group innovation: development and validation of the team climate inventory", *Journal of Organisational Behaviour*, Vol. 19 No. 3, pp. 235-258.

Aouad, G., Ozorhon, B. and Abbott, C. (2010), "Facilitating innovation in construction: directions and implications for research and policy", *Construction Innovation*, Vol. 10 No. 4, pp. 374-394.

Aristotle (384-322 BC), "Politics", in Berseth J. (Ed.), *Aristotle Politics*, Dover Publications, Ontario.

Asch, S.E. (1955), "Opinions and social pressure", *Scientific American*, Vol. 193 No. 5, pp. 31-35.

Badke-Schaub, P., Lauche, K., Neumann, A. and Ahmed, S. (2009), "Task, team, process: the development of shared representations in an engineering design team", in McDonnell, J. and Lloyd, P. (Eds), *About Designing: Analysing Design Meetings*, Taylor & Francis, London, pp. 153-170.

Baiden, B.K., Price, A.D.F. and Dainty, A.R.J. (2006), "The extent of team integration within construction projects", *International Journal of Project Management*, Vol. 24 No. 1, pp. 13-23.

Bales, R.F. (1950), *Interaction Process Analysis*, Addison-Wesley, Cambridge, MA.

Barrett, J. (2010), "Evolving the idea: designing teams for detailed design", Proceedings of the 9th International Detailed Design in Architecture Conference, , University of Central Lancashire, Preston, 4-5 November.

Bateson, N. (1966), "Familiarisation, group discussion, and risk taking", *Journal of Experimental Social Psychology*, Vol. 2 No. 2, pp. 119-129.

Bechtoldt, M.N., De Dreu, C.K.W., Nijstad, B.A. and Choi, H. (2010), "Motivated information processing, social tuning and group creativity", *Journal of Personality and Social Psychology*, Vol. 99 No. 4, pp. 622-637.

Beersma, B. and De Dreu, C.K.W. (2005), "Conflict's consequences: effects of social motives on postnegotiation creative and convergent group functioning and performance", *Journal of Personality and Social Psychology*, Vol. 89 No. 3, pp. 358-374.

Beersma, B., Hollenbeck, J.R., Humphrey, S.E., Moon, H., Conlon, D.E. and Ilgen, D.R. (2003), "Cooperation, competition and team performance: toward a contingency approach", *Academy of Management Journal*, Vol. 46 No. 5, pp. 572-590.

Breuer, O., Caglio, A., Gottlieb, F., Groskovs, S., Hiltunen, A., Sanint, M.N. and Schewe, B. (2012), "The facets of design thinking", in Rodgers, P. (Ed.), *Articulating Design Thinking*, Libri Publishing, Faringdam, Oxfordshire, pp. 171-188.

Brown, R. (1965), *Social Psychology*, Free Press of Glencoe, New York, NY.

Bucciarelli, L.L. (1994), *Designing Engineers*, MIT Press, Cambridge.

Burnstein, E. (1969), "An analysis of group decisions involving risk ('The risky shift')", *Human Relations*, Vol. 22 No. 5, pp. 381-395.

Butler, R.J. (1981), "Innovations in organizations: appropriateness of perspectives from small group studies for strategy formulation", *Human Relations*, Vol. 3 No. 9, pp. 763-788.

Cartwright, D. (1971), "Risk taking by individuals and groups: an assessment of research employing choice dilemmas", *Journal of Personality and Social Psychology*, Vol. 20 No. 3, pp. 361-378.

Construction Research and Innovation Strategic Panel (CRISP): Motivation Group (1997), "Creating a climate of innovation", report to UK Construction Industry Board (CIB), CRISP, Motivation Group, London.

Cross, N. (2011), *Design Thinking: Understanding How Designers Think and Work*, Berg Publishers, Oxford.

Cross, N. and Clayburn Cross, A. (1996), "Observations of teamwork and social processes in design", *Design Studies*, Vol. 16 No. 2, pp. 143-170.

Dainty, A., Moore, D. and Murray, M. (2006), *Communication in Construction: Theory and Practice*, Taylor and Francis, London.

Davis, J.H., Laughlin, P.R. and Komorita, S.S. (1976), "The social psychology of small groups", *Annual Review of Psychology*, Vol. 27, pp. 501-541.

De Dreu, C.K.W., Weingart, L.R. and Kwon, S. (2000), "Influence of social motives on integrative negotiation: a meta-analytic review and test of two theories", *Journal of Personality and Social Psychology*, Vol. 78 No. 5, pp. 889-905.

Deutsch, M. (1949), "A theory of co-operation and competition", *Human Relations*, Vol. 2, pp. 129-152.

Deutsch, M. and Gerard, H.B. (1955), "A study of normative and informational social influences upon individual judgement", *Journal of Abnormal and Social Psychology*, Vol. 51 No. 3, pp. 629-636.

Dong, A. (2007), "The enactment of design through language", *Design Studies*, Vol. 28 No. 1, pp. 5-21.

Dorst, K. and Cross, N. (2001), "Creativity in the design process: co-evolution of problem-solution", *Design Studies*, Vol. 22 No. 5, pp. 425-437.

Egbu, C.O., Henry, J., Kaye, G.R., Quintas, P., Schumacher, T.R. and Young, B.A. (1998), "Managing organisational innovations in construction", in Hughes, W. (Ed.) *14th Annual ARCOM Conference, 9-11 September*, Vol. 2, Association of Researchers in Construction Management, University of Reading, Reading, pp. 605-614.

Emmitt, S. and Gorse, C. (2007), *Communication in Construction Teams*, Taylor and Francis, Abingdon.

Festinger, L. (1954), "A theory of social comparison processes", *Human Relations*, Vol. 7 No. 2, pp. 117-140.

Forsyth, D.R. and Burnette, J.L. (2005), "The history of group research", in Wheelan, S. (Ed.), *The Handbook of Group Research and Practice*, Sage, London, pp. 3-18.

French, J.R.P. (1956), "A formal theory of social power", *Psychological Review*, Vol. 63 No. 3, pp. 181-194.

Glock, F. (2009), "Aspects of language use in design conversation", in McDonnell, J. and Lloyd, P. (Eds), *About Designing: Analysing Design Meetings*, Taylor & Francis, London, pp. 285-301.

Goldschmidt, G. (1995), "The designer as a team of one", *Design Studies*, Vol. 16 No. 2, pp. 189-209.

Goldschmidt, G. and Badke-Schaub, P. (2010), "The design-psychology indispensable research partnership", *DAB Documents, Proceedings of the 8th Design Thinking Research Symposium (DTRS8), Sydney, 19-20 October*, pp. 199-209.

Goldschmidt, G. and Eshel, D. (2009), "Behind the scenes of the design theatre: actors, roles and the dynamics of communication", in McDonnell, J. and Lloyd, P. (Eds), *About Designing: Analysing Design Meetings*, Taylor and Francis, London, pp. 321-338.

Gonzalez-Roma, V., Fortes-Ferreira, L. and Peiro, J.M. (2009), "Team climate, climate strength and team performance: a longitudinal study", *Journal of Occupational and Organizational Psychology*, Vol. 82 No. 3, pp. 511-536.

Gorse, C.A. (2009), "Researching interpersonal communication in AEC projects", in Emmitt, S., Prins, M. and den Otter, A. (Eds), *Architectural Management: International Research and Practice*, Wiley-Blackwell, Chichester, pp. 55-71.

Harris, R., Romer, J., Kelly, O. and Johnson, S. (2003), "Design and construction of the Downland Gridshell", *Building Research and Information*, Vol. 31 No. 6, pp. 427-454.

Hurley, R.F. (1995), "Group culture and its effect on innovative productivity", *Journal of Engineering and Technology Management*, Vol. 12 No. 1, pp. 57-75.

Janis, I.L. (1982), *Groupthink: Psychological Studies of Policy Decisions and Fiascos*, Houghton Mifflin, Boston, MA.

Johnson, M.D., Hollenbeck, J.R., Humphrey, S.E., Ilgen, D.R., Jundt, D. and Meyer, C.J. (2006), "Cutthroat cooperation: asymmetrical adaptation to changes in team reward structures", *Academy of Management Journal*, Vol. 49 No. 1, pp. 103-119.

Kelman, H.C. (1961), "Processes of opinion change", *Public Opinion Quarterly*, Vol. 25 No. 1, pp. 57-78.

Kululunga, G.K. (2009), "Construction process improvement through cognitive power under team generative learning", *Engineering, Construction and Architectural Management*, Vol. 16 No. 4, pp. 307-324.

Latham, M. (1994), *Constructing the Team*, HMSO, London.

Le Dantec, C. and Yi-Luen Do, E. (2009), "The mechanisms of value transfer in design meetings", in McDonnell, J. and Lloyd, P. (Eds), *About Design: Analysing Design Meetings*, Taylor & Francis, London, pp. 101-110.

Leonard, D.A. and Swap, W.C. (1999), *When Sparks Fly: Igniting Creativity in Groups*, Harvard Business School Press, Boston, MA.

Levinger, G. and Schneider, D.J. (1969), "Test of the 'risk is a value' hypothesis", *Journal of Personality and Social Psychology*, Vol. 11, pp. 165-170.

Lloyd, P. (2009), "Ethical imagination and design", in McDonnell, J. and Lloyd, P. (Eds), *About Designing: Analysing Design Meetings*, Taylor & Francis, London, pp. 85-100.

Love, P., Edwards, D. and Wood, E. (2011), "Loosening the Gordian knot: the role of emotional intelligence in construction", *Engineering, Construction and Architectural Management*, Vol. 18 No. 1, pp. 50-65.

Luck, R. (2009), "Does this compromise your design? Socially producing a design concept in talk-in-interaction", in McDonnell, J. and Lloyd, P. (Eds), *About Designing: Analysing Design Meetings*, Taylor & Francis, London, pp. 233-250.

McDonnell, J. and Lloyd, P. (Eds) (2009), *About Designing: Analysing Design Meetings*, Taylor and Francis, London.

MacKinnon, D.W. (1965), "Personality and the realization of creative potential", *American Psychologist*, Vol. 20 No. 4, pp. 273-281.

Maher, M.L., Poon, J. and Boulanger, S. (1996), "Formalising design exploration as co-evolution: a combined gene approach", in Gero, J.S. and Sudweeks, F. (Eds), *Advances in Formal Design Methods for CAD*, Chapman & Hall, London, pp. 1-28.

Matthews, B. (2009), "Intersections of brainstorming rules and social order", in McDonnell, J. and Lloyd, P. (Eds), *About Designing: Analysing Design Meetings*, Taylor & Francis.

Mayo, E. (1949), *The Social Problems of an Industrial Civilization*, Routledge and Kegan Paul, London, pp. 33-48.

Morton, S.C., Brookes, N.J., Dainty, A.R.J., Backhouse, C.J. and Burns, N.D. (2006), "The role of social relationships in improving product development decision making", *Proceedings of the Institution of Mechanical Engineers, Part B, Journal of Engineering Manufacture*, Vol. 220 No. 6, pp. 1017-1024.

Murray, M. and Langford, D. (Eds) (2003), *Construction Reports*, Blackwell Science, Oxford.

Nijstad, B.A., De Dreu, C.K.M., Rietzschel, E.F. and Baas, M. (2010), "The dual pathway to creativity model: creative ideation as a function of flexibility and persistence", *European Review of Social Psychology*, Vol. 21 No. 1, pp. 34-77.

Nordhøy, F. (1962), "Group interaction in decision-making under risk", unpublished Master's thesis, School of Industrial Management, Massachusetts Institute of Technology, Cambridge, MA.

Oak, A. (2011), "What can talk tell us about design? Analyzing conversation to understand practice", *Design Studies*, Vol. 32 No. 3, pp. 211-234.

Oyedele, L.O. (2010), "Sustaining architects' and engineers' motivation in design firms: an investigation of critical success factors", *Engineering, Construction and Architectural Management*, Vol. 17 No. 2, pp. 180-196.

Panuwatwanich, K., Stewart, R.A. and Mohamed, S. (2008), "The role of climate for innovation in enhancing business performance: the case of design firms", *Engineering, Construction and Architectural Management*, Vol. 15 No. 5, pp. 407-422.

Paulus, P.B. and Dzindolet, M. (2008), "Social influence, creativity and innovation", *Social Influence*, Vol. 3 No. 4, pp. 228-247.

Plato (ca. 380 BC), Republic in Reeve, C.D.C. (Trans) (2004) *Plato Republic*, Hackett, Indianapolis, IN.

Pour Rahimian, F. and Ibrahim, R. (2011), "Impacts of VR 3d sketching on novice designers' spatial cognition in collaborative conceptual architectural design", *Design Studies*, Vol. 32 No. 3, pp. 255-291.

Pruitt, D.G. (1971), "Choice shifts in group discussion: an introductory review", *Journal of Personality and Social Psychology*, Vol. 20 No. 3, pp. 339-360.

Pruitt, D.G. and Rubin, J.Z. (1986), *Social Conflict: Escalation, Stalemate and Settlement*, Random House, New York, NY.

Pruitt, D.G. and Teger, A.I. (1969), "The risky shift in group betting", *Journal of Experimental Social Psychology*, Vol. 5 No. 2, pp. 115-126.

Pryke, S.D. (2004), "Analysing construction project coalitions: exploring the application of social network analysis", *Construction Management and Economics*, Vol. 22 No. 8, pp. 787-797.

Pryke, S.D. (2005), "Towards a social network theory of project governance", *Construction Management and Economics*, Vol. 23 No. 9, pp. 927-939.

Rose, T. and Manley, K. (2010), "Client recommendations for financial incentives on construction projects", *Engineering, Construction and Architectural Management*, Vol. 17 No. 3, pp. 252-267.

Runco, M.A. (2008), "Creativity research should be a social science", in Mumford, M.D., Hunter, S.T. and Avers-Bedell, K.E. (Eds), *Multi-level Issues in Creativity and Innovation*, Elsevier, Oxford, pp. 75-94.

Russell, A.D., Tawiah, P. and De Zoysa, S. (2006), "Project innovation – a function of procurement mode", *Canadian Journal of Civil Engineering*, Vol. 33 No. 12, pp. 1519-1537.

Salter, A. and Gann, D. (2003), "Sources of ideas for innovation in engineering design", *Research Policy*, Vol. 32 No. 8, pp. 1309-1316.

Schacter, S. (1951), "Deviation, rejection and communication", *Journal of Abnormal and Social Psychology*, Vol. 46 No. 2, pp. 190-207.

Shelbourn, M., Bouchlaghem, N.M., Anumba, C. and Carillo, P. (2007), "Planning and implementation of effective collaboration in construction projects", *Construction Innovation*, Vol. 7 No. 4, pp. 357-377.

Sherif, M. (1936), *The Psychology of Social Norms*, Harper Collins, New York, NY.

Slaughter, E.S. (1998), "Models of construction innovation", *Journal of Construction Engineering and Management*, Vol. 124 No. 3, pp. 226-231.

Steele, J. and Murray, M. (2004), "Creating, supporting and sustaining a culture of innovation", *Engineering, Construction and Architectural Management*, Vol. 11 No. 5, pp. 316-322.

Stoner, J.A.F. (1968), "Risky and cautious shifts in group decisions: the influence of widely held values", *Journal of Experimental Social Psychology*, Vol. 4, pp. 442-459.

van Ginkel, W.P. and van Knippenberg, D. (2012), "Group leadership and shared task representations in decision making groups", *The Leadership Quarterly*, Vol. 23 No. 1, pp. 94-106.

Visser, W. (2009), "The function of gesture in an architectural design meeting", in McDonnell, J. and Lloyd, P. (Eds), *About Designing: Analysing Design Meetings*, Taylor and Francis, London, pp. 269-284.

Wallace, W.A. (1987), "Capital costs versus costs-in-use: a content analysis of design team member communication patterns", *Construction Management and Economics*, Vol. 5 No. 4, pp. 73-92.

Wallach, M.A., Kogan, N. and Bem, D.J. (1962), "Group influence on individual risk-taking", *Journal of Abnormal and Social Psychology*, Vol. 65 No. 2, pp. 75-86.

Walton, A.P. (2003), "The impact of interpersonal factors on creativity", *International Journal of Entrepreneurial Behaviour and Research*, Vol. 9 No. 4, pp. 146-162.

Wong, E.M., Kray, L.J., Galinsky, A.D. and Markman, K.D. (2009), "Stimulating creativity in groups through mental stimulation", in Mannix, E.A., Neale, M.A. and Goncalo, J.A. (Eds), *Creativity in Groups*, Emerald, Bingley, pp. 111-134.

Corresponding author
Jennifer Barrett can be contacted at: jebarrett@uclan.ac.uk