

CHANGES IN SELF-EFFICACY BELIEFS, LEARNING AND AROUSAL FOLLOWING ATTRIBUTIONAL RE- TRAINING IN NOVICE WHITE WATER KAYAKERS

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DEDICATION

To all the people who have dared to step into the

UNKNOWN

It is to these people that we owe what we are today

and what we will be tomorrow

TABLE OF CONTENTS

Attestation of authorship.....	vi
Acknowledgements.....	vii
List of publications arising from this doctoral thesis.....	viii
List of figures.....	ix
List of tables.....	xii
Thesis abstract.....	xiii
Chapter 1: Introduction.....	1
1.1 Background.....	1
1.2 Rationale.....	2
1.3 The researcher.....	4
1.4 Thesis organisation.....	4
Chapter 2: Literature review.....	6
2.1 Introduction.....	6
2.2 Self-efficacy theory.....	6
2.3 Attribution theories.....	11
2.4 Linkages between attributions and self-efficacy.....	19
2.5 Attributional re-training.....	21
2.6 Stress, anxiety and arousal.....	29
2.7 Summary.....	50
Chapter 3: General methods.....	55
3.1 Introduction.....	55
3.2 Research design.....	55
3.3 Research constraints.....	57
3.4 The participants.....	57
3.5 Data collection measures.....	60
3.6 The attributional re-training intervention.....	79
3.7 Data presentation and statistical analysis.....	84
3.8 Methods used to answer research questions.....	88
Chapter 4: Heart rate in white water kayaking.....	91
4.1 Purpose.....	91
4.2 Methods.....	91
4.3 Results.....	93
4.4 Discussion.....	99

Chapter 5: Arousal in white water kayak training.....	104
5.1 Purpose.....	104
5.2 Methods.....	104
5.3 Results.....	106
5.4 Discussion.....	112
 Chapter 6: Self-efficacy and arousal.....	 120
6.1 Purpose.....	120
6.2 Methods.....	120
6.3 Results.....	122
6.4 Discussion.....	133
 Chapter 7: Self-efficacy and learning.....	 143
7.1 Purpose.....	143
7.2 Methods.....	144
7.3 Results.....	146
7.4 Discussion.....	150
 Chapter 8: Arousal, emotion and learning.....	 155
8.1 Purpose.....	155
8.2 Methods.....	155
8.3 Results.....	158
8.4 Discussion.....	163
 Chapter 9: Attributional re-training, learning and self-efficacy.....	 168
9.1 Purpose.....	168
9.2 Methods.....	168
9.3 Results.....	170
9.4 Discussion.....	176
 Chapter 10: Attributional re-training, arousal and emotion.....	 183
10.1 Purpose.....	183
10.2 Methods.....	184
10.3 Results.....	185
10.4 Discussion.....	190

Chapter 11: General discussion.....	197
Chapter 12: Conclusions.....	206
12.1 Introduction.....	206
12.2 Research objectives.....	206
12.3 Contribution to research.....	209
12.4 Limitations.....	210
12.5 Application of this research.....	211
12.6 Future directions.....	212
References.....	214
Appendix A Self-efficacy questionnaire.....	239
Appendix B Somatic arousal questionnaire.....	247
Appendix C Ethical approval.....	249

ATTESTATION OF AUTHORSHIP

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of a university or other institution of higher learning, except where due acknowledgement is made.

Matthew Robert Barker

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**PUBLICATIONS AND PRESENTATIONS ARISING FROM THIS
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LIST OF FIGURES

Figure 2.1. Anxiety reaction pathways.....	33
Figure 2.2. Tellegen's (1985) circumplex.....	35
Figure 2.3. State-trait model of anxiety.....	36
Figure 2.4. Yerkes and Dodson's (1908) inverted U model.....	38
Figure 2.5. Hardy and Fazey's (1987) catastrophe model.....	39
Figure 2.6. Csikszentmihalyi's (1975) model to describe the theory of flow.....	40
Figure 2.7. Apter's (1982) reversal theory.....	41
Figure 2.8. Conceptual model of the structures and nervous pathways involved in the arousal response to stressing stimuli.....	43
Figure 3.1. Original continuous heart rate recording.....	65
Figure 3.2. Original continuous heart rate recording.....	67
Figure 3.3. Detail from original recording of heart rate.....	68
Figure 3.4. Detail from original recording of heart rate.....	68
Figure 4.1. Original continuous recording of heart rate from two novice female kayakers.....	95
Figure 4.2. Heart rate 1 min pre rapid and peak heart rate for three major rapids	96
Figure 4.3. Heart rates for various paddling stroke rates.....	98
Figure 4.4. Heart rate response after cessation of kayaking exercise.....	99
Figure 5.1. Heart rate for males and females while resting and white water kayaking.....	107
Figure 5.2. Salivary cortisol concentrations for the males and females.....	108

Figure 5.3. Critical flicker fusion threshold values for males and females	109
Figure 5.4. Somatic arousal for males and females.....	110
Figure 5.5. Qualitative themes of somatic arousal for males and females.....	111
Figure 6.1. Self-efficacy correlated against somatic arousal.....	122
Figure 6.2. Salivary cortisol concentration at on water one correlated against post self-efficacy.....	123
Figure 6.3. Correlation between change in salivary cortisol between rest lodge and on water two and post self-efficacy.....	123
Figure 6.4 Arousal in females during different phases of the training day correlated against pre and post self-efficacy.....	125
Figure 6.5. Arousal in males during different phases of the training day correlated against pre and post self-efficacy.....	127
Figure 6.6 Physiological and cognitive arousal of participants with weak, moderate and strong pre self-efficacy.....	129
Figure 6.7 Somatic arousal of participants with weak, moderate, and strong pre self-efficacy.....	130
Figure 6.8 Somatic arousal of participants with weak, moderate, and strong post self-efficacy.....	131
Figure 6.9 Physiological and cognitive arousal of participants with weak, moderate and strong post self-efficacy.....	132
Figure 7.1. Change in ferry glide skill correlated against pre ferry glide self- efficacy.....	147
Figure 8.1 Change in skill (learning) for upper and lower quartiles of change in arousal.....	159
Figure 8.2 Physiological and cortical arousal for participants who expressed excitement or anxiety.....	160

Figure 8.3 Change in arousal for participants who expressed excitement or anxiety	161
Figure 8.4 Change in skill (learning) for participants who expressed excitement or anxiety	162
Figure 9.1 Post skills scores for attributional re-training and non-intervention groups.....	170
Figure 9.2. Change in skills between pre and post tests.....	171
Figure 9.3 Overall pre and post self-efficacy for the attributional re-training and non-intervention groups.....	172
Figure 9.4. Relative difference of change for individual question self-efficacy scores between the attributional re-training group and the non-intervention group	172
Figure 10.1 Physiological and cognitive arousal during rest, kayaking and recovery for attributional re-training and non-intervention groups	186
Figure 10.2 Change in physiological and cognitive arousal markers.....	187
Figure 10.3 Change in CFF from rest lodge to on water two for males and females from the attributional re-training and non-intervention groups	188
Figure 10.4. Qualitative expressions of emotion for attributional re-training and non-intervention groups.....	189
Figure 11.1 Proposed model of the psychophysical-pedagogical pathway	203

LIST OF TABLES

Table 3.1 Time line of data collection for the main study.....	79
Table 3.2. Test of normal distribution of data used in this thesis.....	85
Table 4.1. Occurrence of kayak activities associated with high heart rate.....	94
Table 4.2. Occurrence of kayak activities associated with low heart rate.....	94
Table 4.3. Summary of interviews with the white water group.....	97
Table 7.1. Self-efficacy correlated against post skills.....	146
Table 7.2. Self-efficacy correlated against (change) skills.....	148
Table 7.3. Self-efficacy antecedents correlated against skill and self-efficacy....	149
Table 9.1. Questions that show a significant ($p < 0.05$) positive difference between the pre and the post self-efficacy questionnaire.....	175

THESIS ABSTRACT

One of the problems faced by teachers who train outdoor pursuits instructors in the hot-house environment of time limited, criterion referenced training and assessment programmes in tertiary education is managing the students' anxiety, arousal and self-efficacy beliefs. Evidence suggests that poor progress and failure by students through these programmes is associated with feelings of increased anxiety, weak efficacy for the tasks and high physiological arousal when engaged in certain activities in outdoor environments.

The literature review focuses on three main areas of research: (1) self-efficacy theory, (2) attribution theories, and (3) arousal and anxiety. These areas are inter-related with the main themes of self-efficacy and learning being discussed in each section.

An attributional re-training intervention was trialed and its effects on self-efficacy, arousal and learning were measured. To give a holistic appreciation of the arousal response, emotional reactions, strength of self-efficacy beliefs, their inter-relationships in a white water kayak-training environment, a concurrent nested mixed methods approach was used. The elements of qualitative data (self-efficacy, somatic arousal, and emotional state) and quantitative data (skill, heart rate, critical flicker-fusion threshold, salivary cortisol concentration, self-efficacy and somatic arousal) were blended together to provide a fuller picture of causation and the relationships, in this white water environment.

The level of arousal students experience while participating in white water kayak training courses is characterised in Chapters 4 and 5. Very high physiological arousal was found at low to moderate exercise intensities. Heart rates showed large and early anticipatory responses and were slower to return to resting values at cessation of kayaking. The cognitive arousal marker of CFF was depressed when other arousal markers were at their zenith, particularly for females suggesting a different cognitive arousal response. The relationship between self-efficacy beliefs and arousal is examined in Chapter 6. An interactive two-way relationship was demonstrated between arousal and self-efficacy beliefs. The formation of self-efficacy beliefs appears to occur at differing levels

of arousal for males and females. These findings suggest a more important role for arousal in self-efficacy belief formation, in this environment, than is generally reported in the literature. Chapter 7 investigates the relationships between self-efficacy beliefs and the learning of kayaking skills. Pre and post self-efficacy correlate well with skill, however, the relationships between change in self-efficacy and change in skill or pre and post self-efficacy with change in skill were not proportional. The performance accomplishment antecedent was the best predictor of subsequent skill. The relationships between arousal (physiological, cortical and somatic), emotion and the learning of kayaking skills are illustrated in Chapter 8. Greater learning occurs when participants have smaller changes in arousal. Anxious participants did show greater change in arousal. Chapter 9 considers the influence of attributional re-training on the change in participants' kayaking skills (learning) and their self-efficacy beliefs. Attributional re-training has a positive effect on skill attainment and skill change. It also appears to have a positive influence on the development of stronger self-efficacy beliefs. Chapter 10 looks at the relationship between attributional re-training and arousal. Attributionally re-trained participants experience higher physiological arousal and a greater increase in cortical arousal. Evidence is presented to suggest that attributional re-training may lessen the depression of CFF and therefore the inferred decline in cognitive processing capacity, especially for females. Attributional re-training stimulates the notions of high positive affect (excited, confident) and low negative affect (calm, relaxed).

In conclusion, this exploratory research suggests that the environment in which white water kayak training occurs is shown to be highly stress inducing. Attributional re-training and associated self-efficacy augmentation can have a mediating role, reducing negative environmental effects on learning in white water kayak training. Further findings suggest implications for course design and programme delivery to improve learning and self-efficacy belief development.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

One of the problems faced by teachers who train outdoor pursuits instructors in tertiary education programmes is managing the students' anxiety, arousal and self-efficacy beliefs. Anecdotal evidence suggests that poor progress and failure by students through these programmes is associated with feelings of increased anxiety, weak efficacy for the tasks and high physiological arousal when engaged in certain activities in outdoor environments.

In the past when outdoor instructor training took place in a model involving a long work place apprenticeship, it was normal for the learner to undertake a lengthy period of habituation (Ferrero, 1998) or systemic desensitisation (Ewert, 1989). In this training mode, through prolonged exposure, the learner became less affected by the anxiety inducing factors and could slowly learn the art of teaching and leading. As and when the learner was able to control the effects of the environmental stimuli, for a given range of conditions, they could progress to the next level of exposure. With the short time frames involved in leadership education in tertiary institutions today, it is posited that these normal habituation processes rarely have the necessary periods of time or conducive conditions to develop. This is particularly so when applying competency levels set by industry bodies.

The environment in which outdoor activities are undertaken have been found to be highly stress inducing in a number of studies (Bunting, Tolson, Khun, Suarez & Williams, 2000; Ewert, 1988; Hardy & Hutchinson, 2007; Pijpers, Oudejans, Holscheimer, & Bakker, 2003). This is particularly so for white water kayaking where there are perceived and actual risks involving capsizing and a high incidence of physical injury (Bunting et al., 2000; Fiore & Houston, 2001). High physiological arousal and, or anxiety, are thought to be detrimental for optimal

performance as demonstrated with Hardy and Fazey's (1987) catastrophe model (Fig. 2.5). Engagement in outdoor pursuit activities has been shown to increase stress hormone levels (Bunting et al., 2000), while the level of anxiety experienced has been shown experimentally to adversely affect rock climbing performance (Pijpers et al., 2003).

The strength of self-efficacy beliefs is thought to have an important role in the ability of people to perform various stressful and phobia related tasks (Lloyd Williams, 1995; Maddux, 1991), with weak self-efficacy beliefs associated with sub optimal performance (Manstead & van Eekelen, 1998; Multon, Brown & Lent, 1991). Self-efficacy augmentation has been shown to increase academic achievement (Manstead & van Eekelen, 1998) but there is not yet data to support the value of self-efficacy augmentation for outdoor instructor education within tertiary institutions.

1.2 RATIONALE

Anecdotal evidence would suggest that in outdoor pursuit teaching and learning environments, excessive anxiety and arousal levels and weak self-efficacy can have negative impacts on the productivity of teaching and learning. It would appear that the ability of students to learn may become impaired by their lack of control of their fears, high anxieties or excessive physiological arousal in stressful scenarios or tasks. When physiological arousal, fears and anxieties are not effectively monitored or controlled through strategies given by their teachers to the learners, they could be a major factor which limits learners' options in, and progress through, tertiary outdoor pursuits instructor courses. In the current climate prevalent in New Zealand tertiary study, teachers must develop strategies for ensuring that all students have the best opportunity to flourish and develop their skills at the maximum rate possible. Reducing or limiting exposure to the stress inducing stimuli, by lowering the severity of the environment in which teaching takes place or extending the training period, is not an option. Tertiary courses are time limited and industry assessment standards dictate that certain environmental conditions be used for the

assessment of personal performance as well as teaching and leading demonstrations. The learner must therefore be exposed to the challenging environment, become efficacious and produce controlled performances during training as well as at the point of assessment under the prescribed conditions.

If students are able to self-regulate their anxiety, maintain arousal at optimum levels for learning, and trainers could provide practical steps to monitor and support this self-regulation, the learning potential of these training sessions should increase. The teacher must monitor and manage the learner's exposure and responses to a far greater degree. It is hypothesised that the learner could achieve this through training in self-regulation techniques to strengthen perceptions of self-efficacy and therefore improve learning and performance.

It is necessary for exploratory research to be undertaken which examines the exact nature of the student's reaction to stressors, the interplay between the reactions, and their effects on the student. This must be followed by an evaluation of a strategy designed to enhance self-regulation and augment self-efficacy to provide the platform on which to build optimum teaching and learning conditions.

The purpose of this research is threefold: Firstly, to characterise the arousal response, perceptions of self-efficacy and emotions of participants whilst engaged in the outdoor pursuit of white water kayaking in a natural environment, within an instructor training programme at a tertiary institution. Secondly, to identify the relationships that exist between the participants' arousal response, perceptions of self-efficacy, emotions and the learning of white water kayaking skills. Thirdly, to assess the utility of a self-efficacy augmentation intervention to increase learning of white water kayaking skills in high stressed natural environments. This research could help more students to have the opportunity to achieve a higher level of competency in shorter time frames.

This research has relevance to any situation where competency levels need to be achieved in a limited time period and where stressors in the learning

environment may compromise educational objectives. The development of this body of knowledge with practical applications for outdoor pursuits instructor training within tertiary institutions may have application more widely in outdoor pursuit teaching and outdoor recreation. It potentially provides techniques that the outdoor educator and student can use in order to limit the debilitating effects of anxiety and over arousal. These techniques may not only nurture the creation a more productive teaching and learning environment, but may also offer some self-regulatory tools that the students can use to reduce their anxiety levels when they are not under the direct supervision of the educator.

1.3 THE RESEARCHER

The author and researcher of this thesis is a serving university senior lecturer who specialises in outdoor education and outdoor pursuit instructor training through the medium of white water kayaking. He has an extensive career in teaching and coaching kayaking spanning a 25-year period, holding the highest kayaking qualifications from both the United Kingdom and New Zealand. He has been a teacher and lecturer in both secondary and tertiary education systems for over 20 years. The author of this work wears many hats concurrently; he is author, researcher and primary teacher of the participants studied. Although this presented difficulties regarding ethical considerations, great efforts were undertaken to reduce potential bias where researcher and teacher are one and the same. This potential bias lead to the constraining ethical requirements by the local committee (Appendix C) e.g. that the data must be collected by independent third parties.

1.4 THESIS ORGANISATION

This thesis is presented in twelve chapters. Chapter 2 is a literature review that evaluates self-efficacy theory and attribution theory, before linking these two theoretical constructs together. The adjustment of attributions through misattribution and attributional re-training are reviewed next. The literature

pertaining to anxiety, arousal and stress is appraised with reference to models of the relationships between arousal and anxiety and performance, the physiological response to stress, measurement of arousal and anxiety and how arousal and anxiety affect performance and learning are presented. The last part of this section seeks to link the literature on anxiety and arousal together with the construct of self-efficacy before finally identifying areas of scant literature and research that need to be further investigated. Chapter 3 describes the methods used in the collection and analysis of the data for the main study. Chapter 4 presents the data from a stand alone preliminary study that describes the heart rate response of novice white water kayakers during a training day involving three major rapids in a natural setting. It also compares this heart rate response to an exercise only heart rate response during kayaking on an ergometer in the laboratory. Chapters 5, 6, 7, 8, 9 and 10 present various aspects of the data from the main study. Chapter 5 covers the characterisation of physiological, cognitive and somatic arousal response of novice white water kayakers during day two of a three-day training programme. Chapters 6, 7 and 8 present the data from investigations regarding the relationships between self-efficacy, arousal, emotion and learning during the three-day white water kayak skills training course. Chapters 9 and 10 present the data that was collected following the use of an attributional re-training intervention regarding changes to self-efficacy, learning, arousal and emotion during the three-day kayak skills training programme. Chapter 11 is a general discussion that brings the various aspects of the studies together. Chapter 12 is a conclusion of the research findings, discusses the contribution this thesis makes to the field and looks forward to future research directions.

CHAPTER 2.

LITERATURE REVIEW

2.1 INTRODUCTION

This review focuses on three main areas of research: Firstly self-efficacy theory is reviewed with reference to learning, arousal and anxiety. Secondly, attribution theories and attributional re-training are examined. Thirdly the literature relevant to arousal and anxiety and its relation to performance is commented upon. All three areas of literature are related to one another but most notably are referenced to both self-efficacy and learning as the main themes running through this work.

2.2 SELF-EFFICACY THEORY

As part of a wider Social Cognitive Theory, Bandura (1977) proposed that how people function in a given situation was influenced by their perceptions of capability for that task in those situations. He proposed that these self-efficacy beliefs were influenced by feedback from the following sources, which he referred to as antecedents; vicarious experience (i.e. watching others do the task), performance accomplishment or mastery experience (i.e. actually completing the task), verbal or social persuasion (i.e. receiving feedback or encouragement), and physiological state (i.e. state of arousal). These antecedents were added to by Maddux (1995) with imaginal experiences (i.e. imagining themselves doing the task) and Schunk (1995) with emotional state (i.e. anxiety or sadness). These antecedents of self-efficacy beliefs have been described as additive (the more sources that are present the greater the effect), multiplicative (the sources interact with each other), configurative (sources depend upon each other) and relative (one source is stronger than another source) (Usher & Pajares, 2008). However, many researchers subscribe to the view that self-efficacy antecedents are relative, with the order of potency in forming beliefs being, performance accomplishments, vicarious experience, social persuasion and lastly physiological arousal, with performance accomplishments being far

more influential in the formation of self-efficacy beliefs than the others (Bandura, 1997; Bates & Khasawnek, 2007; Britner & Pajares, 2006; Pajares, Johnson, & Usher, 2007; Schunk & Meece, 2005; Usher & Pajares, 2008). Notably, Usher and Pajares (2006b) give evidence that all four main antecedents predict subsequent self-efficacy beliefs. Allied to this are the findings of Rose, Paisley, Sibthorp, Furman, and Gookin (2010) which conclude that the actual outdoor experiences account for the most learning while on a National Outdoor Leadership Schools course. This supports the findings that performance accomplishments are the most potent sources of self-efficacy beliefs (especially for males) and further supports the central tenet of experiential education approaches. Priest and Bunting (1993) suggested that the performance accomplishment antecedent has the largest influence on subsequent physical skill. While it is accepted that performance accomplishment or mastery experience has the greatest influence on subsequent self-efficacy beliefs (Bandura, 1997; Bates & Khasawnek, 2007; Britner & Pajares, 2006; McGowan, 1986; Pajares, Johnson, & Usher, 2007; Schunk & Meece, 2005; Usher & Pajares, 2008), it should be noted that self-efficacy should not be linked directly with performance attainment as it is the individuals interpretation of that performance that has a greater influence on subsequent self-efficacy beliefs than the actual attainment displayed. Chan and Lam (2010) found that self-referenced feedback to students had a greater positive effect on student's self-efficacy beliefs than norm-referenced feedback did.

Whilst most researchers have not reported gender differences in the strength of sources for the development of self-efficacy beliefs (Usher & Pajares, 2008), there are a growing number of studies finding that males use performance accomplishment sources to a greater extent than females do (Britner & Pajares, 2006; Hampton & Mason, 2003; Usher & Pajares, 2006a; Zeldin, Britner, & Pajares, 2008). Females use vicarious experience and social persuasion to a greater extent than males (Pajares, et al., 2007; Usher & Pajares, 2006a; Usher & Pajares, 2006b; Zeldin & Pajares, 2000; Zeldin et al., 2008).

Self-efficacy theory differs from other concepts of self in that unlike self-confidence, self-concept and self-esteem, which are global in nature, self-efficacy beliefs are specific (Bandura, 1997; Maddux, 1995; Pajares, 1997; Schunk & Meece, 2005). Self-efficacy beliefs are formed from beliefs about the individual's ability to summon the resources necessary to complete a specific course of action at a specific time and place. There may be transference to other actions in other contexts, with Luszczynska, Gutierrez-Dona, and Schwarznier (2005) describing general self-efficacy as a generalised global expectancy based upon self-efficacy for specific tasks. However, they, like many authors agree that for the majority of applications, self-efficacy should be regarded as a construct regarding specific situations. The more dissimilar the action and context the less accurate and reliable the self-efficacy judgements will be. The sources of self-efficacy beliefs are however shared with other self-concepts and therefore there is predicted to be some crossover of that information to beliefs of a more stable and generalised nature (Usher & Pajares, 2008). This may explain the apparent transfer of self-efficacy beliefs to more global contexts.

Self-efficacy beliefs have been widely used as predictors and as measurement tools in a wide range of contexts. Pajares and Urdan (2006) found that strength of self-efficacy beliefs accurately predicted subsequent academic achievement while Brown and Lent (2006) showed that strength of self-efficacy beliefs predicted college major and subsequent career choice, all of these factors being important in this current thesis. Studies of self-efficacy related to test or exam anxieties show large negative correlations (Pintritch & DeGroot, 1990; Smith, Arnkoff, & Wright, 1990). Several authors have found inverse relationships between self-efficacy and state anxiety in stressful environments (Bandura, 1983; Litt, 1988) and that weak self-efficacy was a characteristic of anxiety disorders and phobias (Maddux, 1991). The extent to which an individual believes they can exert a controlling influence over a stressful situation was shown to vary directly with arousal and performance (Averill, 1973; Bandura, 1983; Folkman, 1984), while perceptions of a lack of control have been associated with increased anxiety (Endler, Speer, Johnson, & Flett, 2000; Glass, Singer, Leonard, Krantz, Cohen, & Cummings, 1973; Geer & Maisel, 1972).

Perceived control in stressful situations and level of self-efficacy have been found to be strong predictors of academic achievement (Manstead & van Eekelen, 1998; Multon, Brown, & Lent, 1991). While Endler et al. (2001) have suggested that control and self-efficacy are separate constructs derived from separate sources that affect behaviour in differing ways; they also believe that both have strong influences on performance and accomplishment. Thus, research regarding performance in academic fields of endeavour suggests a strong relationship between self-efficacy, control and stress. Teaching outdoor pursuits skills, seems to have strong elements of perception of control and stress and therefore self-efficacy may have a great influence on learning in these natural environments.

Self-efficacy beliefs have been positively affected by teachers offering interventions to students (Bandura, 1997; McWhirter, Crothers, & Rasheed, 2000; Schunk & Ertmer, 2000). Augmented self-efficacy beliefs appear to, in turn, improve learning and academic performance (Chemers, Hu, & Garcia, 2000; Pajares, 1996). Students who have strong and positive self-efficacy are engaged in academic processes to a higher degree in terms of their behaviour, cognition and motivation for the educational tasks (Linnenbrink & Pintrich, 2003) and work harder, evaluate progress more frequently and engage in self-regulatory strategies (Schunk & Pajares, 2005). Similarly, the degree of self-efficacy for a task has been found by several authors to affect motivation for, and level of effort and persistence in, educational tasks (Bandura, 1977; Salomon, 1984; Berry, 1987; Schunk, Hanson, & Cox, 1987). Although Multon, Brown, and Lent's (1991) meta analysis of research examining the relationship between self-efficacy and academic performance found that ~14% of the variation in students' performance could be assigned to their self-efficacy beliefs, they also reported that there is a stronger relationship between self-efficacy beliefs and academic achievement in low achieving students than those who are making good progress. However, as Pintrich and De Groot (1990) found, students must not only have the will to succeed, they must also have the necessary skills. Therefore students in the mid range of academic performance are most likely to improve their ability through self-efficacy augmentation. There would appear to be, especially in outdoor leader self-efficacy development, gender differences in the

strengthening of self-efficacy beliefs. Propst and Koesler (1998) suggest that females respond better to positive feedback, whereas the most important factor for males is the immediacy of the feedback.

Taking Bandura's (1977) model of self-efficacy and an inverted U model of optimal arousal (Fig. 2.4), it is proposed that the following processes could happen if physiological arousal is used as the dominant initial factor. Increased physiological arousal above the optimum level leads to decreased self-efficacy, which in turn leads to decreased performance accomplishments, which are then followed by further increases in physiological arousal, which lead to further decreases in self-efficacy and so forth and so on, in a downward spiral of decreasing function. However, a more desirable outcome would be to decrease physiological arousal from above the optimum, which is associated with strengthened self-efficacy, which can lead to increased performance accomplishments, which are associated with maintenance of optimum physiological arousal, which leads to further strengthening of self-efficacy and so forth and so on, in an upward spiral of increasing function. However, self-efficacy may be the initial dominant factor that would suggest the following spiral would ensue: self-efficacy to physiological arousal to performance accomplishment to self-efficacy, and so on. Certainly, performance accomplishment has been found to have the greatest influence on self-efficacy beliefs (Priest & Bunting, 1993; McGowan, 1986), but the mechanism to change performance accomplishment may be found in optimal physiological arousal.

The strength of self-efficacy beliefs has been successfully used as a measure of the effectiveness of outdoor programmes (Propst & Koesler, 1998) and outdoor programmes have been shown to be successful in augmenting self-efficacy beliefs and other concepts of self (Priest & Bunting, 1993). An area that is lacking in the literature is the development of self-efficacy beliefs in order to increase the productivity in terms of skills and competencies of outdoor pursuit and outdoor education programmes.

Further literature linking self-efficacy with attributions, arousal and anxiety has been addressed later in this review within the relevant sections on attributions, arousal and anxiety.

2.3 ATTRIBUTION THEORIES

Attribution theories generally involve the study of perceived causation and subsequent effect. For example, a person will display certain behaviour and they will attribute their behaviour, or their reactions, to a particular cause. Attribution theories only refer to an individual's perception of the cause of their, or another's, actions.

The psycho-social constructs widely known today as attribution theories did not, unlike many contemporary theories, form from the publication of a new research paradigm but rather developed from a number of dissimilar areas of research. These can be traced to the works of Heider (1958), research on person perception (Jones, Davis, & Gergen, 1961), self-presentation (Jones & Wortman, 1973), locus of control (Rotter, 1966), theory of emotion (Schachter, 1964), and self-perception (Bem, 1967). The major authors largely responsible for bringing these research areas together and linking them with the concept of attribution theories (as cited in Kelly & Michela, 1980) were Jones and Davies (1965) and Kelly (1967).

There have emerged two distinct areas of attribution research, misattribution and re-attribution. Misattribution research was stimulated by the classic work in the area by Schachter and Singer (1962) and their two-factor theory of emotion. Whereas, re-attribution research has developed from a diverse assemblage of theories from the 1970s, namely Bandura's (1977) self-efficacy theory, Seligman's (1975) theory of learned helplessness and Weiner's (1979) theory of achievement motivation. Misattribution focuses on the arousal and cognitive labelling for that arousal with interventions primarily giving alternate (more positive) causality for increased arousal e.g. attributing arousal to an ingested pill in insomnia suffers. Conversely, re-attribution (attributional re-training)

focuses on the alteration of causal cognitions regarding behavioural outcomes, by encouraging participants to seek more favourable causal attributions, e.g. attributing failure to the strategy used or degree of effort expended.

Early attribution research sought to find the sources of the attributions that people make categorising these attributions based on how they come to attribute a certain cause to a certain observed effect. Jones and Davis (1965) divided people's sources or antecedents of attribution perceptions into three areas, namely information, beliefs and motivation. The information antecedent, can be divided into, non-common effects, co-variation, similarity and contiguity, and primacy (Kelly & Michela, 1980). The links between available information and likely attributions take many forms. Some appear to be based on logic (for example, co-variation and non-common effects) whereas others defy logic and are based on degree of dominance of possible causes (salience) and earliest likely cause identified (primacy). The beliefs category includes perceptions generated by suppositions that certain causes lead to particular effects and that, given a certain cause, people will have notions of expectancy about the effect. It can therefore be seen that cause and effect are also linked by preconceptions on the part of the observer, and are not based solely on actual events. This supposition allows the observer to make variations in attribution based on their perceptions of success or failure. Attributions are also made with reference to how factors are perceived to combine causing certain effects (causal schemata). The motivation to make attributions about actions can be affected in several ways. They can be affected by the desire to understand or the desire to find blame or praise. One's notion of self can be affected by the attributions one makes and therefore there may be a degree of subjectivity to the attributions one makes to protect or enhance one's own perceptions of self. This may therefore create a bias in the way attributions are apportioned. There are examples of studies showing a bias towards attributing failure to external factors and success with internal or individual centred factors, creating what is known as self-serving bias (Bradley, 1978; Zuckerman, 1979).

More recent attribution research has focused on the dimensional nature of attributional perceptions. Research has moved away from the how these perceptions are made and onto where they reside. Weiner, Frieze, Kukla, Reed, Rest and Rosenbaum (1971) assigned people's attributions into two dimensions, namely, locus of causality (internal or external) and stability (the degree to which the cause may change over time or not). Later, Weiner (1979) added controllability (whether the cause can be controlled by the individual or not) as a third dimension. Abramson, Seligman and Teasdale's work (1978) added two further dimensions, globality (the degree to which it is situation specific) and universality (its affect on other people). These latter three dimensions have been linked under the wider dimension of generalisability (Rees, Ingledew, & Hardy, 2005) and linked to Fosterling's (1988) dimensions of consistency with stability, distinctiveness with globality, and consensus with universality.

Emotion and attribution of arousal

The seminal work in this area is that of Schachter and Singer (1962), which led to Schachter's (1964) two-factor theory of emotion and the misattribution of arousal paradigm. This theory proposed that perception of emotion is comprised of two elements, physiological arousal and an emotional label for that arousal. This theory also proposed that arousal without an emotional label will not be perceived as emotion and that if arousal is not present there will not be a perception of emotion. The arousal provides the strength of emotional perceptions and the emotional label gives that perception a direction. This is similar to Apter's (1982) reversal theory where different emotions are different cognitions regarding the same level of arousal. The theory also postulates that un-labelled (attributed) arousal will not be tolerated and that labels will be sought (attributed) for any un-labelled arousal. There have been challenges to Schachter's (1964) theory, notably in one of which Maslach (1979) concluded that in the absence of an explanation for arousal, that arousal evokes fearful emotions. It would therefore seem to follow that, by giving the individuals suitable attributions or explanations for their arousal, more positive emotions may be encouraged. Schachter's original work and those that have questioned it have induced a state of arousal with adrenaline administration or hypnosis for

particular symptoms. Arousal (physiological and cognitive) is a much broader condition than can be adequately reflected by only one system or symptom (Ursin, 1988) and that arousal is more adequately described as a multidimensional construct (Gould & Udry, 1994). Individual differences in perception of, and activation of, the various arousal responses to the same stimulus would suggest that a more global approach, using many arousal markers, may indicate the individual's state of arousal in experiments such as Schachter and Singer's (1962) or Maslach's (1979) to a much better degree. There is also the question of whether artificially induced (through injection of adrenaline) arousal symptoms are actually relevant to the psychological effects that occur when these same symptoms, along with a host of others (Zaichkowsky & Baltzell, 2001), occur as a natural response to an actual stimulus.

Schachter's theory (Schachter & Singer, 1962) also has application to fear and anxiety reduction using what has become known as the misattribution effect (Cotton, 1981). This theory proposes that if the attribution for arousal is changed from an emotional source (fear, anger etc) to a non-emotional source (in Schachter and Singer's (1962) experiments, to a drug) the perceived strength of that emotion will be reduced. This effect was successfully demonstrated in a wide array of experimentation and has proved to be highly effective in fear reduction (for review see Cotton, 1981). However, Cotton, Baron and Borkovec (1980) found that the misattribution effect was only successful when used in novel settings, as when the participants are too accustomed to the stimulus and its attributed effect, no amount of persuasion can dissuade them from making the attribution to that source. It would appear that the plausibility of alternate attributions for arousal diminishes with habituation and therefore alternate attribution or attributional re-training must deliver a more plausible, or at least equally plausible, alternative early in the exposure to a stimulus to have the greatest effect on reducing negative emotional perceptions.

The theory of cognitive dissonance (Festinger, 1957) has also been a fertile area of research into the misattribution paradigm. Cognitive dissonance has been defined as the unpleasant psychological state caused by the simultaneous

holding of two or more mutually inconsistent thoughts or ideas. The theory suggests that people are motivated to reduce dissonance and until this is achieved the psychological tension of cognitive dissonance increases physiological arousal (Kiesler & Pallak, 1976; Zanna & Cooper, 1974). The unpleasant tension that cognitive dissonance describes may be the motivating factor that causes individuals to make attributions which in many cases are incorrect but the desire to reduce the psychological tension is enough for them to jump to the most obvious (salience), or any possible, causation that immediately precedes (primacy) the arousal. Further, Pittman (1975) found that if arousal is attributed to a dissonance relevant source then dissonance reduction, and therefore arousal reduction, would occur.

These theories would further suggest that through a process of attributional re-training that encourages participants in novel situations to attribute arousal away from emotional causation to other non-emotional causes, will not only reduce fearful perceptions but, by resolving cognitive dissonance, will also reduce physiological arousal. Schachter's theory (Schachter & Singer, 1962) has been shown to accurately predict emotional reactions, but as yet does not adequately explain those reactions (Cotton, 1981). More research is needed to explain how these changes in emotion occur.

Effects of attributions

Attributing the cause of an event to an internal, unstable, and controllable factor allows the learner to have some level of control over subsequent attempts to achieve a desired result (Ziegler & Heller 2000). A failed attempt by a learner, but for which the learner can attribute an internal causation, will allow that learner to take a differing course of action, change the antecedents and therefore display a greater confidence of outcome expectancy for a successful result at the next attempt. On subsequent attempts, a successful performance will enhance their self-efficacy for this task and their sense of efficacy for the altered attribution process. Having a greater degree of positive outcome expectancy will lead to lower apprehension and anxiety for the task, a more relaxed and confident performance (Pijpers et al., 2003) and therefore a better performance

regardless of whether the learner correctly attributed failure in the first instance or not. As long as the learner believes that they are doing something different for each subsequent trial, and that this change will influence their success or failure, their outcome expectancy will be enhanced, their anxiety levels will be more appropriate and more optimal conditions for a successful outcome will result. The use of attributing causation for failure to one's self for future benefit must be tempered with an awareness of the dangers of creating a potential environment of lack of self-belief and pessimism. If the natural and usual approach is to seek causation for failure from external sources, as suggested by the literature (Bradley, 1978; Zuckerman, 1979), it is a challenge and an unnatural process to attribute causation to internal sources. This is difficult to achieve especially when the possible outcome of this process is to harm self-perceptions which can be detrimental to one's self-concept and beliefs. Participants must set suitable proximal and long-term goals, seeing the process as a means toward that goal. If they are motivated to desire a better performance, the participants are more likely to display greater resilience to the knock-backs along the way and will more readily seek to learn new skills and new strategies to meet the perceived demand (Holschuh, Nist, & Olejnik, 2001).

The benefit of attributing causation to an external factor may make the individual feel better about themselves in the short term, but does not allow them to have a mechanism to change the negative outcome of a subsequent attempt. The learner is just as likely, in the future, to fall prey to the same set of causes and have a similar negative result as these external influences are beyond the sphere of their control. Once the locus of causation is internalised, however, the learner can change their behaviour and have a higher degree of expectancy that the subsequent performance will have a different, and potentially more positive, result.

The extent to which an individual believes they can exert a controlling influence over a stressful situation has been shown to vary directly with levels of arousal and performance (Averill, 1973; Bandura, 1983; Folkman, 1984), while

perceptions of a lack of control have been associated with increased anxiety (Endler et al., 2001; Glass et al., 1973; Geer & Maisel, 1972). Both perceived control in stressful situations and level of self-efficacy have been found to be strong predictors of academic achievement (Manstead & van Eekelen, 1998). While Endler et al. (2001) suggest that control and self-efficacy are separate constructs derived from separate sources and affect behaviour in differing ways, both have strong influences on performance and accomplishment.

There have been a number of studies exploring the emotional effects of attributions to particular causes (Holschuh et al., 2001). Attributions for success and failure are most commonly assigned to effort, ability and strategy use (Clifford, 1986; Peterson, 1992). When attributions for poor performance were assigned to effort, students feel saddest regarding their capability and least sad when the attribution was made to strategy. Males, with regard to failure, regardless of attribution, reported shame, but that the attribution to effort was most likely to bring out shameful feelings in females. Failing students experience guilt when attributing failure to internal causes, while external causes evoke emotions of anger and hostility (Forsyth & McMillan, 1981). The emotion of guilt has been linked to the controllable attribution of effort, and shame reported when the uncontrollable cause of ability is attributed to failure (Weiner, 1994). Feelings of guilt and anger were similarly reported, with attribution to effort showing the greatest response, while attributions to strategy evoked the least response. Holschuh et al. (2001) go on to report that students who attribute failure to a stable, uncontrollable factor such as ability will set lower future goals and have the greatest difficulty in meeting their original goal. Students who attribute failure to unstable but controllable factors, such as effort and strategy, will better set and achieve future goals. They found that the strongest emotional responses were reported when attributions for failure were based on level of effort and that, as reported by Forsyth and McMillan (1981), students who display the greatest emotional response to failure are most likely to change behaviour in the future.

When attempts to modify the attributions are made following failure, in order to increase the perception of a more favourable future outcome, there is a presumption that the factor to which the attribution has been made is unstable (i.e. open to modification) and is controllable (i.e. within the sphere of influence of the individual). Effort, an internal, unstable and controllable factor, has been recommended as a factor to attribute to failure (Weiner, 1986; Holschuh et al., 2001). The danger of this is that a future failure with increased effort leads to greater feelings of helplessness (Biddle, Hanraha, & Sellers, 2001; Abramson, et al., 1978) with associated decreases in self-efficacy and motivation. However, applying the unstable, controllable attribution of strategy choice (Biddle et al., 2001; Hardy, Jones, & Gould, 1996) to a failed attempt will allow many failed attempts to be withstood while different strategies are trialled, and before negative emotions are likely to manifest.

The emotions of shame, guilt, anger and sadness are questionable and potentially dangerous educational motivators. Therefore basing attributions on effort, although perhaps the easiest cause to change and the factor giving the greatest emotional response, will be potentially most damaging to self-concepts and motivation for continued work. Holschuh and colleagues (2001) reported that students believed that when failure was attributed to strategy they would be able to change their behaviour in the future even though this cause had the weakest emotional response. The distance provided between the self and the cause, when attributions are based on strategy, allows both change and protection of self-percepts.

Attributing failures or less than perfect performances to the strategy used can often lead to greater motivation to seek out and learn new strategies (Holschuh et al., 2001). Wilson and Linville (1985) reported that attributions made to unstable causes reduced anxiety about academic performance and increased expectancy about future performance as well as increased actual future performance.

Within the learning environment, the learner who has not been coached to make attributions of an internal, unstable or controllable nature can be seen as a naive attributor, one who will most likely fall into the naturalistic pattern of self-serving bias. The actively learning student is also increasing in ability, often with great improvements over small periods of time and therefore perception of ability, within this context, should be seen as an unstable factor. In the elite performer, most often studied in this line of research, ability is a much more stable construct, as changes are smaller and take longer to accomplish. In the context of this present line of research, the learner should be re-trained to seek and accept internal, unstable and controllable attributions for poor or failed performances, rather than the excuse making or self-protecting attributions that they may be more prone to assign without such re-training (Zuckerman, 1979). Effort may be seen as an unsuitable attribution, due to the potentially negative emotions and damage to self-efficacy that may occur. Ability may be used, but changes may be slower bring about, and therefore this factor may be better suited to longer-term goals. It is postulated here that the most constructive attribution to use in an intervention or re-training context, within the scope of this study, is strategy, it being easy to change and relatively safe to the students' emotions and concepts of self.

However the ability of attributional re-training to provide excuse pathways must be guarded against. It is the role of the teacher/mentor to ensure that the student does not use the process to find excuses for failure, but instead engages in the process to find ways to achieve. This distinction between negativity and positivity must be reinforced in the training process for the full benefit of attributional re-training to be realised.

2.4 LINKAGES BETWEEN ATTRIBUTIONS AND SELF-EFFICACY

Anxiety has been described as the fear of the unknown, the uncontrollable and is a future orientated emotion (Barlow, 2002). Therefore it should follow that to assign effects and actions to internal, unstable and ultimately controllable factors is likely to reduce the perceptions of anxiety. This should then augment

perceptions of self-efficacy and lead to better performance and increased potential to learn novel tasks.

If Bandura's (1977) antecedents for self-efficacy perceptions are used as a guide, it can be seen how attributions may be linked to the formulation of these perceptions and beliefs regarding self-efficacy. Students' perceptions of control through the attributions they make toward their failures have been linked to levels of anxiety, which in turn affect the physiological arousal antecedent. If attributions are made to internal, controllable causes then it should follow that this will give rise to feelings of control over the process or situation allowing appropriate physiological arousal together with the perception of a successful outcome expectancy. Strong self-efficacy is likely to lead to failure being attributed to a lack of effort, while with weak self-efficacy failure is likely to be attributed to a lack of ability (Bandura, 1999).

Through attributional re-training, any verbal persuasion given may seem to have more importance, be more relevant and be internalised to a greater extent if the learner views the feedback and comment/encouragement as pertinent and that the advice will lead to a better future outcome. This gives the verbal persuasion a greater degree of utility and is more likely to be acted upon making such feedback more effective.

Improved performance accomplishment is likely not just through the reduction in anxiety, but also as a result of more effective advice or feedback. Greater gains in this antecedent are also provided by students' increased motivation to succeed and improved motivation to gain the skills or strategies they lack.

If the observer can attribute successes and failures to causes stemming from the learner, then they too can see that the locus of control of the effects lies with the learner. The observer soon realises that through their own actions, they also can gain this control and change negative effects into positive ones, thus allowing positive vicarious experiences to be perceived. However, Marlatt and Gordon (1985) found that attributing failure to internal causation caused self-efficacy to

be weakened and therefore the benefits of this style of attribution should be tempered with careful application in order to maintain and enhance self-efficacy beliefs.

Schunk's (1995) emotional state antecedent is protected through not using effort as an attribution, but by focusing on the strategy to be changed. Lastly Maddux's (1995) imaginal experience could be improved through the learner internalising the problem and allocating it to unstable, controllable factors. This may allow the learner to foresee a different outcome over which they have ultimate control, which in turn may lead to a strengthening of self-efficacy beliefs for change, and for the task in the future. The learner is encouraged to see that there is a way out of the present set of undesirable circumstances and that they have the control to make that change.

2.5 ATTRIBUTIONAL RE-TRAINING

The self-serving bias effect suggests that people generally have the propensity to attribute failure or disappointing performance to external factors (Bradley, 1978; Zuckerman, 1979). Making attributions in this manner allows little potential for future change and leaves the attributor little control over making those changes. The perception of control is best achieved by attributions made to internal factors. Attributional re-training is needed so that attributions are made that allow the person to do something to bring about control over a better future outcome. The perception of control is the common factor in the literature pertaining to self-efficacy constructs and attribution theory research (Ingledew, Hardy, & Cooper, 1996; Rees et al., 2005). Perception of control has been shown to have a major influence on self-efficacy. When attributions are focused on controllable, unstable, and internal factors, anxiety levels are lowered while motivation and emotional state are improved.

Rees et al. (2005) give evidence for supporting controllability as the primary attributional dimension for use in intervention programmes. Causal controllability has been identified as positively associated with the formation of

perceptions of internal locus of causality (Ingledew et al., 1996; McAuley, Duncan, & Russell, 1992). Bringing the locus of the attribution from external to internal allows the individual to bring the causation within their sphere of control rendering it open to change. Sports psychologists will often try to attribute failures to internal, unstable and controllable causes, usually lack of effort or poor strategy (Rees et al., 2005). In relapse prevention therapy, however, it is recommended that the causes be assigned to external, unstable and controllable factors (Marlatt & Gordon, 1985), to avoid potential damage to emotions and self-efficacy. Stable and uncontrollable attributions will lead to a lowered self-efficacy or outcome expectancy (an individual's judgement that performing certain behaviours will likely be followed by certain outcomes) (Gibbs, 2006).

Miller and Brickman (2004) report that helping students acquire new physical and cognitive skills or strategies that increase the likelihood of success and encourage positive attributions to be made can improve self-efficacy. They also show that when self-efficacy is strong, students are motivated to increase effort even when they have experienced failure. Performances that match or exceed personal standards or goals generally strengthen self-efficacy, while performances deemed lower than their personal standards or goals weaken self-efficacy.

The internal locus of attributions is associated with the desirable dimension of controllability (Ingledew et al., 1996; McAuley et al., 1992), but attributing effects to self can cause problems of negative emotions and the lowering of self-efficacy for the task (Marlatt & Gordon, 1985). This leads these authors to suggest that external, unstable and controllable factors offer greater utility. Rees et al. (2005) argue that regardless of locus, the controllability of the attribution is the more important dimension upon which to focus for re-training and intervention purposes, rather than locus and stability. However, it must follow that, to some extent, in order to be fully controllable by the attributor, the causality must be internal and to some degree unstable.

An interesting link to self-efficacy augmentation (strengthening of self-efficacy beliefs) can be seen in studies that show an inclination to make attributions to internal sources for positive outcomes, which may be read as a device for self-enhancement, while assigning negative effects to external causation, which may be viewed as self-protection (for review see Kelly & Michela, 1980).

However, self-theories cannot adequately explain the action of others in the self-serving bias process and that while self-serving bias may act as a self-enhancing or self-protection tool, this may be a by-product and that there are greater innate motivations for the attribution of success and failure at play. Internal causation of failure and external causation of success (Ross, Beirbrauer, & Polly, 1974) have been explained by the motivation to present the self and others in a positive way which may lead to a degree of modesty, causing bias in the reported attributions. In other words, this allows external factors to be attributed to success in order for the individual to appear modest, or to internal factors in order to appear competent, to others. It is interesting to note that attributions to internal factors may allow progress on a difficult task, by bringing the causation into the effective control of the individual and therefore into their sphere of influence. Through appropriate goal setting, skill acquisition and effort on the part of the individual, success is more likely. This in turn has a positive effect on perceptions of self-efficacy for a task or for future successful outcome expectancy at a given task. However, the process of attributing these causes for failure to an internal rather than an external factor may have a damaging effect on the individual's self-efficacy (Marlatt & Gordon, 1985). Therefore the environment in which to develop attributions that will allow the causation to come within the individual's effective control requires some careful managing and monitoring.

There is a lack of consensus as to which dimension has the greatest utility in intervention work. Weiner's (1986) model points to stability, as stable attributions lead to perceptions of certainty, whilst unstable attributions lead to perceptions of uncertainty towards future performance. To increase the likelihood of positive future performance, success should be attributed to stable

causes, so that they may be repeated and failures to unstable causes so that they may be changed. On the other hand, Biddle et al. (2001) and Hardy, Mullen and Jones (1996) believe that controllability could be the more significant dimension, as a highly controllable cause has the greatest potential to be changed in the future. Grove and Pargman (1986), and Rees et al. (2005) noted that in real world situations where there is a dearth of possible unstable attributions, controllable factors should form the focus of research and attributional re-training practice. Attributions made to strategy use can be seen as highly controllable and relatively safe to use, as these attributions are completely at the discretion, and under the control, of the individual. Strategies are also highly variable (there is a surfeit of options) and very unstable but highly repeatable. Lastly they are of internal locus, yet to some extent distant from the individual, as a failure can be seen as a result of poor choice of strategy, rather than a personal failing or a lack of their ability.

Attributional re-training in educational contexts

Changing a learner's general propensity of attributing failure to external forces, to one where the perceived causal antecedents for that failure are viewed as internal, allows a teacher to have greater veracity and utility of feedback than in situations where learners are allowed to attribute the actions or effects to causes that are external and, or, outside their sphere of control. In Ruthig and colleagues (2004) study, they found attributional re-training to have a positive effect on students' grade point average together with decreased anxiety and lowered voluntary course withdrawal in college students. Ziegler and Heller (2000) used a form of attributional re-training in a natural educational setting. The re-training involved written and verbal feedback attributing success to ability (stable internal locus) and failure to lack of effort (unstable internal locus). The students who received the re-training changed their attributional style and had improved motivation and achievement in the subject studied. The control group, who received no re-training, experienced an increase in learned helplessness (Biddle et al., 2001; Seligman, 1975). Attributional re-training has also been successfully used to increase motivation and achievement with at risk (risk of failing college courses), low self-esteem college students (Haynes, Perry,

Stupinsky, & Daniels, 2009; Perry, Hall, & Ruthig, 2005) and improved academic performance of college students when they had previously shown poor use of learning strategies (Hall et al., 2007). Some researchers have reported negative effects of attributional re-training treatments seemingly with students who previously displayed high self-esteem (Hall et al., 2006; Hall, Jackson, Goetz, & Musu-Gillette, 2011), this may be able to be somewhat negated by incorporating small group feedback into the treatment.

Attributional re-training has been shown to have two key benefits to learners; an increase in motivation (Hall et al., 2007; Haynes et al., 2008) and an increase in perception of control (Perry et al., 2005). These were aligned to an increase in academic achievement particularly with students who perceive they have low to average control (Perry et al., 2010). The changes after attributional re-training seem to have lasting positive effects of at least 5 months (Hall et al., 2004; Haynes et al., 2006) and up to 3 years (Perry et al., 2010). Effective teachers have been shown to be, on their own, ineffective for students with low perceptions of control (Perry, 2003) and that those that are in most need (i.e. low achieving students) are least likely to benefit from these otherwise effective teachers (Haynes, 2009). As teachers are more effective with students who display high levels of motivation and control, attributional re-training is an effective way to increase these factors in student groups and therefore enable otherwise effective teachers to help students to reach their potential (Perry & Smart, 2007).

Accurate perceptions of attribution will allow the learner to seize control of the learning environment, see that they can make a difference through their own actions and take positive steps to improve future outcomes. This will generally lead to increased levels of efficacy they feel for a given task. Attributional re-training could have a great affect on the learner's perceptions of self-efficacy. Whenever re-training focuses attributions for failure on internal, controllable, unstable causes the learner can exert great power to make changes, feel efficacious about the effect of those changes and is highly likely to gain the motivation to ultimately succeed. Attributions to effort, ability and strategy can

all be used, but strategy appears to be the safest and most effective attribution to make in terms of protecting emotions and efficacy. The learner needs to make attributions that allow them to do something about the cause. If that cause is perceived to be external, i.e. the flow of the river, this is outside their sphere of influence and therefore they cannot exert control over it. Whereas, if they attribute the effect to a failure on their part, to read a cue, or poor strategy choice, by way of examples, then they are in a position to change the effect of that cause at a future time. Consequently, they can see a pathway to success and will not have to rely on luck, or persist with trials that perpetually have the same causation for failure. If they do have subsequent success they are more likely to attribute that success to change in themselves and progression on a given task, rather than luck.

On a kayaking ferry glide, changing the perceived attribution that ‘the water caught the bow of my boat and it pushed me round’ (an external force that the learner is not, and never will be, in control of), to, ‘I mistimed my strokes, I needed to be paddling on the left as I crossed the eddy line’, gives the learner a way forward, a way of changing their actions to stop the effect of something they cannot control. Whereas, if the notion of the external force remains we subject the learner, even in subsequent successful outcomes, to consider that it was luck or it just happened to *come right* that time. The learner’s confidence in subsequent successful outcomes will be low, as they are not in control of their fate. This leads to low self-esteem or low self-efficacy and a possible lack of motivation, as a learner who does not see progression may become disheartened at their lack of control over the situation and potentially give up.

A role model can be used as a vicarious experience as was used by Perry and Penner (1990) and adapted by Luzzo, Funk and Strang (1996) and extensively used by Perry and colleagues (Haynes et al., 2008; Perry et al., 2010), who showed students a video of a professor explaining how he had changed his attributional style to good effect. This re-training had the greatest effect of improving performance in students who had an external locus of control. The

teacher guides observation of another performing the same task and helps the learner to identify differences in outcome and to attribute these to internal, controllable and unstable factors. This could take a similar form to the following hypothetical dialogue.

‘Why is Bob not losing his angle?’ ‘He is doing x, y or z (success attributed to the individual). It’s not the water is it? The water is the same for both of you. What could you try next time to keep your angle?’

In a typical review session after an activity, teachers often ask students to use ‘I’ statements. This attributes the issue to an internal cause and allows the student to control the effects by changing their own behaviour, over which they alone have ultimate control. If we allow students to attribute causes to external factors, they then have a distinct lack of control over the causes and future outcomes. Students will experience greater feelings of anxiety, have lower self-efficacy and will be less motivated to pursue more favourable outcomes. This may also lead to perceptions of helplessness about their future performance. Re-trained perceptions of attribution will allow the learner to seize control of the learning environment and therefore increase the level of efficacy they feel for it. This in turn will raise their perception of their ability and reduce the level of anxiety that they feel, thus further improving performance and enjoyment of the experience. The recipient of accurately attributed feedback where the locus of control is internal, unstable and controllable is less inclined to perceive feelings of helplessness and is more likely to be motivated to make positive changes.

Brief attributional re-training interventions (e.g. ~1hr duration) have been shown to be effective with college students (Wilson, Damiani, & Shelton, 2002). The most effective treatments having an intervention followed by a consolidation phase, comprising of a discussion or small group feedback element with effects lasting up to 3 years (Perry, Hall, & Ruthig, 2007).

Attribution re-training, when it augments self-efficacy perceptions, is a very useful approach for the educator. Attribution re-training has three-fold benefits

for educational practice. Firstly, it can be used to improve learning in activity based programmes. Attributing faults to controllable factors reduces anxiety and allows the learner to regulate their own learning. Secondly, educational experiences often take people outside their norms; this is often the primary motivation for using new activities as an educational medium. Whilst participating in new experiences with novel tasks, environments and situations, attributions and self-efficacy perceptions are made and displayed in a much more overt state. Away from the complications under which everyday perceptions are constructed the lessons are more easily observed and understood. From this new understanding, the learner can then focus back on their normality and use the learning to make pertinent and lasting changes. Thirdly, the use of attributional re-training is a valuable reflective tool. When linked with self-efficacy, it also becomes a highly effective evaluation and planning tool. Students can reflect upon their performance and plan for future success, leading to increased self-efficacy and motivation for the task.

The theoretical constructs of attribution and self-efficacy can have great application in the practice of educators. They are relatively easy to incorporate and can have lasting positive effect (Luzzo et al., 1996; Hall et al., 2004; Haynes et al., 2006; Ruthig et al., 2004; Perry et al., 2007). The practice of educators can be improved through such techniques (Haynes, Perry, Stupnisky, & Daniels, 2009). Self-efficacy perceptions are not transferable but efficacy for a successful re-training process is. Efficacy for the re-training process means that it is more likely to be absorbed and used in the everyday lives of the learner to over-come difficulties. This makes effective and lasting change more likely. However, like all powerful tools, attributional re-training is not without its dangers. To avoid damaging self-efficacy, motivation and emotions, it must be carried out carefully and within a supportive context. Properly conducted, attributional re-training could be one of the most effective approaches within education.

2.6 STRESS, ANXIETY AND AROUSAL

The concepts of stress, arousal and anxiety, have been studied and theorised through a diverse range of disciplines, including psychology, sports psychology, physiology and education. However, through the multi-discipline approaches used to study these constructs, issues of semantic interpretation have arisen. The terms have been used inconsistently or synonymously both inter discipline, intra discipline and even within the same research. 'Arousal' and 'anxiety' have been used interchangeably with some authors even using anxiety scale instruments to report arousal effects (Sage & Bennett, 1973; Sonstroem & Bernardo, 1982), which adds confusion to this subject area. This lack of clarity has been a major handicap for the development of this line of research in the past. The terms must be clearly defined and be used consistently across the disciplines, or new terms must come into common usage if the various interested fields of research are to work together more closely.

The terms have been defined as

Stress: A state in which a demand is placed on an individual that affects the homeostasis (Jones, 1990).

Arousal: An organism's state of readiness to perform a task (Duffy, 1962). Early works viewed arousal as a single construct, but later works have used a multi-dimensional model to describe it, most notably the distinction between physiological arousal and cognitive arousal as separate facets. Arousal can be viewed along a continuum of deep sleep to high excitation (Zaichkowsky & Baltzell, 2001).

Anxiety: A negative emotional response derived from the cognitive processing of information (Folkman & Lazarus, 1988), which leads to feelings of inability to summon the necessary resources to meet the perceived demand. However, anxiety has also been described as a blend of basic emotions (Izard, 1977), the product of a wide affective network stored in memory (Lang, 1985) and a multi-referential construct viewed differently from individual to individual (Hallam, 1985)

To these terms have been added the prefixes of physiological, somatic or cognitive, in an attempt to distinguish between the elements of the multi-dimensional constructs.

Cognitive anxiety is usually connected with emotions regarding the negative (worry) or positive (excitement) interpretation of somatic perceptions. However, this does make the cognitive prefix appear somewhat redundant as anxiety, being an emotion, or blend of emotions (Izard, 1977), is created and resides in the emotion centres of the brain and therefore, can be nothing but cognitive. Further to this, anxiety usually refers only to perceptions of unpleasant negative affect and not to the perception of pleasant positive affect, and so to use the anxiety term for both anxiety and excitement is somewhat misleading and may even influence the respondent of a questionnaire to view the subjective sensations as negative. A more neutral term might reduce the possibility of this bias. Possible alternative terms include sensations, feelings or perceptions, as these have little emotional direction associated with them.

Somatic anxiety has been used synonymously with the term somatic arousal and both terms generally refer to perceived symptoms of physiological arousal (Hardy, 1990). The same symptoms may be construed as arousal or anxiety depending on their interpretation as having facilitative or debilitating effects (Jones, 1995), and as Burton and Naylor (1997) point out, perceptions of cognitive or somatic anxiety that were perceived to be facilitative are not likely to be reported as anxiety at all and it is more likely that these perceptions would be reported with terms such as excitement, self-efficacy or readiness. As anxiety has a negative connotation, and arousal has a more neutral connotation, it is suggested that somatic arousal is a more apt term to use to describe these perceptions. Ideally a direction of anxious or excited or relaxed/bored should be added to these perceptions to discern the effect that these feelings have on the individual. What is of interest to researchers in this line of enquiry is the strength of perceptions of physiological response to a given situation or task and also the emotion that those somatic sensations evoke, and therefore the nomenclature used ought to reflect this. Indeed, recent studies (Ward & Cox,

2004) have shown a lack of correlation between somatic anxiety scales and somatic arousal scales. This suggests that the two constructs and measuring instruments should not be used interchangeably.

Whilst somatic anxiety and somatic arousal are seen as synonymous by some authors, the term cognitive arousal must not be used interchangeably with the term cognitive anxiety. Cognitive anxiety is, as described above, an emotion, whereas cognitive arousal is the degree of electrical activity in the cerebral cortex of the brain, as measured by an electroencephalogram. It may be that the emotion of anxiety induces cognitive arousal and indeed physiological arousal, but the terms must be clearly distinguished.

Physiological arousal is not usually confused with the other terms and correctly refers to the degree of activation of the body's systems in readiness for the perceived or actual demands placed upon it. It has, however, been used as synonymous with the term physiological stress response (Bunting et al., 2000; O'Leary & Brown, 1995) in the literature.

Stress

Stress has been used synonymously with the construct of state anxiety by several authors (Robinson & Stevens, 1990; Spielberger, 1983; Martens, 1987; Ewert, 1988). However, more recently, stress has been proposed as an antecedent of anxiety (Lazarus 1991) and not therefore synonymous. Lazarus (1991) reported that stress reactions follow what he termed a primary appraisal, where the stimulus was assessed against its relative importance and potential affect upon the individual. This then leads to a secondary appraisal whereby the individual's resources to mitigate or manage the stressor are assessed. The primary appraisal is seen as the stimulus for physiological arousal responses and the secondary appraisal for emotional responses based on the degree of perceived capability of the coping strategies available (Jones & Hardy, 1990; O'Leary & Brown, 1995).

Arousal

This construct may be seen as the degree to which the body's systems are energized in readiness for the requirements, actual or perceived, of a given task (Magill, 1989; Cox, 1990). This construct was seen as uni-dimensional in early works but began to be regarded as a multi-dimensional construct as early as the 1970s. Pribram and McGuinness (1975) posited that the construct has two distinct elements; they called one activation and the other arousal. Activation refers to the increases in cognitive and physiological activity for a planned response, for example, at the start of a race. Arousal refers to the more automatic response to, for example, a loud noise. However, Ursin (1988) makes the point that arousal is not identical to changes in heart rate, galvanic skin resistance, rise in plasma cortisol and growth hormone or increases in metabolism. Each constitutes only part of the response and each can be individually altered without necessarily affecting the others. This lack of correlation between the various indicators of arousal has been found by many authors (Jones & Hardy, 1990; Lacey, 1967) and would suggest that the activation of the various arousal responses follow differing pathways and affect an individual's response to different degrees. Furthermore, researchers have identified arousal as having at least three components, physiological, cognitive and behavioural (Zaichkowsky & Baltzell, 2001). The cognitive component is demonstrated in research by Chao, Backman and Backman (2005), where they found that participants recalling and talking about an exciting white water rafting trip had higher physiological arousal than participants recalling and talking about a relaxing white water rafting trip. This suggests a link between emotion (affect) and physiological arousal in a psycho-physiological relationship. Gould and Udry (1994) posit that the physiological arousal response can be delineated as a physiological component and a cognitive component with the cognitive component, derived from appraisal of physiological response, being further divided into positive affect (excitement) and negative affect (anxiety) of the appraisal of increased physiological arousal. The weight of support for arousal to be interpreted as a multi-dimensional construct is now almost universal (Gould & Udry, 1994; Hardy, Jones, & Gould, 1996). Mounting evidence suggests that the arousal construct consists primarily of a physiological component, a cognitive appraisal

component and a human affect component that can further influence the physiological component (Zaichkowsky & Baltzell, 2001).

Anxiety

Emotions, such as anxiety, are complex constructs derived from the interweaving of several factors. There are thought to be two pathways that invoke fear or anxiety reactions, a relatively reactive process involving the thalamus and a more cognitive process involving the cerebral cortex (Fig. 2.1).

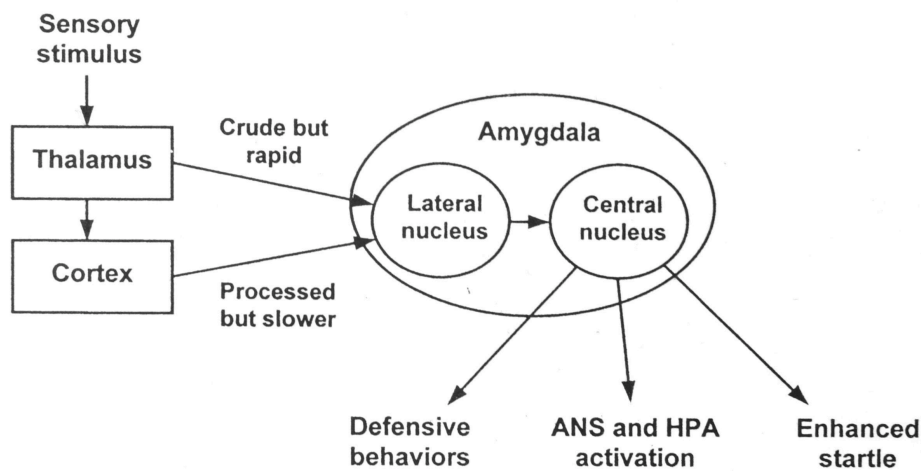


Figure 2.1. Anxiety reaction pathways. ANS, autonomic nervous system, HPA, hypothalamic-pituitary-andrenocortical axis (elsewhere referred to as HPAC). Reproduced from Spiegel and Barlow (2000).

Barlow (2002) considers four major components that together form the emotional response; the subjective experience of affect, expressive behaviour, an integrated neuro-biological response and a cognitive perception or appraisal.

Of the multitude of theories of emotion from the psychology literature, three theories are of particular interest to the study of anxiety in this research.

Mandler's interruption theory

Mandler (1975; 1984) proposed a theory in which an outside stressor interrupts ongoing cognitive activity and that this interruption produces an autonomic arousal discharge. The discharge causes a detailed cognitive appraisal of the arousal to be undertaken. Depending on the result of the appraisal, i.e. the

perceived causation, and the intensity of the autonomic arousal, a positive emotion e.g. excitement, or a negative emotion e.g. anxiety, will be induced. Critics of this theory cite examples of highly anxious individuals who display low levels of arousal.

Hallam's theory of anxiety as a personal construct

Hallam (1985) describes anxiety as a multi-referential lay construct and the theory goes some way to address the criticism of previous theories which cannot adequately account for individual differences in the reporting of anxiety. This theory suggests that anxiety covers a range of emotions, psycho-physiological and behavioural effects, the combination of which can be reported by an individual as anxiety or not. The theory also suggests that the construct known as anxiety varies from individual to individual because it is a learned label (as opposed to a description) for a group or combination of effects, and therefore differs depending on how it was learned.

Lang's bio-informational theory of emotion

This theory also accounts for how emotions can be evoked when the full collection of antecedents are not presented (Lang, 1985). Lang posits that emotions are stored in memory as a series of propositions accessed by information processing mechanisms. Matching the information to the stored propositions accesses particular emotions. The more matches that are made between the available information and the stored propositions the more likely the full emotion response will be accessed, but limited emotional response can still be accessed on limited matches. The structure of this theory would suggest that if modification of some of the propositions can be made then the maximal emotional response might be attenuated. Lang (1985) also suggests that emotional expression lies along three dimensions, one dimension is arousal, from low arousal to high arousal, another dimension is valence, from unpleasant to pleasant with the third dimension being the degree of control.

Those analysing the dimensions of affect have produced various circumplexes to identify and map out emotional expression. Two researchers have identified

dominant dimensions within their circumplexes. Russell (1980) has identified activation (state of arousal) and valence (pleasantness) as the principal dimensions with dominance –submission (ability to exercise control or influence) as a third dimension of emotion. Tellegen (1985) identified four dominant dimensions on which the circumplex (Fig. 2.2) was based. These being: *positive affect*, from high to low, *negative affect*, from high to low, *pleasantness*, from pleasant to unpleasant and *engagement*, from strong to disengaged.

The positive and negative affect axes are presented as orthogonal, a position that has been questioned by others (Russell & Carroll, 1999) who suggest that positive and negative affect may well occupy different positions along the same axis, and restate that emphasising the axes of pleasant-unpleasant and arousal-calm provides a better fit to the available data.

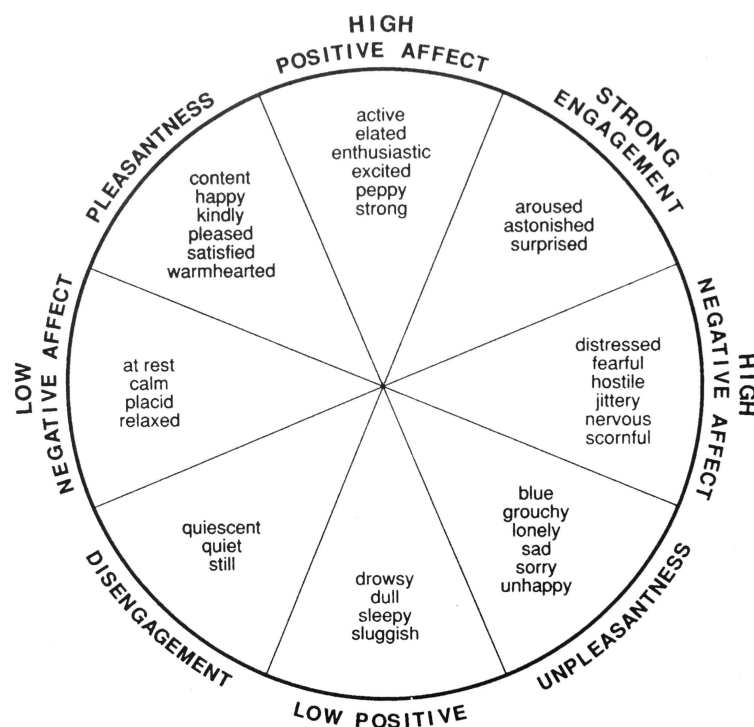


Figure 2.2. Tellegen's (1985) circumplex. Reproduced from Barlow (2002).

It is interesting to note that self-efficacy to has an influence on affect (Laczczyńska, Gutierrez-Dona, & Schwarzer, 2005). They found a positive relationship of general self-efficacy to positive affect and a negative relationship with negative affect.

Anxiety is now commonly viewed as a multi-dimensional construct. It can be divided into state or trait anxiety (Spielberger, Gorsuch, & Lushene, 1970). These divisions distinguish between anxieties brought on by reaction to an acute stimulus (state anxiety) and the anxieties of individuals who show a general propensity (trait anxiety) to display the features of anxiety (Fig 2.3) and also cognitive and somatic anxiety as separate constructs to distinguish between the mind and body indicators of anxiety (Jones & Hardy, 1989; Martens, Burton, Vealey, Bump, & Smith, 1990).

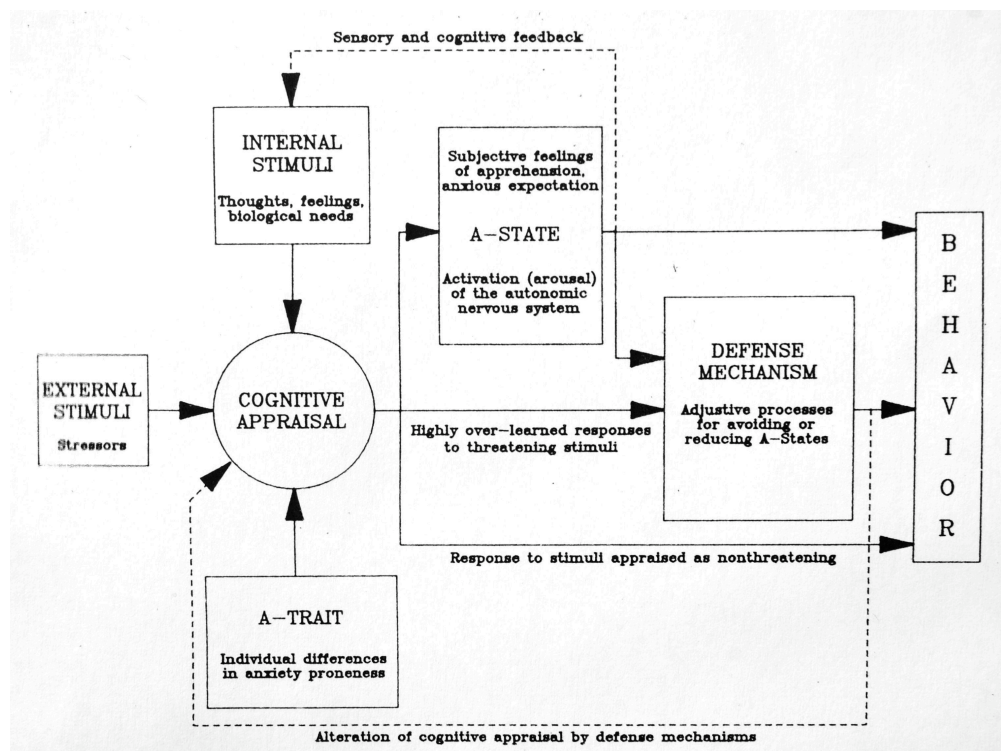


Figure 2.3. State-trait model of anxiety. This model presents the pathway to anxious expression as two constructs state anxiety (A-state) and trait anxiety (A-trait). Reproduced from Spielberger (1972).

Hackfort and Schwenkmezger (1989) have divided the physiological indicators of anxiety into three distinct groups; respiratory and cardiovascular indicators e.g. heart rate, respiration rate, biochemical indicators, e.g. adrenaline, cortisol and electrophysiological indicators, e.g. electroencephalogram, skin resistance. However, this list of indicators is identical to those used to assess physiological arousal and therefore the terms physiological arousal and physiological anxiety

are likely to be used synonymously. This makes interpretation of the data in this research difficult as the elevated or lowered levels for these indicators could be due to changes in exercise intensity or as a result of a more intense emotional response. Synonymous usage does not allow adequate differentiation to be made apparent.

Although there is certainly confusion regarding the choice of words to describe the responses to stressing stimuli, what is apparent is that there is a consensus that the responses have complex physiological and cognitive components and that they interrelate, both ways, very closely.

Models which relate arousal, anxiety and performance

There have been many models proposed to illustrate and predict the relationship between stress, arousal or anxiety with performance. Many of these models have been developed in the disciplines of psychology and, more recently, sports psychology.

One of the earliest models is the inverted U model for the relationship between arousal and performance (Fig. 2.4). It was originally developed by Yerkes and Dodson (1908) but was later utilised by Broadhurst (1957) and Oxendine (1970) to describe the relationship between arousal and performance. It has been included here as it paved the way for future developments that more completely describe and explain the relationship.

This model suggests that the highest performance will be at moderate levels of arousal and that sub maximal performance will be attained when the performer is under or over aroused. The theory suggests that under and over arousal have the same symmetrical detrimental effect on performance.

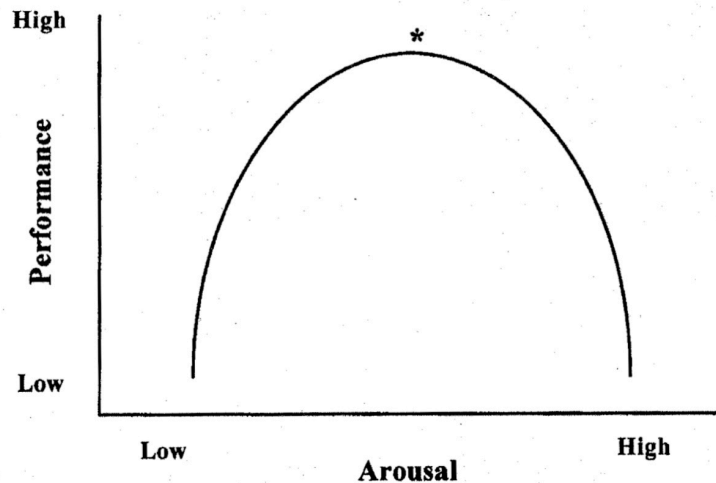


Figure 2.4 Yerkes & Dodson's (1908) inverted U model. Reproduced from Murphy (2005) * indicates peak performance/optimal arousal.

Major challenges to this model are that it was originally developed to describe a different relationship, that of habit strength formation against punishment stimulus in mice and therefore the basic premise on which it was originally based may not extrapolate to the arousal and performance or anxiety and performance domains for which it has been used to describe and explain. This model is also challenged because it treats arousal as a singular construct; modern thinking suggests that arousal is a multi-dimensional one. The relationship suggested by the model is symmetrical in that if a performance starts to wane, whether because of under or over arousal, small changes in arousal will bring the performance back to the optimal zone. This is contended by Hardy and Fazey (1987), who suggest that while this may be true for under arousal, the over arousal curve would appear to drop away much more steeply and that it is difficult to return to optimum arousal from the over aroused state. They suggest that the curve should be much more asymmetrical in nature and proposed the catastrophe model (Fig. 2.5).

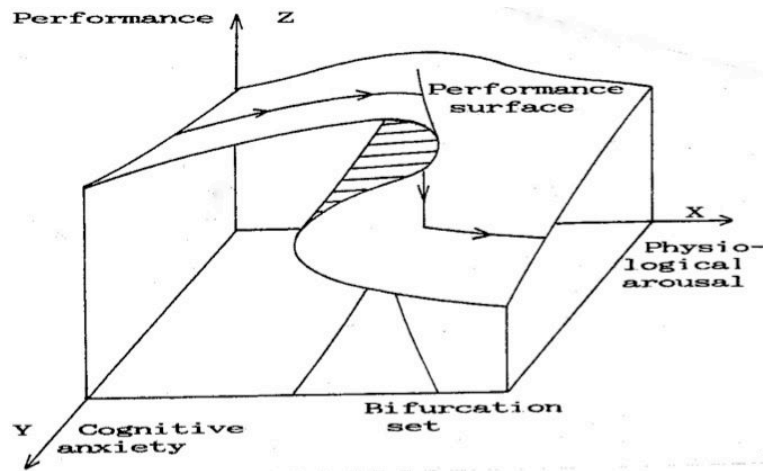


Figure 2.5. Hardy and Fazey's (1987) catastrophe model of the relationship between physiological arousal, cognitive anxiety, and performance. Reproduced from Hardy (1990)

In the catastrophe model the physiological component has been separated from the cognitive component as Hardy and Fazey (1987) posited that the two components behave in differing manners. The physiological component behaves in a similar way to the inverted U model but with an increasing cognitive component, the relationship adopts a catastrophe curve. This catastrophe curve is characterised by the notion that performance increases with cognitive anxiety up to a certain point and then performance drops away dramatically with a small increase in anxiety. What is most interesting about this model is that anxiety and or arousal levels must be lowered significantly for the performance to once again attain the upper performance surface. This is shown by an increasing degree of hysteresis with increasing cognitive component. Later versions of this model show two much more distinct performance surfaces, an upper one and a lower one with the break point between them being much more dramatic (Hardy, Jones, & Gould, 1996).

Other theoretical models have been developed to illustrate the nature of arousal anxiety and performance. Two models used to describe the arousal and anxiety levels that lead to superior performance are the individual zone of optimum function (IZOF) that is based on the works of Hanin and Syrja (1995), and the Flow theory developed by Csikszentmihalyi (1975). The flow model (Fig. 2.6)

developed by Csikszentmihalyi (1975) depicts that a state of optimal performance (flow) is reached when skills and challenge are matched, but that both boredom caused by too high a skill level compared to the task causes stress, as does anxiety caused by too difficult a challenge for the skill of the individual.

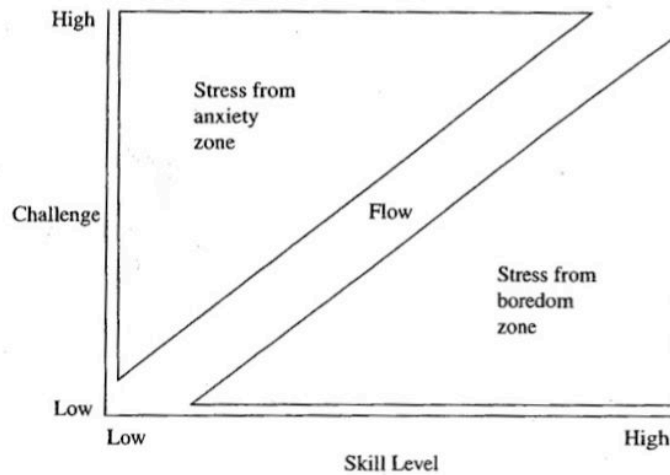


Figure 2.6 Csikszentmihalyi's (1975) model to describe the theory of 'Flow'. Reproduced from Zaichkowsky and Baltzell (2001).

This model indicates that the state of Flow is not dependant on level of challenge (threat) or skill level independently but is relative to them both concurrently. Notably, the state of Flow can be achieved at all levels of challenge (threat) and skill, provided that they are in equal proportion. The state of Flow is not only associated with optimal arousal and performance but also with pleasant feelings and exhilaration (Zaichkowsky & Baltzell, 2001). These more recent uses of Flow theory suggest a possible connection between Flow and strength of, or development of, self-efficacy beliefs.

In his IZOF theory Hanin (2000) posits that an individual will perform optimally when their anxiety lies within a narrow band, and that if anxiety lays either side of this band it will be to the detriment of peak performance. He found that there was a great deal of inter-person variation in the IZOF theory and also that athletes tend to have their optimal zone at either high or low levels of anxiety and not at moderate levels (Raglin, 1992). This suggests that any technique to alter the anxiety state into the optimal zone must be undertaken on an individual basis. The IZOF theory has been challenged as it was based on a unitary concept

of anxiety that has now been largely discounted. A second criticism is that the theory is based on individual differences but is determined without using individual difference variables (Woodman & Hardy, 2001). However, there does appear to be validity in the concept of individual zones of optimum function. This theory suggests that interventions to bring about this optimum zone must be undertaken on an individual basis. Self-regulation could potentially be a powerful tool to enable the individual to tailor the strategy necessary to bring about this state based on their individual needs. Given Hanin's (2000) proposal that each person has an individual zone of optimum functioning (IZOF), it would not be unreasonable to deduce that individuals also have a zone of optimum learning, with self-efficacy serving the core mediation function in this learning. It is therefore necessary to provide for self-regulatory techniques in order to produce an optimum teaching and learning environment for each individual.

Reversal theory, first developed by Apter (1982) and later adapted to sports psychology by Kerr (1993), gives another dimension to the arousal and emotion relationship. In Apter's (1982) model (Fig. 2.7), emotion comprises of pairs of opposite meta-motivational states that the individual can switch between at any moment. Apter referred to such changes as reversals, hence the theory's name. Apter proposed in this theory that arousal can be perceived as pleasant one moment and unpleasant the next without a change in arousal level.

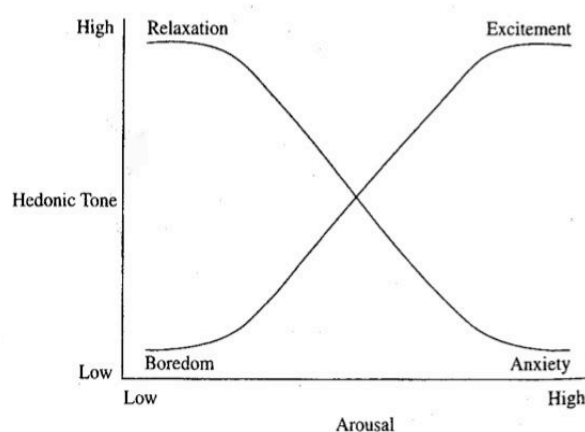


Figure 2.7. Apter's (1982) Reversal theory. Reproduced from Zaichkowsky and Baltzell (2001).

In Kerr's (1993) adaptation of the reversal model, the telic–para-telic pairing represents the individual's somatic arousal and this is used to describe the intensity of emotional. This theory suggests that when an individual has low arousal and is in a telic (non-evaluative) state they will experience relaxation, but in a para-telic (evaluative) state they will experience boredom, similarly in a high arousal and telic state they will experience excitement but switch to anxiety if they are in the para-telic state. The theory suggests that in states of high somatic (somatic arousal) and cognitive anxiety the perception will be of anxiety and a below peak performance is likely and that in states of high somatic and low cognitive anxiety, the perception will be of excitement and enhanced performance is likely. Kerr (1993) recommends that the intervention most likely to enhance performance would be to help athletes interpret their perceptions so that cognitive anxiety is minimized and high arousal is viewed as excitement.

The physiological response to stressors

The physiological arousal response to stressing stimuli are diverse and include: change from theta to beta waves in the brain, increase in muscle tension, increase in heart rate, increase in respiration rate, increase in blood pressure, decrease in skin resistance, increase in adrenaline and noradrenaline and increase in cortisol (Zaichkowsky & Baltzell, 2001).

The works of Malmo (1959) and Duffy (1962) added greatly to our understanding of the brain and the autonomic nervous system's role in the physiological changes that accompany exposure to stressing stimuli. Activation of the sympathetic division of the autonomic nervous system generally causes changes associated with increased physiological arousal including increased heart rate, increased respiration rate etc.

However, the autonomic nervous system activating the sympathetic-adrenomedullary (SAM) pathway does not account for all physiological arousal responses. It is thought that these responses are largely controlled by two pathways, the SAM pathway and the hypothalamus-pituitary-adrenocortical (HPAC) pathway (O'Leary & Brown, 1995). Salivary cortisol has been used as a

marker of HPAC activity and recently a technique utilising salivary alpha-amylase has been developed as a marker of sympathetic nervous system activation (El-Sheikh, Erath, Buckhalt, Granger, & Mise, 2008).

Fig. 2.8 shows a simplified model of the two pathways. LeDoux (1993) suggests that stressing stimuli are received by the reticular activating system (RAS), which then interacts with the hypothalamus. The hypothalamus then innervates response along the SAM and HPAC pathways.

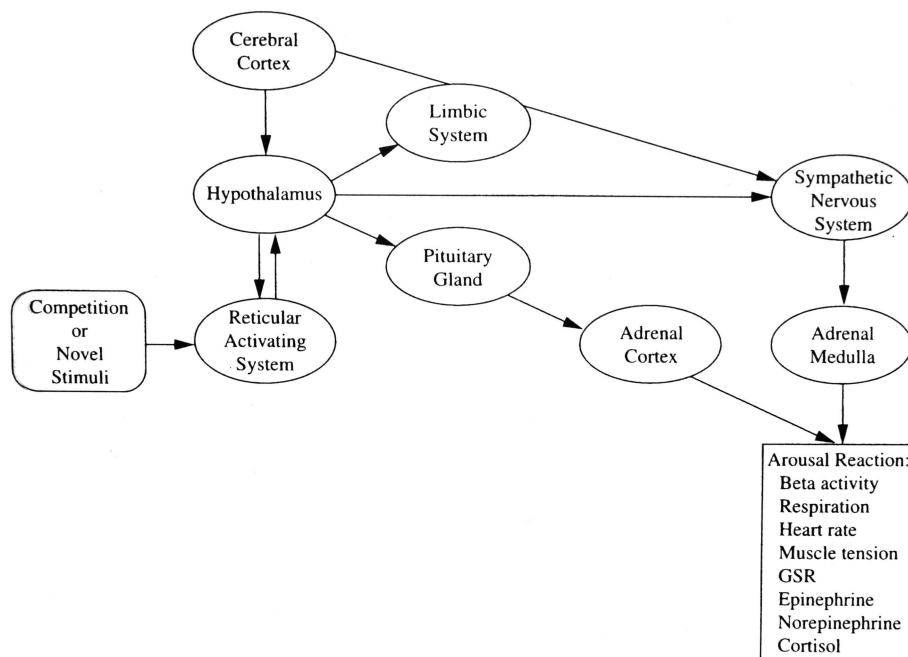


Figure 2.8. Conceptual model of the structures and nervous system pathways involved in the arousal response to stressing stimuli. Reproduced from Zaichkowsky & Baltzell (2001).

The HPAC pathway creates its own self-limiting negative feedback loop. The hypothalamus area of the brain activates the HPAC pathway or axis, the hypothalamus synthesizes corticotropin releasing hormone (CRH (sometimes referred to in the literature as CRF)) which stimulates the pituitary gland to release adrenocorticotropin hormone (ACTH) which acts on the cortex of the adrenal gland, thus releasing cortisol. Elevated levels of cortisol in general circulation act upon the hypothalamus, effectively shutting off synthesis of CRH and also act upon the pituitary gland mediating the release of ACTH, therefore self-limiting the release of cortisol from the adrenal cortex (Miller & O'Callaghan,

2002). However CRH does not only act upon the pituitary gland, receptors for this hormone are found in other areas of the brain, skin, heart and gastrointestinal tract, which suggests a multi-faceted role for CRH in the response to stress. Artificially changing the CRH levels has been associated with changes in attention, mood and pain perception (Fehm & Born, 1987; Hargreaves, Mueller, Dubner, Goldstein, & Dionne, 1987; Kern, Schiefer, Schwartzburg, Stange, Born, & Fem, 1997). Whilst CRH has been associated with wider physiological responses to stressing stimuli and is also affected by non-HAPC axis arousal responses. The presence of CRH receptors in particular parts of the brain (hippocampus, amygdala and cortex) suggest that it may have a more diverse function in modulating factors associated with, but separate from, physiological arousal including anxiety, learning and memory (Miller & O'Callaghan, 2002).

Measurement of arousal and anxiety

The degree of arousal can be indicated through direct and indirect measurement of the physiological changes, cognitive changes and behavioural changes that occur in the response to stressing stimuli. Direct measures include heart rate, electroencephalogram (EEG), electromyogram (EMG), galvanic skin resistance, blood pressure, catecholamine levels in blood and corticosteroid levels in blood, urine or saliva. However the somatic arousal response and the emotion of anxiety cannot be measured directly and the indirect measurement of these factors has been a fertile area of research in the psychology, sports psychology and sports performance disciplines (e.g. Hardy & Hutchinson, 2007; Jansson-Frojmark & MacDonald, 2009; Main, 1983; Martens et al., 1990; Pijpers, et al., 2003; Schwartz, Davidson, & Goleman, 1978).

In order to establish the perceived level of arousal and emotional response, interviews or self-report questionnaires are generally used. Three commonly used scales include the State-Trait Anxiety Inventory (STAI) (Spielburger, Gorsuch, & Lushene, 1970), the Somatic Perception Questionnaire (Landy & Stern, 1971) and the Sport Competition Anxiety Test (Martens, 1977). However, with the more recent approaches to the multi-dimensional construct of anxiety,

further instruments have been formulated that take this into account. The Cognitive-Somatic Anxiety Questionnaire (Schwartz, Davidson, & Goleman, 1978) was the first to address the concept of discrete cognitive and somatic aspects of anxiety, and perhaps the most used tool in sports psychology, the Competitive State Anxiety Inventory-2 (CSAI-2) developed by Martens et al., (1990), has cognitive anxiety, somatic anxiety and self-confidence subscales. These scales assess somatic anxiety with questions referring to physiological arousal, for example: How tense are the muscles in your body? Cognitive anxiety is assessed with questions such as: Do you worry a lot? (Zaichkowsky & Baltzell, 2001). Assessing arousal in this manner creates bias as arousal can be perceived as having positive and negative effects and assessing arousal based solely on somatic anxiety makes reference only to the negative effects (Raedeke & Stein, 1994). It is therefore necessary for future instruments to not only assess the somatic arousal state but also to take into account the positive or negative perceptions (i.e. direction) of that state of arousal.

Several instruments have been developed to address the somatic arousal response as opposed to the perceived anxiety response, for example, the somatic perception questionnaire (Landy & Stern, 1971), the body awareness scale (Stegner, Tobar, & Kane, 1999), the sport grid-revised (Ward & Cox, 2004), and the modified somatic perception questionnaire (Jansson-Frojmark & MacDonald, 2009; Main, 1983). However, the body awareness scale remains unpublished and the modified somatic perception questionnaire is incompletely validated. Nonetheless, data from these instruments does add strength to the theory that somatic anxiety and somatic arousal are independent constructs (Ward & Cox, 2004) with perhaps the sport grid-revised, with its independent arousal and anxiety axes, showing the most functionality for future research. These findings add to the weight of recent evidence and opinion that making inferences regarding somatic arousal from somatic anxiety inventories and questionnaires is not appropriate.

Of the available and validated measures of anxiety the CSAI-2 (Martens et al., 1990) is reported to take up to 10 minutes to complete when the parameter it measures is in a constant state of flux, and is arguably not measuring anxiety at

all. At the other end of the scale, the Anxiety Thermometer (Houtman & Bakker, 1989; Pijpers et al., 2003) is very quick to complete, but is simplistic and lacks any detail of the nature of the anxiety state reported.

How arousal and anxiety affects performance and learning

Although the models illustrated earlier describe potential relationships between arousal, anxiety and motor learning or performance, they do not explain the mechanism by which arousal and anxiety affects motor learning and subsequent performance. Positive mood and positive affect, it is suggested, lead to better activation of human memory (Bauml & Kuhbandner, 2009). This therefore could have an effect on both short and long-term memories as well as learning (Moore & Oaksford, 2002), while anxiety and negative affect have been found to reduce learning and lessen cognitive processing ability (Khan & Zafar, 2010). There are several theories that help to explain how arousal and anxiety affect performance and motor learning. Of these theories, four are particularly relevant to this study. These theories include, the information processing model (Humphreys & Revelle, 1984), selective attention (Braunstein-Bercovitz, 2003), the processing efficiency theory (Eysenck & Calvo, 1992) and the conscious processing hypothesis (Masters, 1992).

Humphreys and Revelle's (1984) information processing model is complex and predicts information processing performance as a function of the combined effects of personality, situational moderators (stressors) and motivational states. In this model cognitive performance is predicted for two types of tasks, sustained information transfer tasks and short-term memory tasks. Sustained information transfer tasks are characterised by tasks that require the individual to react to fast changing circumstances where the reactions are not required to be retained in memory. Short-term memory tasks are characterised by planned actions that require information to be available immediately or stored for short periods. The model predicts that performance in sustained information transfer tasks varies directly with arousal; the greater the level of arousal the better the performance. Whereas, short-term memory tasks are predicted to have an inverse relationship with arousal, greater arousal leads to inferior performance.

In this model increased arousal does not necessarily lead to poor performance; it is dependant on the nature of the task.

Selective attention theory (Braunstein-Bercovitz, 2003) suggests that normally attention is devoted to both relevant and irrelevant stimuli, however as the capacity to attend (Gopher, 1992) to this information stream is exceeded the ability to selectively attend to only the relevant stimuli and to ignore irrelevant stimuli leads to superior performance. If both irrelevant and relevant cues are attended to, it is likely that some relevant cues will remain overlooked and this non-attendance to important relevant stimuli will lead to inferior performance. This theory suggests that under conditions of high stress, the selection of relevant cues is impaired and there are greater errors in the selections made (Baumeister & Heatherton, 1996; Braunstein-Bercovitz, 2003).

The processing efficiency theory (Eysenck & Calvo, 1992) posits that worry (anxiety) affects performance through two mechanisms. Firstly, worry engages resources of memory and processing capacity thereby reducing the available resources to attend to the task at hand. Secondly, worry identifies the importance of the task to the performer and it is hypothesised that through increased effort the processing resources that are held in reserve can be requisitioned. Therefore, according to this theory, an anxious performer can maintain their level of performance under duress but at the detriment of their performance efficiency (Hardy & Hutchinson, 2007).

The conscious processing hypothesis suggests that as state anxiety increases skill becomes less automated and more consciously controlled. In this state of conscious control, the performance is seen as a regression to a lower level of skill or to an earlier stage of learning (Pijpers et al., 2003). These performances are characterised by slow, irregular, jerky and inconsistent movements that require much effort to complete (Magill, 1998; Whiting, Bijard, & Den Brinker, 1987). This hypothesis has been supported by the works of Hardy, Mullen and Jones (1996) and, Mullen and Hardy (2000).

Anxiety, arousal and self-efficacy

Bandura (1977) suggested that one of the four antecedents of self-efficacy beliefs was physiological state (physiological arousal) and further work by Schunk (1995) added emotional state, of which anxiety is one form. It can be reasoned that arousal and anxiety have an important role in the formation of self-efficacy beliefs. However, self-efficacy also plays a moderating role in the physiological arousal response (O'Leary & Brown, 1995). A similar feedback loop has been suggested (Williams, 1995) for the relationship between emotion (anxiety) and self-efficacy, but that this relationship is an asymmetrical one. In this relationship, self-efficacy exercises a greater influence on emotion than emotion does on self-efficacy.

There is some evidence to suggest that emotion perception is non-automatic and is reduced in situations that demand high levels of attention on other tasks. This is thought to be caused by a limited capacity in central processing ability and is thought to result in emotional responses not being processed when attention is demanded by other stimuli in situations where there is a high attentive demand on available processing capability. (Tomasik, Ruthruff, Allen, & Lieu, 2009)

Some authors, including Lazarus (1991) have suggested that physiological arousal and self-efficacy are independent constructs. In this theory the stress response (physiological arousal) is invoked by a primary appraisal where the individual assesses what is at stake and what they have to lose. This is followed by a secondary appraisal, where the individual assesses the resources that they have to cope with the demands of the stressor. Self-efficacy judgements are a form of secondary appraisal (O'Leary & Brown, 1995).

Levels of physiological arousal, as indicated by heart rate and blood pressure, have been shown in the laboratory to vary as a function of the strength of self-efficacy beliefs (Bandura, Reese, & Adams, 1982). Participants with high self-efficacy beliefs showed little change in heart rate or blood pressure. Moderate strength of self-efficacy resulted in the largest change in heart rate and blood pressure. Whereas participants with low self-efficacy had smaller changes in

heart rate although blood pressure remained high. The small changes for participants with low efficacy for the task has been explained (O'Leary & Brown, 1995) by the fact that participants with low self-efficacy for the task had no intention of attempting it, and therefore the task was irrelevant to them and as such did not cause a physiological response. In a later study (Bandura, Taylor, Williams, Mefford, & Barchas, 1985) the catecholamine response to varying self-efficacy conditions was found to have a similar pattern, with moderate levels of self-efficacy having the greatest response. However, the association between self-efficacy and the HPAC pathway appears to differ. The strengthening of self-efficacy beliefs would seem to have a negative relationship with salivary cortisol concentrations and it is speculated that rapid increases in self-efficacy are associated with activation of the SAM pathway, whereas slower strengthening activates the HPAC pathway (Wiedenfeld, O'Leary, Bandura, Brown, Levine, & Raska, 1990).

The invoked fear (anxiety) response has less to do with actual invoked fearful thoughts and more to do with the ability to turn them off, transform them or simply dismiss them (Kent & Gibbons, 1987). This line of research has influenced the expansion of Bandura's (1977) original concept of self-efficacy as the ability to perform coping tasks to include the self-efficacy for controlling scary trains of thought (Bandura, 1988), as thought control inefficacy leads to exacerbated feelings of anxiety. This suggests a strong link not only with physiological arousal markers but with cognitive anxiety also.

Self-efficacy has been shown to have a close association with arousal and anxiety responses and through self-efficacy augmentation strategies, it has been shown to have an attenuating effect on the physiological arousal response and anxiety (Williams, 1995). This may be in part due to individuals with strong self-efficacy beliefs appraising stressful situations as challenges or as excitement rather than fear (Bandura, 1997; Jerusalem & Schwarzer, 1992; Luszczynska, et al., 2005)

2.7 SUMMARY

It is clear that the study of anxiety and arousal is far from complete, but in order to make progress, the individual constructs of arousal and anxiety must be independently assessed before they can be reconstructed into meaningful groupings absent of the assumptions and mis-interpretations with which the literature would appear to be rife. The following terms and definitions will be used within the present study.

Cognitive arousal: The degree of activation of the cerebral cortex typified by increases in beta waves and increased information processing capacity.

Cognitive anxiety: The negative thoughts (worry) regarding an inability to summon the necessary resources to cope with a threat to the status quo or homeostasis.

Physiological arousal: The degree of activation of neural pathways and organs in response to actual or perceived demand placed upon the body, and is characterised by such responses as release of catecholamines, corticosteroids and increases in heart rate.

Somatic arousal: The felt perception of the state of arousal, characterised by perceptions of heart rate, sweating and gastrointestinal changes.

Somatic anxiety: The negative bodily feelings associated with anxiety. These may be the same sensations that characterise somatic arousal but it is the negative interpretation of them that distinguishes them.

It would appear from the literature evidence that certain anxiety responses are more or less hard wired, involving sub-cortical primitive brain structures (Barlow, 2002), for example the startle response, but that the full emotional response is based on at least some form of cognitive processing of heightened arousal responses and perceptions of a lack of resources that are thought to be required to control or manage the demands of a stressor (self-efficacy). The result of this appraisal is then perceived as positive or negative affect. It would appear that by modification of the arousal response, self-efficacy (control) or the

attribution of affect, that the anxiety response may be attenuated or changed from negative affect to positive affect.

The body's reaction to stressing stimuli, the release of hormones, and reaction of the sympathetic nervous system seem to be focussed on the fight or flight response (Cannon, 1929), a situation where historically learning was not a high priority; attack, escape and evasion were the main focus. However, today's teaching and learning environments, particularly in outdoor education, may evoke similar physiological responses and therefore must be dealt with in an appropriate way. Cognitive state affects the ability to think, learn and process information, so this would suggest that learning would be impaired under conditions where cognitive state is heightened beyond specific limits. Likewise, somatic arousal (one's perception of state of arousal/anxiety) must influence self-efficacy. These three factors (cognitive, physiological, and somatic arousal) are probably linked in their feedback loops and partly or fully dependant upon each other.

Arousal should have a strong influence on a person's self-efficacy beliefs, as the arousal/physiological state, according to Bandura (1977), is a major variable by which self-efficacy beliefs are formed. If a raised arousal or anxiety state affects the individual's ability to perform then the most important feedback of performance accomplishment will be adversely affected leading to weakened self-efficacy beliefs being formed. Stress reactions occur after 'primary appraisal' (Lazarus, 1991) where the person focuses on what is at stake and what they have to lose, whereas self-efficacy judgements are related to the 'secondary appraisal' (O'Leary & Brown, 1995) where the person assesses the resources they have to deal with the stressor. Arguably self-efficacy, arousal, anxiety and learning are all interrelated and indeed partly or wholly dependent on each other. Therefore in order to improve learning all factors must be addressed and the tools of misattribution and attributional re-training could potentially make the necessary changes in these factors to improve learning.

Outdoor pursuit related literature

There is a general lack of available literature regarding arousal, anxiety and learning in outdoor pursuits and of those that are available many utilise un-natural settings (Pijpers et al., 2003; Hardy & Hutchinson, 2007) for the research. Ewert (1989) and Priest and Gass (1995) give good accounts of self-efficacy theory, attribution theory and competence effectance theory as related to outdoor recreation and leadership, but unfortunately neither give empirical evidence to substantiate these theoretical perspectives. However, Ewert (1986) provides empirical evidence regarding fear and outdoor activities. It is interesting to note that in this research high scoring factors such as, unable to control environment, surprise, physically entrapped, making wrong decisions and letting myself down are all factors that could be present in white water kayak training. He proposes that fear and arousal or fear and learning behave in a quadratic relationship taking up the classic inverted U model (Fig. 2.4). White water kayaking features in very few studies in this general area, Jones, Hollenhorst, Perna and Selin (2000) studied the theory of flow (Csikszentmihalyi, 1988) in a natural white water setting and Ewert (1988) studied state-trait anxiety for a range of pursuits including white water kayaking. Stress, emotion and performance in competitive white water kayak slalom were studied by Males and Kerr (1996), but only used questionnaire type data collection instruments. Priest and Bunting (1993) researched changes in perceived risk and competence during whitewater canoeing, a related but different pursuit. Kayakers are enclosed in their craft with a spray deck and therefore have to contend with the attendant complication of potentially being trapped in a capsized kayak; canoeists are in open craft and face no such complication. Bunting et al., (2000) reported on the physiological response of the neuroendocrine system during outdoor adventure tasks and Dickinson (1992) reported on the arousal response to white water rafting (again an allied pursuit without the fear of being trapped under a capsized raft), but only measured self-report arousal and stress.

The literature regarding anxiety and arousal is either incomplete in its scope or has been undertaken in un-natural settings and sometimes by un-natural means

e.g. adrenaline injections. Barlow (2002) suggests that the full emotional response must be fully accessed (invoked) for therapeutic change to occur. It would follow that natural arousal and anxiety responses in suitable high stressing environments be used not only for study of these phenomena but also for modification to enable optimum function.

Learning in outdoor pursuit courses has been studied (Jostad, Paisley, & Gookin, 2012; Paisley, Furman, Sibthorp, & Gookin, 2008), with the main findings being that students learn most by actually experiencing the activity. This being the central tenet of experiential approaches to education. They also found that both instructors and students were influential in the degree of retention of outdoor skills, indicating a partnership approach has best effect. However, both these studies used questionnaire type end of course surveys for data collection and therefore the results may be somewhat subjective.

The literature is therefore specifically lacking in both white water kayaking and in outdoor pursuit leader training. Therefore, little is known of the full arousal response to white water kayak training as it has only been partly studied to date and attributional re-training techniques to optimise arousal, affect and self-efficacy to augment learning in natural outdoor settings for outdoor leader training has yet to be undertaken.

This literature review has resulted in the formulation of six research questions:

1. What level of arousal do students have while participating in white water kayak training courses?
2. What are the relationships between self-efficacy beliefs and arousal (physiological, cortical and somatic) in white water kayaking?
3. What is the relationship between self-efficacy beliefs and the learning of kayak skills?
4. What are the relationships between arousal (physiological, cortical and somatic), emotion and the learning of kayaking skills?
5. What are the relationships between attributional re-training, the change in participants' kayaking skills (learning) and their self-efficacy beliefs?

6. What are the relationships between attributional re-training and arousal (physiological, cortical and somatic)?

CHAPTER 3.

GENERAL METHODS

3.1 INTRODUCTION

To construct a holistic appreciation of the arousal response, emotional reactions, strength of self-efficacy beliefs, the relationships that exist between them as well as the effects of an attributional re-training intervention, in a white water kayak-training environment, a mixed methods approach was used. This research collected an array of quantitative data as well as qualitative data. The elements of qualitative data (self-efficacy, somatic arousal) and quantitative data (skill, heart rate, critical flicker-fusion threshold, salivary cortisol concentration, self-efficacy and somatic arousal) were blended together to not only give the researcher a fuller picture of causation and relationships, but also to allow the effects of an intervention on the learner to be examined more closely.

3.2. RESEARCH DESIGN

The design of the main study is based on a concurrent nested design (Creswell, Plano Clark, Gutman, & Hanson, 2004). In this design qualitative and quantitative data are collected simultaneously, the quantitative approach forms the predominant method for the study with the qualitative data embedded or nested within it. The two types of data are mixed at the analysis stage with the qualitative data providing support for the quantitative data. This method allows the interaction of quantitative and qualitative elements to be studied. The nested qualitative data gives the researcher a richer description of what is experienced by the participant in the white water environment. This design also allows differing data types to be collected during one data collection period, this being vital for this present study where transient physiological and psychological factors are present.

This research is essentially exploratory action research (Cherry, 2002) with this research forming one cycle (albeit a rather large and in depth cycle) in the on going process of the development of the researcher as a teacher of white water kayaking. In order to gain a holistic view of what is principally a tripartite interaction between teacher, learner and the environment, traditional research paradigm boundaries must be straddled. Certainly the measurement of the participants physiological arousal responses can fall under an epistemological perspective with an objective point of view, and ontological perspective of naïve realism (external reality that can be comprehended (Teddlie & Tashakkori, 2009)) and the axiology of value free inquiry, suggesting a Postitivist paradigm would be suitable. However, this research is also based around psychological participant perspectives including self-efficacy, somatic arousal and emotion. These variables are not fixed but transient and subjective. They fit better into a research paradigm where the epistemology allows for a subjective point of view, with the ontological relativism of constructed (by the participant) realities in an axiological value bound inquiry. These factors sit squarely in the traditional Constructivist paradigm. This research therefore does not sit in a traditional Positivism/Constructivism paradigm, but must instead subscribe to the more modern emancipatory research paradigm of Post positivism. This paradigm allows for quantitative and qualitative data to be included but the major influence is quantitative with qualitative data filling a supporting role. It allows for a modified dualism epistemology, a critical realism ontology and the controlled influence of values (Teddlie & Tashkkori, 2009).

This research was carried out as a field experiment in a natural white water setting. It used a double blind protocol: the participants were unaware of whether they were in an intervention or in a normal instruction group, and the research assistants who collected the data were unaware of which group the participants were in. This research utilised a pretest-posttest protocol and more specifically a two group control group design (Shuttleworth, 2009), whereby two groups are assigned, by random selection, into an intervention group and control (normal instruction) group. Both groups undertook a pretest, one group received the intervention followed by both groups undertaking a posttest. This design has

strong internal validity, as comparison of the pretest results between groups allows the equivalency of the two groups to be ascertained. The random selection of participants into each group from the cohort of students also reduces selection bias, further improving validity. The common criticism of this design, that of reduced external validity, through lack of capability to ascertain the influence of the pretest on both groups compared to a sample who did not receive the pretest, can be somewhat discounted as the pretest is part of the normal activities that would have been undertaken in any event for this population. However, the issue of being unable to separate the two groups from each other during non-teaching periods remains, and so some degree of social interaction and possibly the comparing of experiences could have occurred. To have used separate cohorts for the intervention and normal instruction, whilst possible to ensure no contact between groups, could have led to reduced validity and possible selection bias. The design of the study was centred on six primary research questions as detailed in the last section of Chapter 2.

3.3 RESEARCH CONSTRAINTS

The constraints on this research were imposed by the logistical and safety requirements of the organisation to which the participants were affiliated, by the local ethics committee and by the natural environment in which this field-based study was undertaken.

AUT University could supply a cohort of twenty to twenty-four participants per year (no other university within New Zealand offers white water kayak instructor training), which meant that a minimum of two years would be necessary for the data collection for the desired participant numbers of between 40 and 50 (this number derived from power calculations for the questionnaires used, www.researchinfo.com). The organisation's (AUT University) health and safety requirements dictated that each cohort had to be split into teaching groups of between six and eight participants, thus requiring three teaching groups. To reduce the interaction between participants receiving the intervention and those who were not (to increase validity), the whole of each

teaching group was required to receive the same teaching mode and therefore it was not possible to have even numbers of intervention and normal instruction participants in each cohort.

The local ethics committee imposed several requirements (Appendix C), notably independent third parties were required to collect the data and that the participants would only be involved in activities that they would normally be involved with in their usual training programme. The first requirement meant that assistants had to be trained by the researcher to undertake the data collection, which meant that these collection methods had to be simple to administer and unequivocal in nature. The second requirement meant that the data collection methods had to fit around the normal training activities and not restrict the participants' learning and assessment. This restriction had the effect of limiting the time and places where data could be collected to normal breaks in the training programme and that the techniques used had to be able to be completed in a short timescale so as to not withdraw the participants for lengthy periods from the normal teaching day. This restriction also meant that the pre and post skill testing could not be performed at the same venue as the participants would have normally moved to a different and more difficult venue by the time of their post test, as is normal for their programme.

The environmental constraints also meant that data collection would have to take place on the riverbank in a number of predetermined places where there was limited access for equipment and personnel, thus restricting the data collection procedures to those methods or apparatus that were portable and self-contained. Furthermore, the participants would be wet and possibly cold at the time of data collection and also wearing long sleeved thermal and waterproof garments, which would limit the choice of measures available to collect data.

3.4 THE PARTICIPANTS

The participants were students enrolled in the Diploma of Outdoor Recreation Leadership at AUT University. These students were engaged in a fast-track

outdoor leadership and instruction course and undertook white water kayak instructor training as a normal part of their programme. This programme could supply a cohort of male and female students who varied in age between 18-30y, in the spring of each year. The aim was to achieve a total sample size of 40 to 50 participants (governed by several factors including, but not limited to, actual student enrolments and participation rates). Participation was voluntary. Individuals who agreed to participate were required to sign a consent form that outlined the purpose of the study, expectations concerning their involvement, and conditions of participation. Participants were able to withdraw at any time without consequence. Participation or non-participation did not affect the participants' grades or involvement in the course of study for which they were enrolled.

There was likely to be a range of ability, confidence and gender within each cohort and because the intervention would need to be given, or not, to a whole teaching group, it was desirable that each group was as similar as possible. In order to achieve this, the cohort was graded during their previous introductory kayaking day for skill (eddy turns and ferry glides) and confidence (willingness to attempt an Eskimo roll). The participants were then divided into groups of high skill-high confidence, low skill-low confidence and high skill-low confidence (there not being any representation in a low skill-high confidence grouping), for each gender. Clusters for the final teaching groups were then made by selecting participants at random (using the random number generator at www.mathsgoodies.com) from each of the six homogenous sub-groupings. If sub-groupings contained less than three people, the remaining empty places were selected by the random number generator. These homologous clusters were then assigned to receive the attributional re-training intervention, or not, again using a random number generator to ensure the teaching groups were as homologous and membership as randomised as possible and that skill, confidence and gender were distributed as evenly as possible, given the constraints presented by the cohort.

3.5 THE DATA COLLECTION MEASURES

No suitable fully validated questionnaires were found in the literature for collecting somatic arousal data and self-efficacy beliefs, regarding white water kayaking, in the field. Therefore two questionnaires were constructed for use in this study. Both questionnaires were subject to face validation by Professor Colin Gibbs who acted as the researcher's self-efficacy specialist advisor and for kayaking technicalities by two members of the researcher's faculty team with expertise in white water kayaking. Basing the self-efficacy questionnaire around the four antecedents of self-efficacy and the three base skills of white water kayaking ensured content validity. A complete validation of these two specialised questionnaires would have taken an equally large study, in terms of resources and time, as the one conducted with the power calculations suggesting a minimum of forty participants. If this validation process had been undertaken it would have delayed the main data collection by at least 2 years (there being only 25 participants available annually). It is acknowledged that incomplete validation of the questionnaires limits the robustness of the findings but with this exploratory type of research it allows for suggested findings to be sought in a timely manner. As mentioned previously, concurrent validity could not be undertaken as there was not a suitable validated gold standard instrument with which to compare the questionnaires used in this study.

Self-efficacy

To quantify the participants' self-efficacy beliefs, a questionnaire was constructed specifically for white water kayaking (Appendix A). This questionnaire made statements regarding the participant's beliefs of capability in the context of the four antecedents upon which self-efficacy beliefs are made (physiological state, vicarious experience, verbal persuasion and performance accomplishment) for each of the three base skills that the participants were learning (staying upright and rolling, eddy turns and ferry glides) An example of such a statement is: *When I think of my past **successes** when doing **ferry glides** I believe I am...* The participants were asked to complete each statement by selecting a final phrase from the following five options: *totally capable, more*

capable than not capable, neither not capable nor capable, more not capable than capable and not capable at all, to give a five-point Likert type scale. This questionnaire was designed to enable an overall score for strength of self-efficacy for white water kayaking to be established and also to record the relative importance of the antecedents and skills to influence self-efficacy beliefs. The final three statements followed the same pattern as the previous statements but asked the participants to consider their capability as the subject in the three base skills. These were designed to not only give an overall measure of general self-efficacy for white water kayaking, but also to allow the participants some scope (through an additional open ended question) to express qualitatively their self-efficacy beliefs and provide data not captured by the other measures taken.

The structure of the self-efficacy questionnaire was organised at two levels. Firstly, the questions are organised into groups of three, for example questions 1a, 1b and 1c all refer to controlling cortical arousal (parameter) and differ by giving different skill contexts (context): 1a refers to when doing *eddy turns*, 1b refers to when doing *ferry glides* and 1c refers to when *trying to stay upright in rapids*. Secondly, the questionnaire is further organised so that all parts of question 1 refer to notions of *control*, all parts of question 2 refer to notions of *physiological arousal*, all parts of question 3 refer to notions of *performance accomplishment*, all parts of question 4 refer to notions of *vicarious experience*, all parts of question 5 refer to notions of *verbal persuasion*, as these notions are all central to the development of self-efficacy beliefs. Question 6 is a general question about overall self-efficacy for white water kayaking. Question 7 is a general question about overall self-efficacy for doing eddy turns. Question 8 is a general question about overall self-efficacy for staying upright in rapids.

There is a large ($r = 0.61$) and significant ($p < 0.001$) correlation of the mean values for all questions for each participant between pre and post self-efficacy. This suggests that the participants were consistent with their judgements and also that participants with higher initial self-efficacy generally reported higher self-efficacy in the post questionnaire. This suggests that the initial strength of self-efficacy judgements may have an influence on the subsequent strength of

self-efficacy beliefs. This may also suggest that self-efficacy is a relatively stable construct.

This questionnaire was administered on the first and last day of training, allowing the tracking of changes in self-efficacy beliefs and to enable correlation patterns between self-efficacy, arousal and learning for intervention and non-intervention groups to be investigated.

Somatic arousal

Data regarding somatic arousal (the personal subjective assessment of how physiologically and cortically aroused the participants *feel*) was collected to complement and compare against data collected of actual arousal and emotion. In order to collect somatic arousal data that was workable notwithstanding the constraints outlined above, a questionnaire was written. The actual measure used (Appendix B), took the form of a series of thirteen statements to which the participants marked their feelings on a 7-point Likert type scale anchored at one end with *strongly disagree* (1) and at the other *strongly agree* (7).

The somatic arousal questionnaire was constructed with twelve of the thirteen questions being in pairs, one question referring to a symptom of arousal in one way and its pair referring to the same set of symptoms but from an opposing perspective. For example, one question made the statement *My body feels calm and relaxed* while its pair made the statement *I can feel my body trembling*. Both statements used the same 7-point Likert type scale. This measure was incorporated into the questionnaire to ascertain whether there was any bias in the way the questions were answered. The average of the two answers (one positive and one negative) should equal 4 (the mid point on the 7-point Likert scale) if both answers truly reflect the same somatic feelings of the participant. The overall mean of the twelve questions for all participants was 3.96. This would suggest that the participants answered the somatic arousal questionnaire with little detectable bias and that it is a suitable tool for collecting and recording participants' feelings regarding their arousal. After this analysis was undertaken, the answers to questions 1, 2, 5, 7, 8 and 12 of the questionnaire were

transposed to make the answers to all questions read that a score of 1 is associated with perceptions of low somatic arousal (calm/relaxed) and a score of 7 is associated with perceptions of high arousal (stimulated/anxious). This allowed the calculation of an overall mean somatic arousal score that was used in correlations.

Of the somatic arousal questionnaire's thirteen questions, four questions ask the participant about mental arousal symptoms (3, 5, 7, 10) and nine questions (1, 2, 4, 6, 8, 9, 11, 12, 13) ask the participant about physical arousal symptoms. The correlation between mental and physical elements of the questionnaire was large ($r = 0.62$) and significant ($p = 0.00018$). A Mantel test was conducted to ascertain the relative closeness of correlation both within and between the mental and physical parameters. This test compares the actual correlation between variables with a predicted difference on a matrix. This test returns $r = 0.47$, $p = 0.0013$, further suggesting that the correlations within each parameter are relatively large while the correlations between the parameters are relatively small. This would therefore suggest that the questions asked for each parameter are being responded to in a similar way but in a different way between the two parameters. This correlation would further infer that all the questions are asking the participant about a similar theme and if at least one question is correctly asking the participant about somatic arousal then due to their relatively close correlation they all are likely to be.

In addition there was an open question at the end of the questionnaire that asked the participant to: *Please describe the sensations you experience and why you think this is, and its effect on you.* This question was designed to elicit data regarding the direction of participants' arousal (positive or negative) and their attributions without the bias of potentially leading questions or statements. The mean quantitative scores from questions 1-13 and the qualitative statements appear to align. For example, participants who had mean quantitative scores exceeding 5 on the Likert scale expressing statements including 'scared', 'sick in the stomach' or 'very nervous', whereas participants with mean scores of less than 2 expressed comments including 'I feel calm', 'normal' or 'just excited'. This

gives some indication of a similarity in the quantitative and qualitative data from this tool, suggesting that they do indeed assess the same parameter, which strengthens the validity assumptions.

The somatic arousal questionnaire was administered at the accommodation at the start of day two of training (rest lodge). It would have been ideal to temporally align the somatic arousal data with the other measures collected through the training day, but unfortunately it was not practical to do so.

Direct measures of physiological arousal

Known physiological responses to stressful events include increased heart rate, release of the hormones adrenaline, noradrenaline and cortisol, increased beta waves in the brain, increased blood pressure, increased respiratory rate, increased muscle tension and increased skin conductivity (Zaichkowsky & Baltzell, 2001). The physiological arousal responses are largely controlled by two pathways: the hypothalamus-pituitary-adrenocortical pathway (HPAC) and the sympathetic-adrenomedullary pathway (SAM) (O'Leary & Brown, 1995). Measurement of these parameters, or a sample of them from both major pathways, was needed in order to give as full a picture as possible of the response to the stressful events. These measurements needed to be taken in the field as stress responses reverse with time and therefore timely measurements were necessary. Data also had to be collected in the wet and cold environment of the riverbank without notably delaying the teaching and learning process.

To enable an appreciation of the arousal levels during the different phases of the kayak training day data was collected several times. It was desirable to collect a base line level of arousal with the participants not in the kayaking environment, during the preparation to go kayaking, on the water between rapids and after the largest rapid, with a further measurement off the water after a break to assess recovery. To this end the following data collection points were used and the measures taken at each site are outlined in Table 3.1: before leaving the accommodation in the morning (rest lodge), at the training venue before getting on the water (rest riverbank), after the first major rapid (on water one),

immediately after the biggest and last rapid of the section kayaked (on water two) and after an hour long lunch break (rest recovery).

Measures used:

Heart rate

This is a common indicator of physiological arousal and is largely controlled through sympathetic nervous system stimulation and therefore is an indicator of SAM activation. Heart rate can be measured in a non-invasive way through the use of a chest band and wrist-watch style display and monitor as produced by Polar. These chest bands can be placed on the participants at the beginning of the day and left in place until the conclusion of activities, as they do not impede movement and the participants are largely unaware of their presence. The wrist-watch constantly displays the heart rate of the individual and data collection is expeditious. This collection can be carried out on the river without breaking the flow of activities and so was an ideal method.

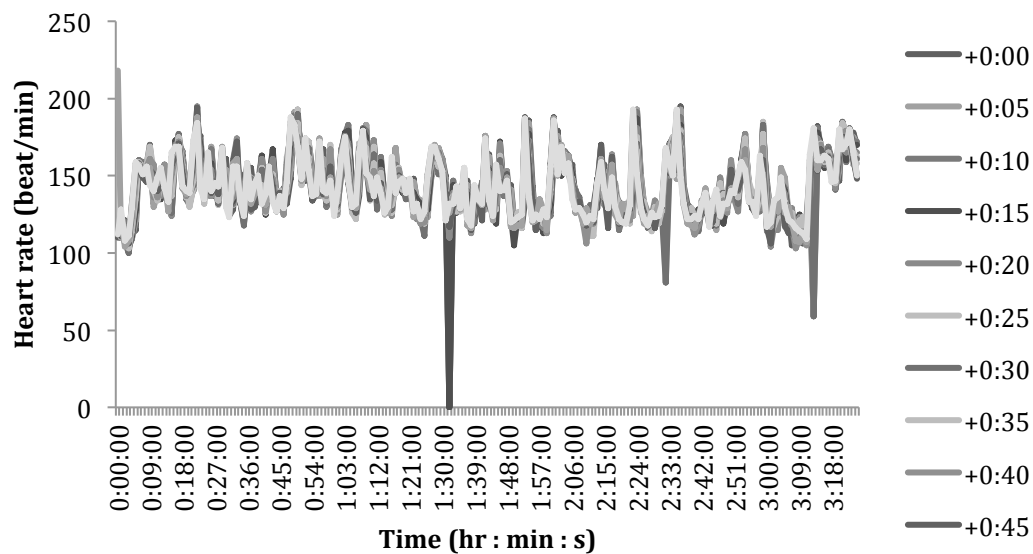


Figure 3.1 Original continuous heart rate recording. Each line represents recordings taken at 5s intervals plotted each min. i.e. all recordings from 10s past each min are plotted on one line while those from 15s past each min are plotted on a separate line.

At each of the five data collection sites used in the main study, the heart rate was measured first, as heart rate values can drop relatively quickly compared to the other measures taken. As each participant reached the data collection site they showed their wrist-watch display to the research assistant who recorded the displayed value alongside their participant number in a note book.

The Polar heart rate monitors proved to be very reliable, performing faultlessly even when the participants capsized in the rapids, exited their kayaks and swam in the turbulent water. The Polar heart rate monitors were found to be used successfully to monitor and record, at 5s intervals, the heart rates of participants while white water kayak training for at least a 4hr duration during the pilot study (Chapt. 4) with few errors in the recorded heart rate. The errors that occurred were of two types, an unusually high heart rate and an unusually low heart rate. The high heart rates can be seen on two participants (218 beat/min, 208 beat/min) recordings (Fig. 3.1, 3.2.) at 5s and 10s, respectively. This error was picked up immediately when the equipment was being checked. Moving the two participants away from each other, to a distance in excess of 2m, resolved this error. This error was attributed to interference between the signals of the heart rate monitors. It can be seen that the recorded heart rates fell to ~50% of their initial value as soon as the two participants were moved apart.

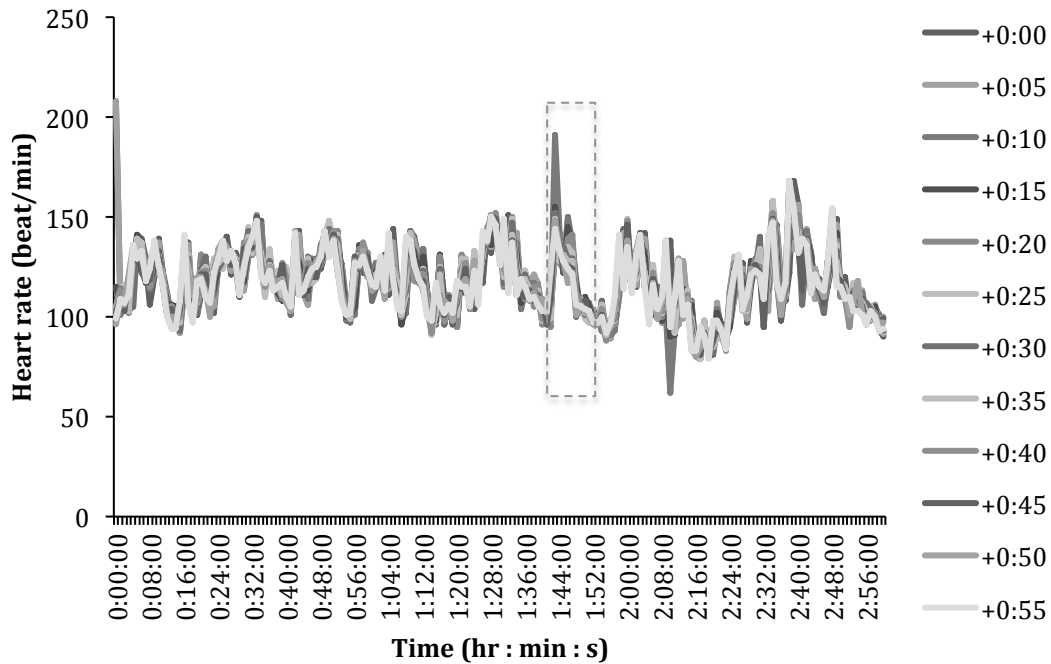


Figure 3.2 Original continuous heart rate recording. Each line represents recordings taken at 5s intervals plotted each min. i.e. all recordings from 10s past each min are plotted on one line while those from 15s past each min are plotted on a separate line. Dotted rectangle represents area of chart shown in Fig.3.4.

The exceedingly low heart rate values seen in Fig. 3.1 at 1:32, 2:32 and 3:13 and in more detail in Fig. 3.3 could be accounted for by a short-term (2-5s) loss of contact between the monitor's chest strap and this participant's skin. These errors were straightforward to identify as they only affected one or two data streams of the twelve into which each minute of recording was separated and were characterised as a sudden and short-lived drop in recorded value with the other data series being unaffected.

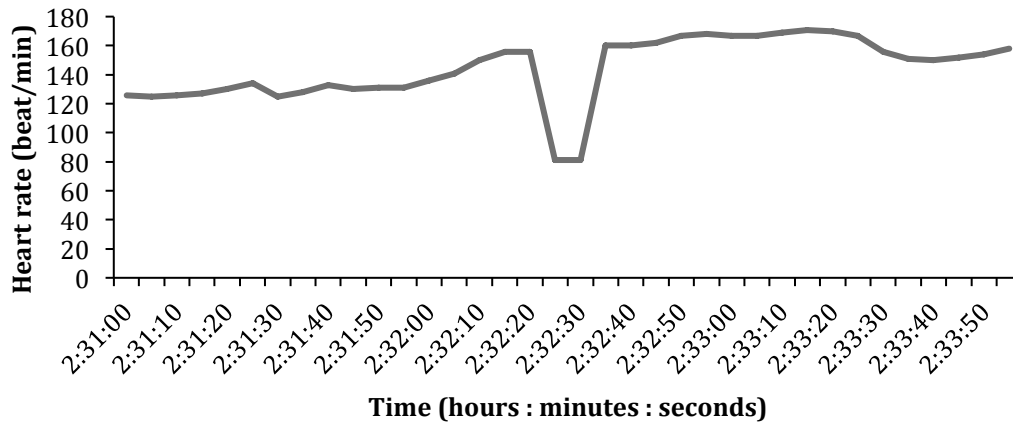


Figure 3.3. Detail from original recording of heart rate between 2hr 31min and 2hr 34min.

This contrasts with the seemingly anomalous heart rate as seen in detail in Fig. 3.4. Although this shows a sudden increase, it can be seen, when viewed in detail, to be a very steep rising limb accompanied by a steep falling limb.

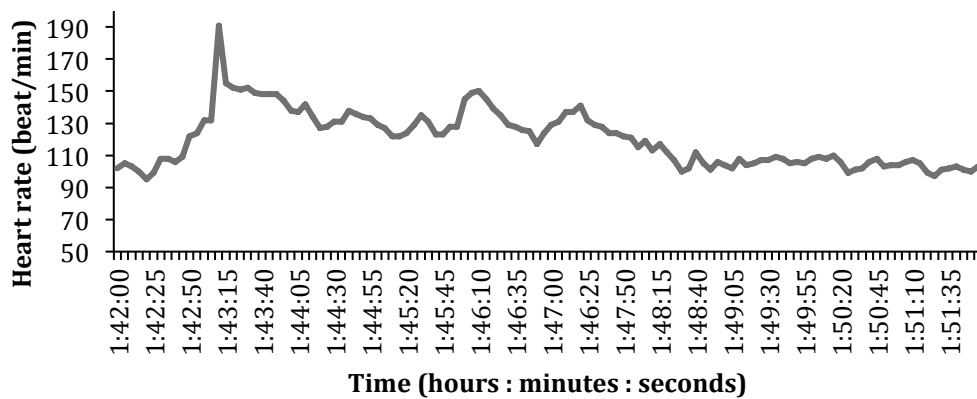


Figure 3.4. Detail from original recording of heart rate between 1hr 42min and 1hr 52min.

It is proposed that Fig. 3.4 shows an actual arousal event (rather than a recording error) due to the timing of the peak and the slow return to normal, coupled with the participants' activity at the time (preparing to and then descending the first large rapid of the day).

Cortisol

The release of cortisol (a corticosteroid hormone) is triggered by activation of an alternate system, the hypothalamus-pituitary-adrenocortical (HPAC) pathway, in the event of increasing physiological arousal. Therefore using heart rate and cortisol as physiological arousal markers gives an indication of the activation of both primary physiological arousal pathways, the SAM and HPAC systems.

Cortisol is released in response to the action or presence of stressors of a physical or psychological nature (Dallman, la Fleur, Pecoraro, Gomez, Houshyar, & Akana, 2004). The primary function of cortisol is to regulate blood glucose in order to meet the body's requirements exerted by the stressor (Martini & Welch, 2001). Cortisol can be measured in the blood or urine but is also able to be measured through samples of saliva. This is because cortisol is lipid soluble and therefore can pass through membranes into all cells and fluids in the body (Lewis, 2006). Saliva sampling for cortisol is a convenient and non-invasive procedure as the only requirement is a 5ml sample of fresh saliva, which can be collected quickly and without the participants getting out of their kayaks. The collection of salivary cortisol also reduces any arousal or anxiety effect associated with conducting venepuncture (Kirschbaum & Hellhammer, 2000). Salivary cortisol concentrations show large correlations with serum concentrations, which suggest that salivary cortisol measurement has high validity and may indeed reflect to a higher degree the bio-available (unbound) cortisol in circulation than can be determined through total serum values (Crewther, Lowe, Ingram & Weatherby, 2010; Gozansky, Lynn, Laudenslayer & Kohrt, 2005), making salivary cortisol concentrations potentially a more suitable measure than serum concentrations in an exercise situation (Stupnicki & Obminski, 1992). Hormones in saliva are relatively stable for hours and days at room temperature (Gröschl, 2008) and, when held at -20°C, for up to 3 months (Levin, 2008). These factors make cortisol an excellent marker for a riverbank measurement of stress hormones.

The following protocol was used for collection and assay of salivary cortisol in this study. Participants at each testing point were given a piece of sugar free

chewing gum (Extra ®, Peppermint, Wrigley's, N.Z.), to stimulate saliva production. They were then asked to swallow the saliva in their mouths, draw a fresh ~5 ml saliva sample and expectorate the sample into a labelled graduated collection tube (LBST1002; Labserve, Auckland, N.Z.). Racked collection tubes were placed into a chilly bin with ice. At the end of the day the samples were frozen at -20°C until the assay was performed.

The samples were assayed in triplicate using a method modified from that described by Granger, Schwartz, Booth & Arentz, (1999) and as used by Beavan, Hopkins, Hansen, Wood, Cronin, & Lowe, (2008) and Crewther et al. (2010). The assay used a standard DSL-2000 Cortisol Radioimmunoassay (RIA) kit manufactured by Diagnostic Systems Laboratories, Texas. This kit contains radioactive labelled cortisol and a separate cortisol antigen. The supplied 51.2ng/ml saliva standard was diluted in an assay buffer made from 0.05% Bovine serum albumin (BSA [ICP-BIO, ABGE-100G, Henderson, Auckland, N.Z.]) in a phosphate buffered saline made up freshly from tablets (P4417-100TAB, Sigma-Aldrich, St. Louis, U.S.A) to provide standards of 0, 0.05, 0.2, 0.8, 3.2, 12.8, and 51.2ng/ml. Using a 5ml pipette tip, 50 µl of standards and unknown samples was added to labelled 5ml test tubes (Labserve, LBS514, East Tamaki, Auckland, N.Z.). Using a 5ml pipette tip, 300 µl of the rabbit anti-cortisol serum from the DSL-2000 Cortisol kit was added to all tubes except the non-specific binding tubes and total count tubes. Into the non-specific binding tubes 350 µl of phosphate buffered saline was then added. All tubes were then vortexed to mix the solutions and then incubated at 4°C overnight.

Into each tube a known quantity (100 µl) of [I-125]-labelled cortisol was added using 5ml pipette tip. The samples are then vortexed again and incubated in a water bath at 37°C for two hours to allow for binding of the labelled and unlabelled cortisol with the anti-cortisol serum. There is competition between the labelled cortisol and the cortisol derived from the sample for a limited number of

antigen binding sites. The amount of radioactive cortisol bound to the antigen is inversely proportional to the concentration of non-labelled cortisol in the sample.

Into each tube, except the total counts, 500 μ l of cold 6% polyethylene glycol solution in deionised water (BDH Prolabo, Geldenaaksebaan, Leuven, Belgium) was added. Polyethylene glycol is added to the sample to aid precipitation of the bound cortisol (labelled and un-labelled) under centrifuge. At the conclusion of the centrifuge process, the bound cortisol and polyethylene glycol form a rubbery layer, or pellet, adhering to the bottom of the tube. All tubes were vortexed and incubated at room temperature for one hour, then cooled with centrifuge bucket liners in ice slurry for at least five minutes until centrifuged. All tubes were then centrifuged except the total counts at 4°C and 3700rpm, for 15min. The unbound free cortisol (labelled and un-labelled) was then poured off by simultaneous inversion over a radioactive waste receptacle and the tubes allowed to drain over paper towels for 30s. Gentle blotting of the tube rims improves data replication but care must be taken not to disturb the layer or pellet of polyethylene glycol. The tubes were then placed in a gamma counter for 60s.

A log-linear curve is then plotted using the known standard's gamma count and the concentration of non-radioactive cortisol (from the unknown collected sample) is calculated from comparison to this curve.

Measures not used

Direct measurement of adrenaline (another stress hormone) is a useful marker but it needs blood samples uncontaminated by water for accuracy of measurement. The taking of finger prick type blood samples with wet and cold white water kayaking participants (who may take a variable time to reach the testing site due to perhaps an unforeseen capsized) was deemed to be unsuitable for a number of reasons: such a measurement would likely delay proceedings, collecting uncontaminated blood from wet, cold fingers would be difficult and

there was a possibility that the finger prick procedure could cause the participants stress.

Arterial blood pressure can also be used as an indicator of physiological arousal. To measure blood pressure a sphygmomanometer must be used on a bare upper arm and the disappearance and appearance of the pulse must be listened for with a stethoscope against the skin of the elbow. This procedure is not practicable for riverbank use as clothes would have to be repeatedly removed and put back on again and data collection would be a lengthy procedure, especially in an outdoor environment with a degree of background noise. For these reasons blood pressure was not deemed to be a suitable measure for this research.

Galvanic skin resistance is another arousal measure and is the basis upon which the popular 'lie detector' works. It works on the presumption that telling an untruth is to some degree stressful and this stress triggers physiological responses causing the skin to become more conductive through vasodilatation leading to higher blood-flow near the skin and sweating. This is usually measured with a skin galvanometer. Again this is a large piece of electrical equipment and its use in stress measurements on the wet participants would very likely lead to a large degree of error in any readings taken. It was therefore not considered to be a useful measuring tool for this research.

Measures of cortical arousal

Cortical arousal is essentially how active the cortex of the brain is. The cortex is where the centres for emotion, thought, memory and learning are located (Miller & O'Callaghan, 2002). Therefore, cortical arousal is another useful parameter to be measured when investigating signs and symptoms of stress as well as learning. The function and arousal level of the cortex have been described by Hardy (1990) in his catastrophe model (Fig. 2.5). Function is predicted to increase with rising arousal to a certain point and then function rapidly diminishes to a low level with increased arousal and only returns when arousal levels have been markedly reduced.

Measures used

Critical flicker-fusion threshold (CFF) is an indirect measure of cortical arousal. CFF involves the visual perception of a flickering light source and is measured in flashes per second (Hz). In an ascending rate of flickers from an observed flickering light source, a point will be reached where the light is discerned to be steady. At this rate the observer cannot distinguish between the flashes and reports that the light source remains on. This is known as the fusion point; a point discerned at a critical rate of flashes, hence the critical flicker fusion threshold. It is also measured where a discerned to be steady light source begins to flicker with a descending rate of flicker. Technically, ascending values give a critical *fusion* frequency and descending values give a critical *flicker* frequency. The smallest difference between the fusion and flicker frequencies will be at least as large as the smallest graduation of adjustment of the apparatus.

Changes in CFF are small and are controlled by the sensitivity and excitability of the retinal cells and neural pathways to the brain. Pulses of light produce robust, transient responses from the amacrine cells whose cell bodies are found in the inner nuclear layer and synapses in the inner plexiform layer of the retina (Bartley, 1959). However, measures of both temporal and spatial summation found in the optic nerve through to the lateral geniculate body show a higher sensitivity than is reported by the observer. Perceived sensitivity to pulses of light appears to be controlled by a balance between the central inhibitory and excitatory states. The CFF point is sensitive to central sympathetic stimulation and reactive to imbalance between parasympathetic and sympathetic nervous systems. Electrical recording at various levels of the visual pathway suggests that the eye responds to higher frequencies than the CFF value obtained and so it is believed that the limiting factor in CFF determination is not the sensitivity of the eye but further into the neural pathways of the brain. It would appear that the ultimate critical point for determination of CFF lies within the cortex of the brain and that the sensitivity of the cortex to retinal impulses is what in fact changes when the CFF point varies (Bartley, 1959). The use of CFF has been cited by Grandjean (1970) as a good indicator of cortical activity of the brain in general. Rammsayer and Netter (1988) refer to CFF as the psycho-physiological measure

of cortical arousal and Parrot (1982) describes CFF as a measure of overall information processing capacity and that there is a direct relationship between mental arousal and fusion threshold. CFF is a measure of the ability to distinguish discrete sensory data and is therefore an indicator of CNS [central nervous system] activity and can be used as a measure of a participant's alertness and arousal (Parkin, Kerr & Hindmarch, 1997).

There are also notable effects seemingly caused by data collection methods. Ginsburg (1967) experimented with the effects of ascending and descending flicker rates and the distance of the flicker source from the focal point or point of gaze. An ascending flicker rate, to the fusion point, gives higher CFF with greater distance from the focal point. While with a descending flicker rate, lower CFF is reported with greater distance from the focal point. It was also found that varying a high starting point (light perceived to be solid) had little or no effect on the CFF value reported, but while ascending from a flickering source the CFF value was depressed. It is postulated that prior exposure to a flickering light source depresses the perceived fusion point; Ginsburg (1967) refers to this as local adaptation. Hosokawa, Mikami and Saito (1997) also found CFF variance with distance of the eye from the source of the flickering light but found that room illumination had no effect.

CFF is reportedly a robust and reliable measure and as no changes occur over time (hour to hour) and between days (Parkin, Kerr, & Hindmarch, 1997; Presland, Dowson & Cairns, 2005). Brozek and Keys (1944) found that there was no learned effect of CFF determination over their 15-day trial and repetition of the measure did not cause changes to the CFF thresholds reported. Parkin et al. (1997) suggest that for CFF, six trials conducted in a 1hr period are adequate to reach a measurement plateau.

The CFF measure is thought to work not by measuring the sensitivity of the eye and its structures, but by measuring the capacity of the cortex of the brain to process these retinal signals (Bartley, 1959), as it has been shown that sensitivity of the retina is greater than the perception of the CFF (Bartley, 1959).

The signals are being made by the structures of the eye and conveyed by the optical nerves but are not being processed by the cortex at a fast enough rate for the flickers to be discerned. The higher the flicker rate, the more acute the cortex has to be in order to register the change from 'light-on' to 'light-off' conditions, as the time interval between on and off signals diminishes. This would suggest that in an under aroused cortex, the CFF will be low as the cortex is not active enough to process the signals at the rate in which they are received beyond a certain rate of signal. In an optimally aroused cortex, the CFF will be highest as the cortex can process its maximum rate of signals received. In an over aroused cortex, the rate at which the signals are processed will again be diminished therefore resulting in a lowering of CFF. It can be seen therefore, that cognitive ability (capacity to process discrete signals) may be depressed in an under aroused, and an over aroused state.

For the present study, the CFF meter used was constructed by the Department of Electro-technology at AUT. It consisted of a participant-operated manual dial adjusting the flicker rate of a red L.E.D (Payne, 1982) over the range of 17-72Hz in 1Hz increments. This L.E.D was placed at the bottom of a monocular 13 cm long black tube fitted with a rubber eye piece to negate any distance from the light source effect (Hosokawa et al., 1997) and eccentricity effect (Ginsburg, 1967). The eyepiece was held close to the right eye for all participants. The flicker rate (Hz) was displayed on a Liquid Crystal Display on the unit but out of sight of the participant performing the test. After pre-test familiarisation with the equipment consisting of twenty ascending and descending adjustments carried out 1-3 days previously, each participant's CFF was measured on five occasions during day two of training. Six measurements (Parkin et al., 1997) of CFF were taken for each participant at each testing site with the mean of three ascending values and three descending values recorded (Landis, 1954; Rammsayer & Netter, 1988). Each trial started from a random high or low point selected by the data collector, to lessen the effect of participant fusion point anticipation. CFF was measured at the same sites as the heart rate and saliva sampling and was collected after heart rate, but before saliva sampling.

Measures not used

Direct measurement of cortical arousal is achieved with an electroencephalograph (EEG). This measures the electrical activity of the brain through a series of electrodes placed on the participant's head. Such machines are large and the electrodes would be very obtrusive to normal activity. This type of measurement, although accurate, is not suitable for the limitations placed on this research due to the location and the need to intrude as little as possible into the teaching day. Therefore indirect measures had to be considered.

Kayak skill testing

The central focus of this research is on the factors that impede or facilitate the learning of kayaking skills by trainee outdoor pursuits instructors. A measure was required to determine the relative amount of learning that took place over the three days of teaching and the robustness of those skills for each participant in the given environment. Learning has been defined, in the context of motor learning, as the relatively permanent increase in an individual's capability to execute a motor skill resulting from practice or experience (Cocker, 2009). However, learning cannot be directly observed but must be inferred from performance, retention (assessed from pre and post training tests) and the transference (how skill transfers to a new situation) of skills (Utley & Astill, 2008).

The environment for the first test was at Reids Farm slalom site on the Waikato River. This site has a variety of grade I to grade I+ rapids (Ferrero, 1998; Ray, 1997), as the water passes through a series of islands. The same site could not be used for the repeat tests as the participants' teaching groups had all progressed to another more taxing environment on a different river, a requirement for their learning pathway. This factor did however allow the transference of skills, a key measure of learning, to be assessed (Utley & Astill, 2008). The second test was on the Aniwhenua section of the Rangitaiki River and is a grade II run (Ferrero, 1998; Ray, 1997). The second skill test examined the same skill set and was conducted in the same manner, to the same criteria as the first test but in a more difficult grade of white water. The same assessor assessed the skill tests on each

day in an effort to improve the reliability of the scores through consistent application of the skill grading criteria.

The skills tested were eddy turns, ferry glides and rolling in the current. Eddy turns consist of kayaking from a calm eddy and manoeuvring into the flow of the current, crossing a more defined eddy line with greater current to eddy speed differential, as the grade of white water increases. Ferry glides necessitate crossing the current from an eddy on one bank to the eddy on the opposite bank without losing ground down river. Again, higher grades of white water with faster flows make this skill more difficult to achieve. Rolling involves turning the kayak back upright from a capsized position with the paddle. This becomes an increasingly difficult skill to achieve as the flow increases and the size of waves becomes larger in the higher grades of white water.

These skill assessments were made during the first day of teaching and at the end of the third day of teaching. Of greater importance than the actual level of competency reached (as the tests were in different locations), was the relative differences between the intervention and non-intervention groups at the beginning and end of the training period and the relative robustness of their skill set in a more taxing environment. The participants were graded from 1 (lowest) to 10 (highest) for each of the three skills, using the following scales: -

Eddy Turns

- 10 Role model standard eddy turns.
- 9 Very good, controlled performance producing a smooth, long turn.
- 8 Good display with all aspects of eddy turn performed to produce a smooth turn.
- 7 Uses position, angle, speed and edge to perform an eddy turn.
- 6 Performs eddy turn but is unstable and wobbles.
- 5 Makes it into the centre of the flow upright.
- 4 Makes it to the centre of flow but fails to maintain balance.
- 3 Makes it over the eddy line but fails to maintain balance.
- 2 Makes it over the eddy line but fails to rail.
- 1 Does not make it over the eddy line.

Ferry Glides

- 10 Role model standard.
- 9 Very good, controlled performance.
- 8 Good display with all aspects of ferry gliding performed.
- 7 Paddles strongly and consistently with the kayak travelling smoothly from one eddy to the next.
- 6 Paddles strongly and consistently.
- 5 Ferries across the flow.
- 4 Struggles to maintain ferry angle.
- 3 Loses angle and fails to make a ferry glide.
- 2 Enters the flow but with no control.
- 1 Fails to make it into the flow.

Rolling

- 10 Performs roll in moving water to role model standard.
- 9 Rolls in moving water smoothly with good finish position.
- 8 Rolls in moving water smoothly.
- 7 Rolls in moving water but lacks grace.
- 6 Rolls in moving water to an upright position.
- 5 Rolls in moving water but only just gets upright.
- 4 Performs roll, but only in flat water.
- 3 Performs a barrel roll, is composed and waits to be rescued.
- 2 Performs a barrel roll but only if rescued immediately.
- 1 On capsize, panics and immediately bails out.

Table 3.1 Time line of data collection for the main study. This table shows the when, where and which measures were used to collect data with both the intervention and non-intervention groups.

Day	Introductory day	Day 1 of teaching	Day 2 of teaching	Day 3 of teaching
Data collected	Initial skill and confidence levels measured for allocation of teaching groups	a) Pre skill test b) Pre self-efficacy questionnaire	a) Heart rate b) CFF c) Saliva sampling Collected at: - 1. Accommodation 2. Before getting on the river 3. After first rapid 4. After biggest and last rapid 5. After lunch d) Somatic arousal questionnaire filled out at the accommodation.	a) Post skill test b) Post self-efficacy questionnaire

3.6 THE ATTRIBUTIONAL RE-TRAINING INTERVENTION

The attributional re-training intervention utilised a combination of the two prominent approaches to attributional modification, re-attribution (Fosterling, 1988) and misattribution (Schachter, 1964), both of these approaches were designed to augment the self-efficacy of the participants.

Re-attribution

This strategy implemented in order to achieve re-attribution was to use attributional re-training to reframe the causation for any faults that the participants may have in their performance. The participant group who received the intervention were taught and encouraged, by the researcher, to make attributions for poor or failed attempts to perform the skills being taught, to attributions that were internal (within themselves), controllable (by them) and

unstable (able to be changed) (Rees et al., 2005). Instead of allowing the participant to make the attribution that the flow of the water caused a failed eddy turn (external, stable and uncontrollable), the participants would be encouraged to find an attribution for themselves similar to this example for the same deficiency in performance, *I miss timed my entry stroke and that's why my eddy turn failed* (internal, unstable and controllable). The participants in the intervention group were also encouraged to make attributions linked to poor choice of strategy employed, rather than other internal attributions, like effort (Biddle et al., 2001; Hardy et al., 1996). This was done in order to make provision for the protection of self-image, which can be affected negatively by such attributions (Marlatt & Gordon, 1985).

Misattribution

The intervention group was also encouraged to attribute their somatic arousal (how aroused they feel) to their body getting ready to perform a skill rather than as a result of them being anxious (Schachter, 1964). The typical arousal/anxiety symptoms expressed by the teaching groups were, feelings of strong or pounding heart beat, butterflies in the stomach, flushed and or sweaty, trembling and a mind that flits from one thing to the next.

The attributions given by the researcher to the somatic indicators of stress experienced and expressed by the participants were: -

1. Increased heart rate is your body getting ready to perform a physical act where it might have to work hard. Your heart rate rises in preparation so that your blood can carry the energy and oxygen to your muscles to allow it to perform the task *on demand*.
2. Butterflies in your stomach is your body diverting blood supply away from your digestive system to make a greater volume available to your soon to be working muscles and your digestive tract going into stasis as a result.

3. Flushed skin is preparatory vasodilatation of blood vessels and sweat glands near to and in the skin in order to tune up your cooling system ready to lose heat generated from your muscles when they start to perform physical work.

4. Trembling and mind flitting are both signs of your nervous system becoming active and sharp so that you can sense and react instantaneously to both physical and visual cues.

Providing participants with this information explained why they felt like they did and that feeling these sensations was not something to be anxious about, potentially leading to over arousal, but to understand that their bodies were making these necessary adjustments and preparations before embarking on physical work. These feelings can be attributed to the normal preparations that their body must undertake to allow them to be in the best physical and mental condition to meet the challenge or demands placed upon it, and it was therefore not only normal, but also desirable, for their bodies to go through these changes and for them to feel these sensations before embarking on white water skill training sessions. This provided participants with a positive label for the arousal (Schachter, 1964) and an explanation (Maslach, 1979).

These approaches were designed to encourage the participants to make attributions to factors that were desirable and that they were in control of changing for the better. This approach was also designed to allow the participant to be in much more control of the learning process. If the participant is allowed to self-analyse and self-correct to a much greater degree, this potentially nurtures for greater learning, as they are coaching themselves as well as being taught and coached by the instructor or trainer. Perception of control is an important factor in the development of self-efficacy beliefs, whereas perceptions of a lack of control have been associated with increased anxiety (Endler et al., 2001; Glass, et al., 1973; Geer & Maisel, 1972). Perceived control in stressful situations and level of self-efficacy has been found to be a strong predictor of academic achievement (Manstead & van Eekelen, 1998). Therefore, the shift in

the locus of control from teacher to student was a desirable part of the self-efficacy augmentation package to which the intervention group were exposed.

The misattribution approach and suggested causation for arousal symptoms, was introduced during the instructor's briefing to the intervention group before the group got on the water at the start of the first day of training. This was undertaken so that any anticipatory arousal had not only a label (Maslach, 1979), but a desirable label and that if arousal sensations occurred during the training session then they would immediately have a desirable causation available, so reducing cognitive dissonance (Kiesler & Pallak, 1976) and reducing arousal (Pittman, 1975). If during the following training sessions the participants mentioned their arousal symptoms or outwardly displayed arousal or anxiety symptoms the instructor reminded them of the attributions for those symptoms and the desirability of those factors.

The re-attribution of successful and failed attempts at skills to controllable, unstable and internal factors and where possible to strategy choice, was also introduced as a concept at the start of the first on water training session. The instructor asked the intervention participants to try to find causation for their successes and failures that fitted the brief. The participants then were constantly asked to attribute causation, especially for any failed attempts at skills, throughout the next three days of training. When they did not offer a controllable, internal and unstable causation, they were encouraged to do so and encouraged to plan to use alternate strategies for subsequent attempts. For example, in an eddy turn situation where the participant failed to make the turn because their boat turned too fast, this leads to insufficient lean being applied and a capsize towards the upstream side. The participant would then be encouraged to find an unstable, controllable and internal causation for this failure. A suitable causation might be that they (internal) did not slow (unstable) the rate of turn down to a manageable (controllable) degree. Their strategy of paddling metronomically over the eddy line was likely to be at fault. A suitable strategy to employ would be to place a sweep stroke on the downstream side as the boat begins to turn in the current, thus increasing the radius of the turn and

allowing for a slower less lean-critical performance. This new strategy is internal (they apply it), unstable (the stokes effect will change the course of the kayak) and controllable (they themselves control the strokes application).

The non-intervention (control group)

The non-intervention group received *normal instruction*, which is the prevalent style used in outdoor pursuits teaching within the host organisation. The main difference between this and the intervention is that in the non-intervention style the instructor observes the participant performing a skill and then tells the participant what they have to do differently in the future to get a better performance. In this normal instruction style, the instructor is in control of the learning process and the participant is dependant upon the instructor to work out what is going right or wrong and what they have to do to correct any shortcomings. The two groups (intervention and normal instruction) had equal time devoted to them by the instructors and were taught the same skills in the same locations. The difference was in the style of feedback that the participants received from the instructor when performing skills and the intervention group receiving alternate causation (misattribution) suggestions for arousal responses during the introductory briefing. For example, a participant may capsize when crossing an eddy line into the flow. The instructor of the normal instruction (control) group would *tell* the participant to, on the next attempt, lean downstream more, and, or, approach the eddy line at a more acute angle, which ever he deemed was the most serious fault. This approach is in contract with the attributional retraining method, where the instructor would *ask* the participant why they felt they had failed and guide the participant towards finding an unstable, controllable and internal causation. Even if at first they had attributed it to some other causation like the water tipped them. The instructor would work with the participant to find a strategy that had internal, controllable and unstable features that the participant could implement on the next attempt. This approach hands over the reins of control of the choice of strategy to the participant and illustrates a subtle change in power base from one where the teacher is in control of the rate of emanation of knowledge to one where the participant is the gatekeeper.

3.7 DATA PRESENTATION AND STATISTICAL ANALYSIS

The data used in this thesis was tested for the basic assumption of normality using the Kolmogorov-Smirnov test with the critical alpha set at 0.05. This test was run using the Norm Quant programme for Microsoft excel, downloadable from: -

<http://www2.cedarcrest.edu/academic/bio/hale/biostat/session25links/normality.html>

This test returned the results in Table 3.2. The data presented in this thesis includes all complete data collected. Outliers have been included in order to present fully the exploratory findings without undue researcher bias. There were some missing data points, with the cortisol data. In some cases these were regarded to be due to either (a) contamination of the sample by blood for example, or (b) due to loss of the PEG pellet during assay. Where there was a missing data point the whole set for that parameter, for that participant, was removed from the study, so as to not affect the results for an individual data collection station in relation to another.

The data for this study has been presented in a range of graphical and tabular formats. Column charts have been used to present data where comparison of data is necessary either between groups or within a group across several data collection points. The data presented is a group's mean with error bars showing plus or minus the standard error of the mean (SEM).

Correlations are presented with x-y scatter plots and use Pearson product moment correlation coefficient (r) to signify the closeness of the correlation between the variables and probability (p) to indicate statistical significance has been calculated from Student's tables. Linear regression was calculated and lines plotted using Microsoft excel for mac 2008. The pattern of the ' r ' values for pairs of variables has been plotted for each of the data collection sites and is used to illustrate the changes in correlation over the course of the training day. The whole participant group has been used in correlations where stated, but it has also been divided into distinct sub-groups for gender, upper and lower quartiles

of pre and post self-efficacy, and upper and lower quartiles of change in self-efficacy values between pre to post questionnaires.

Table 3.2. *Test of normal distribution of data used in this thesis.*

Data	Group	Correlation coefficient (r)	Critical value of r using $\alpha = 0.05$	Assumption of data normality Y/N
Self-efficacy	All pre	0.957	0.971	N
Self-efficacy	Intervention post	0.990	0.956	Y
Self-efficacy	Non-intervention post	0.947	0.941	Y
Somatic arousal	All	0.979	0.971	Y
Heart rate	All at rest lodge	0.995	0.971	Y
Heart rate	All at on water two	0.984	0.971	Y
Cortisol	All at rest lodge	0.966	0.968	N
Cortisol	All at on water two	0.981	0.968	Y
CFF	All at rest lodge	0.975	0.971	Y
CFF	All at on water two	0.993	0.971	Y
Rolling skill	All pre	0.978	0.972	Y
Rolling skill	Intervention post	0.952	0.956	N
Rolling skill	Non-intervention post	0.955	0.941	Y
Eddy turn skill	All pre	0.939	0.970	N
Eddy turn skill	Intervention post	0.958	0.955	Y
Eddy turn skill	Non-intervention post	0.875	0.941	N
Ferry glide skill	All pre	0.985	0.970	Y
Ferry glide skill	Intervention post	0.963	0.955	Y
Ferry glide skill	Non-intervention post	0.948	0.938	Y

In most cases differences between sites or gender or pre/post self-efficacy were assessed with *t*-tests with a Bonferroni correction applied, those involving repeated measures on the same individuals have been calculated with a paired *t*-test and the *p*-values derived from two-tail table of *t*-values in Student's tables for the corresponding degree of freedom. Where separate groups have been analysed for differences an independent *t*-test has been used and the one-tail table in Student's tables used to calculate the *p*-value for the corresponding degree of freedom. These differences were later checked with ANOVA's. In Chapter 4 where heart rates were compared over time between two separate groups, an ANOVA was used to determine the differences between groups and probability is stated. As there were an equal number of participants in each group, a Student-Newman-Keuls multiple comparison test was used to calculate at which points in the time line the differences lay. In Chapter 5, where there are unequal numbers of participants in the groups studied, a multiple comparison using a Tukey adjustment was used to find where the differences lay. ANOVA's have also been used to enable more than two variables to be analysed together and to detect interaction effects that may be present. The proportion of variance has been calculated for the different variables present and the *R* square value has been stated. Where ANOVA's, repeated measures ANOVA's and multiple regression have been used in chapters 5, 6, 9 and 10, the SAS (www.sas.com) software was used.

Where the magnitude of the *p*-value has been described qualitatively, Cohen's (1988) scale of Pearson coefficients has been used. In this scale, *p*-values less than 0.1 are described as trivial, *p*-values between 0.1 and 0.29 are described as small, *p*-values between 0.3 and 0.49 are described as moderate and *p*-values equal to or greater than 0.5 are described as large.

The overall self-efficacy values used in this study have been calculated from the answers given on a five-point Likert scale. The mean for all the questions for each participant has been calculated and used to indicate the overall strength of each participant's self-efficacy beliefs, since a single value was necessary for correlations to be made. The self-efficacy data has also has been separated into

its constituent skill areas and antecedents where appropriate. When the self-efficacy for specific skills has been used for analysis, the mean of the responses to the following questions has been used.

- Eddy turn self-efficacy questions: 1a, 1d, 1g, 2a, 3a, 4a, 4d, 5a, 5d, 7.
- Ferry glide self-efficacy, questions: 1b, 1e, 1h, 2b, 3b, 4b, 4e, 5b, 5e, 8.
- Staying upright self-efficacy, questions: 1c, 1f, 1i, 2c, 3c, 4c, 4f, 5c, 5f.

When looking at the four antecedents of self-efficacy the mean of the responses to the following questions has been used.

- Physiological arousal: all parts of question 2
- Performance accomplishment: all parts of question 3
- Vicarious experience: all parts of question 4
- Verbal persuasion: all parts of question 5

Qualitative data regarding arousal and emotion was gained from the last question of the somatic arousal questionnaire (Appendix B). This question asked, *'Please describe the sensations you experience and why you think this is, and its effect on you'*. The answers to this question were then analysed for common phrases and the percentage of each gender group who made similar statements was calculated.

Emotional state has been derived from the participants' answers to the qualitative question at the end the somatic arousal questionnaire (Appendix B) where they were invited to describe their sensations. Where participants responded with the word 'excited' they were placed in the excited group. The anxious group is comprised of those participants who used one of a collection of terms indicating anxiety, including 'very nervous', 'feeling sick', 'very worried', 'scared' and 'anxious'.

Change (Δ) has been calculated by subtracting the pre score from the post score, while relative difference of change has been calculated by subtracting the change

score of one group from the change score of another group. In order to take account of any differences in the mix of arousal symptoms presented by any given participant, in some analyses the data reported selects the 25% of participants with the greatest change (upper quartile) and the 25% of participants with the least change (lower quartile) in each arousal marker. The change in skill from pre to post test for these two arousal quartiles has then been calculated in order to study the effects that any changes in activation of the different arousal systems may have on learning.

3.8 THE METHODS USED TO ANSWER THE RESEARCH QUESTIONS

The research questions were investigated through the use of the following methods: -

Question 1. What level of arousal do participants have while participating in white water kayak training courses?

This research question was investigated in two studies. In the first (pilot) study, presented as Chapter 4, heart rate was measured continuously through a white water kayaking training day. The heart rates were temporally aligned to the activities being undertaken by the participants through the recording of time related hand written notes made by observers. This allowed the heart rate response in relation to activities and river features to be studied. The second (main) study involved the collection and comparing of physiological, cortical and somatic arousal data collected pre, during, and post, white water kayak teaching at five different locations through the second teaching day, and is presented in Chapter 5. To collect data pertaining to physiological arousal, participants were monitored for heart rate via continuous heart rate monitoring with Polar heart rate monitors, and hormone release activity was monitored via saliva samples analysed for the hormone cortisol. Cortical/cognitive anxiety was monitored by means of the Critical Flicker-Fusion Threshold taken at the same time as the other two measures. At the beginning of day two of the training course a somatic arousal questionnaire was also filled in by all participants to collect data not captured by the other measures and to correlate against the other measures

taken. These measures were designed to give an overall picture of participants' responses in the teaching environment over the period of the teaching day.

Question 2. What are the relationships between self-efficacy beliefs and arousal (physiological, cortical and somatic) in white water kayaking?

This question was investigated using the arousal data captured from question 1 and comparing it to data collected through a self-efficacy questionnaire administered on day one and at the end of day three of training. This enabled the study of the relationship between the level of arousal both from physiological, cortical and somatic measures and the participants reported self-efficacy beliefs, to be made. The data relevant to this question forms Chapter 6.

Question 3. What is the relationship between self-efficacy beliefs and the learning of kayak skills?

This question allows the study of the relationship between participants' learning and their self-efficacy beliefs. In order to collect the data to answer this question the following methods were used. The participants were all assessed for skill level on the first day of white water training and again at the end of the third day of training. This allowed the relative, learned improvement in skills and the robustness of skills to be monitored for each individual. Approximately half of each cohort was given an instruction style that lent itself towards attributional re-training and other approaches designed to augment self-efficacy, whilst the other half of the cohort received normal instruction. All the participants filled in a questionnaire on day one and on day three which was designed to illustrate the participant's judgements about their self-efficacy beliefs. The results from the varied sources were then subjected to statistical analysis and correlated against each other for the intervention and non-intervention groups. The data relevant to this question forms Chapter 7.

Question 4. What are the relationships between arousal (physiological, cortical and somatic), emotion and the learning of kayaking skills?

To answer this question the arousal and emotion data collected on day two of the training course were compared with the change in skills from the pre skill test on

day one and the post skill test on day two. The difference between the two skill tests was used as an indicator of the learning that had taken place between the two tests. The emotional expressions made by participants were also compared with the arousal data. The data relevant to this question forms Chapter 8.

Question 5. What are the relationships between attributional re-training, the change in participants' kayaking skills (learning) and their self-efficacy beliefs?

In order to study the relationship between attributional re-training, the participants' learning and effects on self-efficacy beliefs the participants undertook two skill tests, one on the first day of training and one on the third and final day of training. The results from these skill tests were statistically correlated against the intervention and non-intervention group to ascertain which group learned the most and improved their skill level the to the greatest degree, relative to the initial testing. This also allowed the assessment of whether attributional re-training had a beneficial effect on learning. This data was then correlated against the data from the self-efficacy questionnaire filled in on day one and day three of training, to give an insight as to whether attributional re-training can have an augmenting effect on the participants self-efficacy beliefs. The data relevant to this question forms Chapter 9.

Question 6. What are the relationships between attributional re-training and arousal (physiological, cortical and somatic)?

In order to study a potential mechanism by which attributional re-training could have an effect on learning, the physiological and somatic arousal data collected at the five data collection sites, and the somatic arousal data collected on day two were divided into intervention and non-intervention groups. The data from the two groups were compared and is presented in Chapter 10.

CHAPTER 4

HEART RATE IN WHITE WATER KAYAKING

4.1 PURPOSE

Heart rate is a common marker for physiological arousal (Zaichkowsky & Baltzell, 2001) and psychological stress responses (Hackfort & Schwenkmezger, 1989). In this pilot study the heart rate responses to kayaking in a natural white water environment (white water group) and while exercising on a kayak ergometer (ergometer group) are described. The use of the kayak ergometer allowed heart rates to be measured at various fixed exercise levels with stressors, other than exercise, presumably held constant. The continuous measurement of heart rate while kayaking in a natural environment with temporal alignment to activities being noted, allowed the heart rate response of exercise together with any additional stress from the environment, to be compared.

The aims of this chapter are to describe the heart rate response:

- while kayaking in a natural white water environment.
- from purely kayaking exercise.
- differences between kayaking in the laboratory and in the natural environment.

4.2 METHODS

Kayaking in a natural white water environment

Four female participants aged 19-25y took part in the white water component of the study between ~9:30 am and ~12:30 pm. All were AUT University students who were in the early stages of an outdoor-instructor training course. Heart rate was recorded continuously with Polar 610i heart rate monitors during a day's white water kayak training activity on the Ngaawapurua section of the Waikato river, which includes three major grade II to III- rapids (Ferrero, 1995; Ray, 1997). Each participant was paired with a note-taker who wore a stopwatch

synchronised with the heart rate monitor worn by the participant. The note-takers' time-related notes of the various physical activities and salient occurrences while the participant was kayaking, which were written into a waterproof note book, allowed temporal alignment of activities with the continuous heart rate recordings. A video recording was made of the participants kayaking the largest rapid (rapid 3) with a Sony DCR-TRV22E camera in a waterproof housing. At the end of the training day, the participants were interviewed by the note takers and asked the following questions with the participants' responses recorded in the note-takers' waterproof notebook.

- To what do you owe your successes?
- What were the causes of your failures?
- How *in control* did you feel?

Ergometer kayaking exercise

This component of the study involved simulated kayaking using a K1 ergo kayak ergometer in the laboratory. The ergometer was used to enable the heart rate response of the physical exercise of kayaking to be studied without influence from psychological sources or the very real risk of injury that can occur in the natural environment (Bunting, et al., 2000; Fiore & Houston, 2001; Hardy & Hutchinson, 2007). The K1 ergo machine has been found to simulate the physiological demands of actual kayaking in open water (van Someren, Phillips & Palmer, 2000) and was used to determine the heart rate response of the physical exercise of kayaking.

Four other (to the white water component) participants aged 19-28y (one male and three female students) from AUT University who were also in the early stages of an outdoor instructor training course took part in the ergometer component of this study (ergometer group). These participants had similar fitness levels to those in the white water component. The participants wore Polar FT1 heart rate monitors that continuously show the participant's heart rate on the wrist-watch style display. Each participant underwent a short kayaking-technique coaching session at a low intensity (< 20 stroke/min) to

familiarise themselves with the equipment and improve their kayaking technique. A visual and auditory metronome (<http://webmetronome.com/>) set the paddling stroke rate, which started at 30 beat/min and increased in 10 beat/min increments at the end of each minute until the participant could no longer keep pace with the metronome's beat (exhaustion). At this point exercise was terminated and the participant sat in a chair while recovering. The participants' heart rate was recorded at the end of each minute of exercise and then again at the end of each minute of recovery for a period of 7min. This component of the study was conducted between 12 noon and 1 pm.

4.3 RESULTS

White water group heart rate

Table 4.1 presents the physical activities associated with sudden elevation of heart rate (> 150 beat/min) for each individual. Negotiating rapids and performing skill practices account for the majority (21/38) of heart rate peaks. Capsizing or nearly doing so accounts for a further 7/38 peaks, with 5/7 of these peaks accountable to one participant (C). Preparing to get on the river (3/38) and skill failures (missing eddies 3/38) are also notable activities that are associated with peaks of heart rate. Participant A and participant C account for the majority of high heart rate occurrences (23/38) and also have higher mean heart rate for the ~3hr kayaking period with 129 beat/min and 142 beat/min, respectively.

The activities associated with the participant's periods of low heart rate (< 120 beat/min) are shown in Table 4.2. Half (16/30) of the periods of low heart rate are associated with two activities, sitting in eddies (9/30) and performing skill practices (7/30). Other activities associated with low heart rates are watching the instructor brief or demonstrate skills (4/30) and watching others run rapids after they themselves had negotiated them (4/30). It is also apparent that participants B and D account for the majority of low heart rate occurrences (19/30) and also have lower mean heart rate for the ~3 hr kayaking period with 123 beat/min and 117 beat/min, respectively.

Table 4.1 Occurrence of kayak activities associated with high heart rate (> 150 beat/min) for each participant.

Activity	Participant			
	A	B	C	D
Preparing to get on the river	2	1		
Collision	1			
Practising skills	2	2	2	3
Capsizing or nearly	1	1	5	
Missing eddies	1		2	
Sitting in eddies			2	1
Running rapids	3	4	2	3

Table 4.2. Occurrence of kayak activities associated with low heart rate (< 120 beat/min) for each participant.

Activity	Participant			
	A	B	C	D
Preparing to get on river			1	
Instructor saying lets go	1			
Sitting in eddies	1	5	3	
Instructor briefing or demonstrating	3		1	
Performing skills		3		4
Watching others run rapids			1	3
Capsize and rescue				1
Paddling between rapids		2		1

Original recordings of heart rate for rapid 3 are shown in Fig. 4.1. Notable features are the different time of onset for the heart rate increase before entering the rapid and the difference in recovery from the peak heart rate after the rapid has been negotiated. The heart rate of participant D starts to rapidly increase 100s before the rapid was entered, whereas the heart rate of participant A did not increase rapidly until 45s before entering the rapid. Participant D had a more sustained high heart rate, declining by a mean of 4 beat/min for the 3.5min after the rapid had been completed. Participant A shows a quicker decline in heart rate, declining at a mean rate of 8 beat/min for the 3.5min after the rapid was completed.

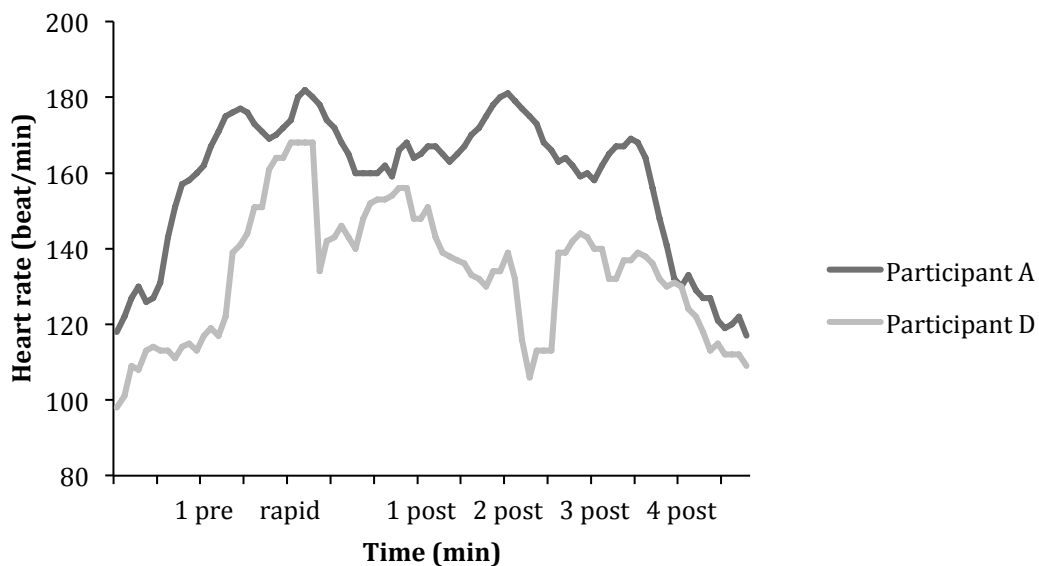


Figure 4.1. Original continuous recording of heart rate from two novice female kayakers. The recording was made before during and after they kayaked a grade III- rapid. Heart rates have been temporally aligned from 2min before they entered the rapids and continue for 5min after the rapids were completed. The rapids took ~30s to complete. Recordings were made at 5s intervals.

This early rise of heart rate was observed in two of the four participants prior to all three major rapids (Fig. 4.2.) Note that the elevated heart rate 1 min before negotiating the rapid for participants A and C does not translate into higher peak heart rate whilst actually negotiating the rapid, particularly for rapid 3, the biggest and last rapid of the day. Indeed the response of heart rate during the 60 s up to the commencement of kayaking the rapid is as low as 11 beat/min

(participant A) or as high as 68 beat/min (participant B). Participants A and C have an early (> 1 min before the rapid) rise in heart rate with a small further increase in the 1 min before (11 beat/min and 12 beat/min respectively) actually kayaking the rapid, compared to participants B and D who have a later (< 1 min before the rapid) increase in heart rate of a larger magnitude (68 beat/min and 51 beat/min respectively). Peak heart rates whilst kayaking the rapid were similar, with a range of 16 beat/min between all participants compared with a range of 55 beat/min 1 min before kayaking the rapid.

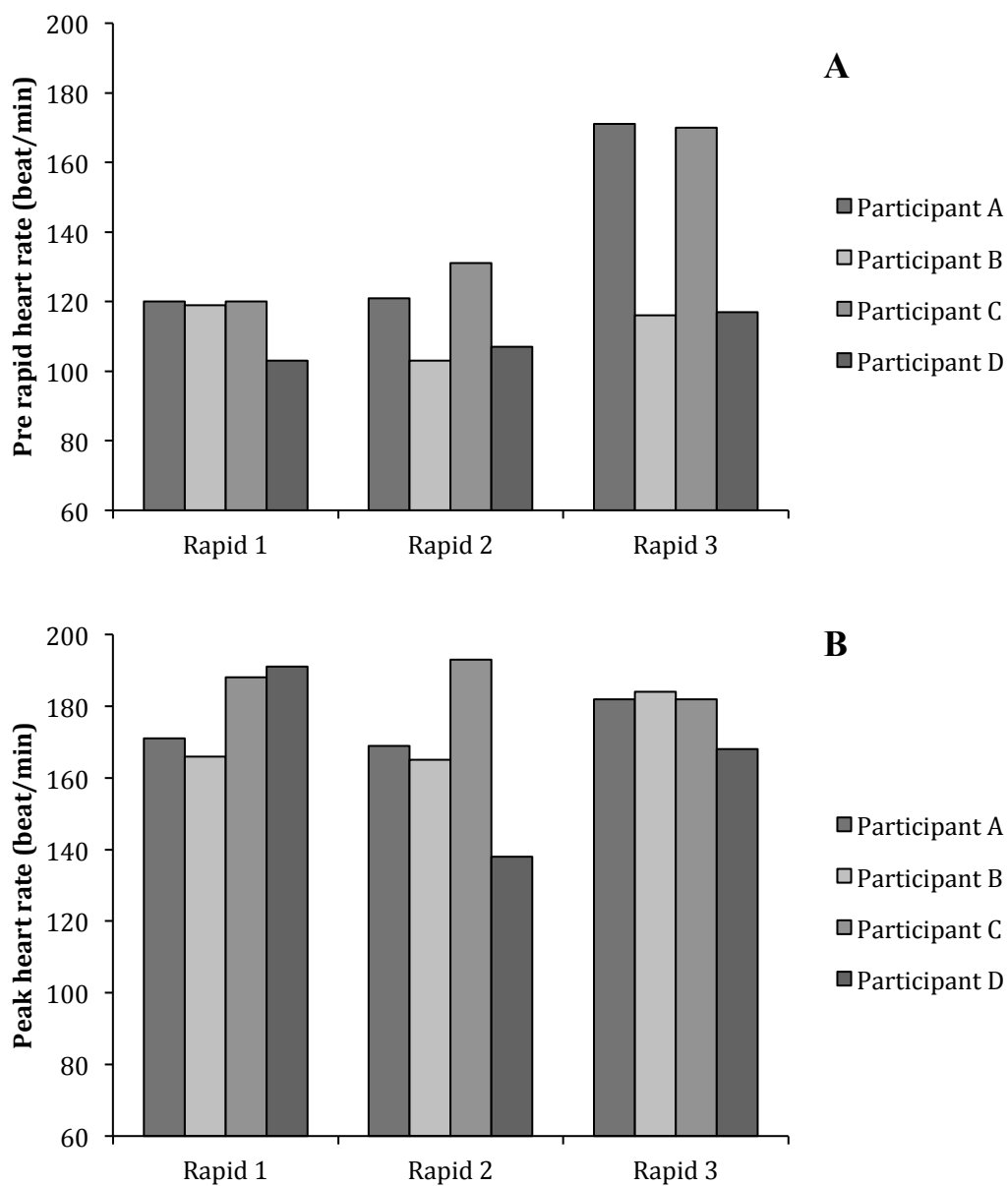


Figure 4.2. Heart rate 1 min pre rapid (A) and peak heart rate (B) for three major rapids.

Video analysis of the stroke rate whilst participants negotiated rapid 3 reveals they had a stroke rate of ~ 1 stroke/s. However, these strokes were only short steerage and control strokes rather than full forward power strokes.

White water group interviews

Participants A and C attribute their successes to their instructors, whereas participants B and D attribute successes to themselves and taking ownership for their actions. On the subject of failure, participants A and C attribute this to lack of confidence, being scared and lack of effort, whereas participants B and D attribute failure to themselves and frustration. In terms of perceived control, participant A and participant C remarked they had no control in the rapids but participant B and participant D commented that they felt sometimes and quite in control respectively.

Table 4.3 Summary of interviews with the white water group conducted at the end of their training day.

To what do you owe your successes?	
Participant A	<i>'Instructors'</i>
Participant B	<i>'Herself but through competent instructors'</i>
Participant C	<i>'Instructors'</i>
Participant D	<i>'Goal setting, instructors, everything seemed to click into place when ownership of actions was taken'</i>
What were the causes of your failures?	
Participant A	<i>'Lack of confidence, lack of effort, didn't like it'</i>
Participant B	<i>'Myself, personal baggage'</i>
Participant C	<i>'Scared, lack of effort'</i>
Participant D	<i>'Frustration and feelings of not being good at kayaking'</i>
How in control did you feel?	
Participant A	<i>'No control whatsoever in the flow'</i>
Participant B	<i>'Sometimes in control'</i>
Participant C	<i>'Not at all in the rapids'</i>
Participant D	<i>'Frustration and feelings of not being good at kayaking'</i>

Ergometer group heart rate

Figure 4.3 shows the mean heart rate for the ergometer group at various stroke rates. The heart rate was recorded at the end of 1 min of paddling at each stroke rate. Heart rate increases as paddling stroke rate increases.

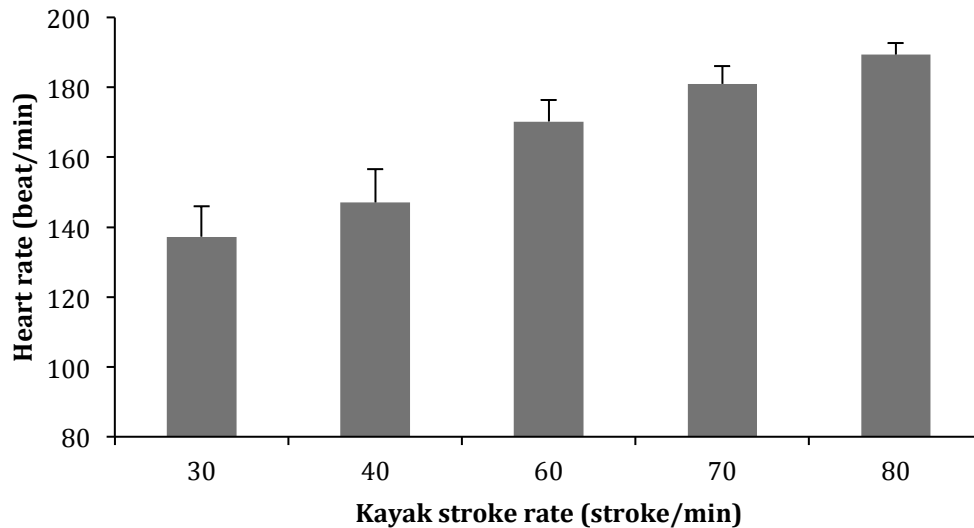


Figure 4.3. Heart rates for various paddling stroke rates. Data are means \pm SEM.

Exhaustion was reached when paddling at 70 stroke/min (one participant) and 80 stroke/min (three participants). Maximum heart rates attained were 189 ± 3 beat/min.

Heart rate recovery for white water and ergometer groups

Figure 4.4 shows the heart rate response after the cessation of kayaking exercise between a group who had paddled to exhaustion on a kayak ergometer (ergometer group) and a group who had just kayaked a grade III- rapid (Ferrero, 1995; Ray, 1997) in a natural white water environment (white water group). Both groups had similar heart rates at the cessation of exercise with the ergometer group having a mean of 188 beat/min and the white water group recording a mean of 178 beat/min. An ANOVA returns an extremely significant ($p < 0.0001$) difference between the two groups overall. A Student-Newman-Keuls multiple comparison test reveals the white water group having a

significantly ($p < 0.05$) to extremely significantly ($p < 0.001$) greater heart rate between 2 and 6min after cessation of exercise.

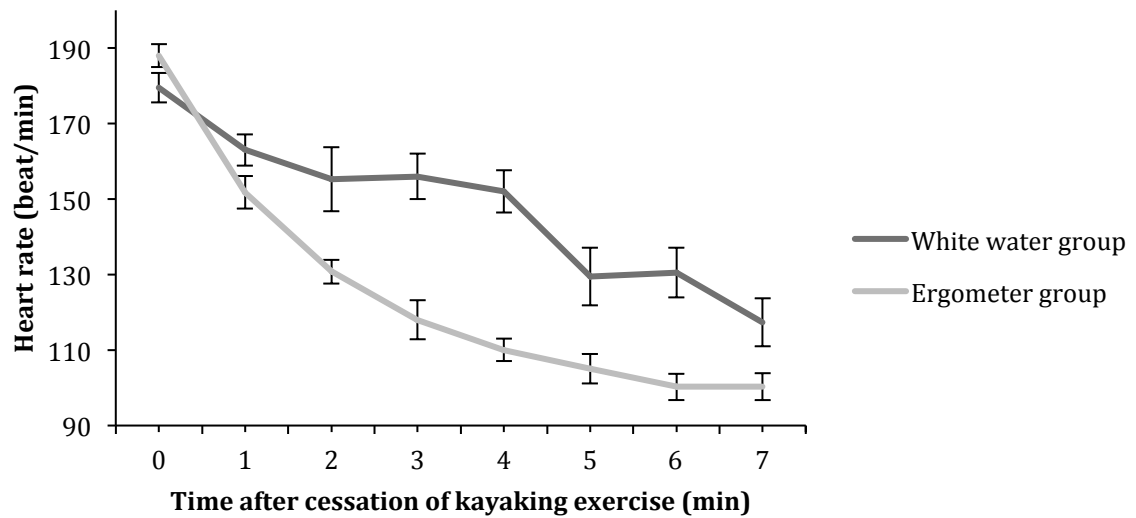


Figure 4.4. Heart rate response after cessation of kayaking exercise. Data are means \pm SEM. Difference between groups $p < 0.0001$ (ANOVA).

4.4 DISCUSSION

Heart rate was successfully recorded over the entire duration of a ~3 hr kayak training day in a natural environment which included three major rapids and capsizes. Peak heart rates occurred when negotiating rapids for all participants (Table 4.1). While skill failures (capsizes, missed eddies) and practising skills were also associated with high heart rates, the latter may be assigned to the physical exercise response of driving the kayak into and out of eddies (eddy turns) and crossing fast currents (ferry glides). However, peak heart rates in rapids would appear to not be fully explained by an exercise response because paddling stroke rate and effort were recorded as low (60 stroke/min, comprising of short steering strokes). Periods of low heart rate were associated with watching others negotiate rapids after they themselves had completed them, listening to the instructor brief or demonstrate skills, sitting in eddies and some skill practices, indicating that these activities were not psycho-physically challenging.

Some participants (A and C) have a large (170-171 beat/min) and early (60-100 s) anticipatory heart rate response before entering the rapid (Fig. 4.2). However, this does not translate into higher peak heart rates while actually kayaking the rapids, as all participants' peak heart rates are similar for rapid 3 (168-184 beat/min). These participants (A and C) also appear to show a longer recovery after the rapid has been completed (Fig. 4.1). These differences in heart rate reactivity may indicate the presence of high and low stress-responders within this small group (Sgoutas-Emch, Cacioppo, Uchino, Malarkey, Pearl, Kiecolt-Glaser & Glaser, 1994). Rushmer and Smith (1959) noted that anticipatory effects on heart rate occur immediately before the onset of exercise or anticipated exercise. Faulkner (1962) refers to this anticipatory effect in early stages of adaptivity as a motivational or emotional response that is subject to further accentuation by conditioning as more experience in the task and the appropriate physiological arousal response for it are gained. Since the anticipatory responses seen in this study occurred at low exercise intensities (sitting in eddies), and given the participants are novices and the response happens 60-100s prior to the activity, it can be reasoned that these responses are based not on exercise but on emotion. The novice participants will not have had suitable experience to become habituated to the activity and apply an appropriate physiological arousal response for the actual physical demands and therefore may be applying an early and large response to meet the greatest perceived demands. Other studies have found that early and large anticipatory heart rate before physical activities are associated with lower performance (Kozar, 1964), which is congruous with the participants who exhibited this trait in this study having more skill failures (Table 4.1). Heart rate reactivity has also been shown to correlate significantly with endocrine responses (cortisol) under conditions of acute psychological stress (Sgoutas-Emch, et al., 1994; Uchino, Cacioppo, Malarkey, & Glaser, 1995), indicating a wider physiological arousal response in heart rate responders.

Heart rate increased on the ergometer as stroke rate increased in an approximately linear fashion. To stimulate heart rate to the peak rate (182-193

beat/min) recorded in rapids (while performing small steerage and control strokes at 60 stroke/min), the participants had to paddle on the ergometer (182-195 beat/min) with full power strokes at a rate of 80 stroke/min. The maximal heart rates obtained in these two studies are similar to the maximum kayaking heart rate suggested by Cox (1992). The predicted theoretic maximum would be, for these participants, in the range of 185 to 194 beats/min. The maximum heart rate in this study also corresponds with the maximum heart rate recorded (185-195 beat/min) in elite racing kayakers in the finals of a world championship event (Tesch & Linburg, 1984). The participants in the 'white water group' although attaining similar heart rates were not subject to the same degree of exertion (from video analysis) as either the ergometer group or trained elite athletes in the finals of a world-class event. This suggests that heart rate for the white water group is being affected by factors in addition to exercise in the natural white water environment.

Recovery of heart rate after cessation of kayaking exercise (Fig. 4.4) was also slower in the natural environment and could also indicate that in the white water environment there are other factors influencing the return of heart rate from exercise levels back to steady state that are not present when participants have kayaked to exhaustion in the laboratory. This study also suggests that capturing peak heart rate during rapids may be of lesser importance (as all participants had similar peak heart rates) than capturing heart rate data before rapids and up to 4 min after rapids have been negotiated. This would appear to better discern between those participants having greater anticipatory and recovery effects.

This study would appear to provide data that may support the notion that in the natural white water environment there are factors that cause heart rate to increase in a early anticipatory type effect and to maintain heart rates at higher levels for longer after the cessation of exercise, than can be accounted for by the demands of kayaking exercise alone. The data also possibly suggests that these physiological arousal responses may find their origin in perceptions of anxiety and the attributions participants make for their actions.

There is an apparent association between perceptions of control, attributing success and failure to themselves (Table 4.3), lower mean heart rate, heart rate reactivity closer to the rapid (Fig. 4.2) and faster reversal of heart rate after the rapid (Fig. 4.1). Conversely, perceptions of a lack of control, attributions made to others for success or failure, feelings of anxiety, higher mean heart rate, earlier heart rate response before rapids, longer heart rate reversal periods and more skill failures are associated together. These findings lead to a proposal that it may be advantageous to encourage participants to make internal and controllable attributions for success and failure of their actions. This may increase perception of control and potentially reduce anxiety, which may be contributing factors that can account for the inter-participant differences seen here.

Main findings from this chapter regarding heart rate in white water kayaking are:

- In the natural setting elevated heart rates are sometimes associated with activities of a non-physically demanding nature (sitting in eddies, preparing to get on the river), which may indicate the presence of psychological stressors.
- Some participants have large and very early anticipatory heart rate and slower recovery heart rate responses. This indicates that there may be individual differences in heart rate response in the natural environment.
- Large and early anticipatory heart rate response does not lead to higher peak heart rate in rapids, but is associated with participants who have more skill failures.
- To invoke peak heart rates similar to those achieved in the natural setting at relatively low exercise intensities, other participants were required to paddle at their maximum effort on the ergometer, further suggesting a significant role of other factors, possibly psychological, in the heart rate response in the natural environment.
- Recovery of heart rates following exercise on an ergometer in the laboratory is faster than from similar peak heart rates induced by rapids

in the natural environment. This possibly indicates a longer lasting effect of additional stressors found in the natural setting.

- A possible association between the attributions made for skill successes and failures, the reactivity of heart rate and number of skill failures was found, suggesting that the style of attributions made by the participants may influence arousal and, or, skill performance.

CHAPTER 5

AROUSAL IN WHITE WATER KAYAK TRAINING

5.1. PURPOSE

Physiological arousal and emotional state are recognised antecedents of self-efficacy belief formation (Bandura, 1977; Schunk, 1995). Therefore, the effects of white water kayaking on arousal and emotional responses (particularly anxiety and excitement) must be characterised in order to help explain, later in this thesis, changes brought about by self-efficacy augmentation through attributional re-training (Chapt. 9, 10). It was necessary to quantify the level of arousal during key stages of the training-day (i.e. preparation, on water skill training, recovery) whilst learning to white water kayak. This helped to establish the effects of the kayak training on the arousal markers (heart rate, salivary cortisol concentration, critical flicker-fusion threshold and somatic arousal) and the possible interplay between them. Earlier unpublished pilot work indicated that gender differences may exist in the arousal response in this environment and therefore empirical evidence was sought regarding this phenomenon.

The aims of this chapter were to characterise:

- The level of physiological, cognitive and somatic arousal during a kayak training-day in a natural white water environment.
- Any relationship between the arousal markers.
- Any gender differences in arousal and emotion while white water kayaking.

5.2 METHODS

For a full description of methods see Chapter 3.

Data collection

Forty participants comprising 28 males and 12 females took part in this study, in two cohorts. The level of arousal was measured with both direct and indirect measurements of physiological, cognitive and somatic arousal. The venue was

the Ngaawapurua section on the Waikato River as used in Chapter 4 and where participants had previously shown a marked physiological and somatic response. In contrast to Chapter 4 where heart rate was measured continuously, five discrete locations were used to collect arousal data for this chapter:

- *rest lodge*: Before getting on the bus to leave the accommodation for the training venue in the morning.
- *rest riverbank*: At the training venue, but before getting on the water.
- *on water one*: Between the first and second major rapid.
- *on water two*: Immediately after the biggest and last rapid of the section kayaked.
- *recovery*: After an hour long lunch break off the water.

Physiological arousal was measured with heart rate and salivary cortisol concentration (cortisol). This provided a marker for the sympathetic-adrenomedullary pathway (heart rate) and the hypothalamic-pituitary-adrenocortical pathway (cortisol). Cognitive arousal was measured with Critical Flicker-Fusion Threshold (CFF). At each of the data collection sites, heart rate was measured first, followed by CFF and then cortisol due to the relative transience of these markers. All three markers were collected for each individual over ~ 90 s. Somatic arousal formed from perceptions of both physiological and cognitive states was measured with a self-report questionnaire (Appendix B) administered once only at rest lodge.

Data analysis

Data collected from the two cohorts was not statistically different and has been pooled, however gender differences were noted and found to be consistent between cohorts and therefore the data has been presented throughout this chapter in gender groups. The data presented are mean values \pm standard error of the mean (SEM). Paired t tests have been used to compare the data from each group at different sites. Independent samples t tests have been used to compare different groups at the same site.

Qualitative data regarding arousal and emotion (positive or negative affect) were gained from the last question of the somatic arousal questionnaire (Appendix B). This question asked, *'Please describe the sensations you experience and why you think this is, and its effect on you'*.

5.3. RESULTS

Physiological arousal response to white water kayak training

Heart rate

Figure 5.1 shows that there is no significant change in heart rate between rest lodge and rest riverbank, but it should be noted that the heart rates at these sites are relatively high (93 ± 3 beat/min and 97 ± 5 beat/min) respectively. Heart rates were also taken at the same time of day on the three preceding days for a small sample of the group ($n = 5$). The mean of these measurements was 77 ± 3 beat/min to 84 ± 1 beat/min, indicating an increase of between 12% and 26% in resting values on the data collection day. There is a significant rise in the heart rate from rest riverbank to on water one (males and females $p < 0.001$) and this upward trend continues with a further significant rise to on water two (males $p < 0.001$, females $p < 0.05$), and then sharply declines to recovery. Heart rates can be seen to have a large reaction to white water kayaking, rising 60% for females and 53% for males between rest lodge and on water two. A repeated measure ANOVA confirms a significant relationship ($p < 0.0001$) between heart rate and site.

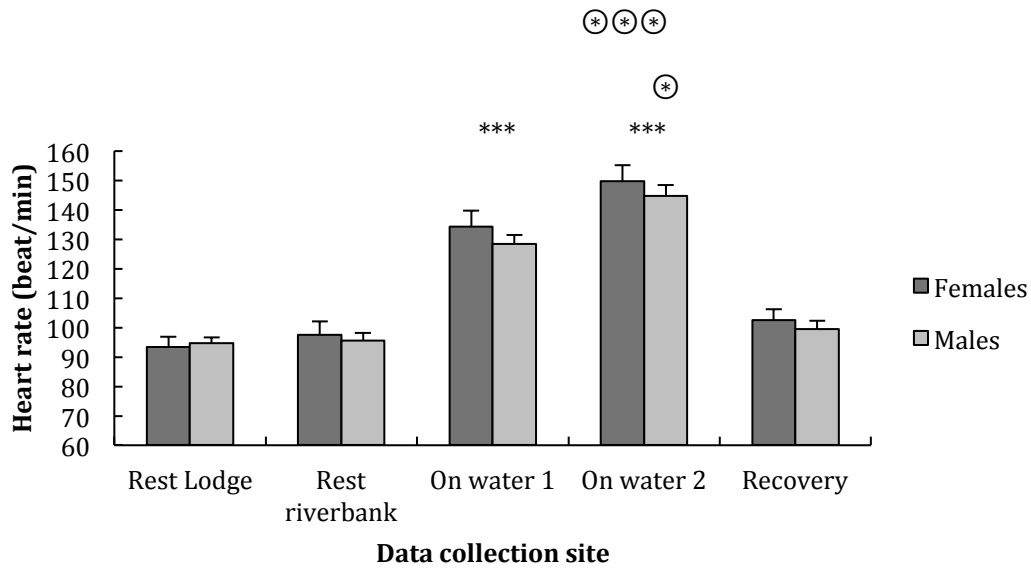


Figure 5.1. Heart rate for males and females while resting and white water kayaking. Data are means \pm SEM. *** indicates $p \leq 0.001$ difference for the same gender from rest. * indicates $p \leq 0.05$, ** indicates $p \leq 0.01$, *** indicates $p \leq 0.001$ difference for the same gender between on water 1 and on water 2. ANOVA confirms no significant difference between genders, but $p < 0.0001$ difference between sites.

Cortisol

Although there is a degree of scatter with individual values for the salivary cortisol concentration measure, the mean for the gender groups show consistent trends across the collection sites (Fig. 5.2). There is a significant decline (males and females $p < 0.05$) in salivary cortisol concentration between rest lodge and rest riverbank from between 2.98ng/ml to 3.54ng/ml at rest lodge to between 1.76ng/ml to 1.78ng/ml at rest riverbank.

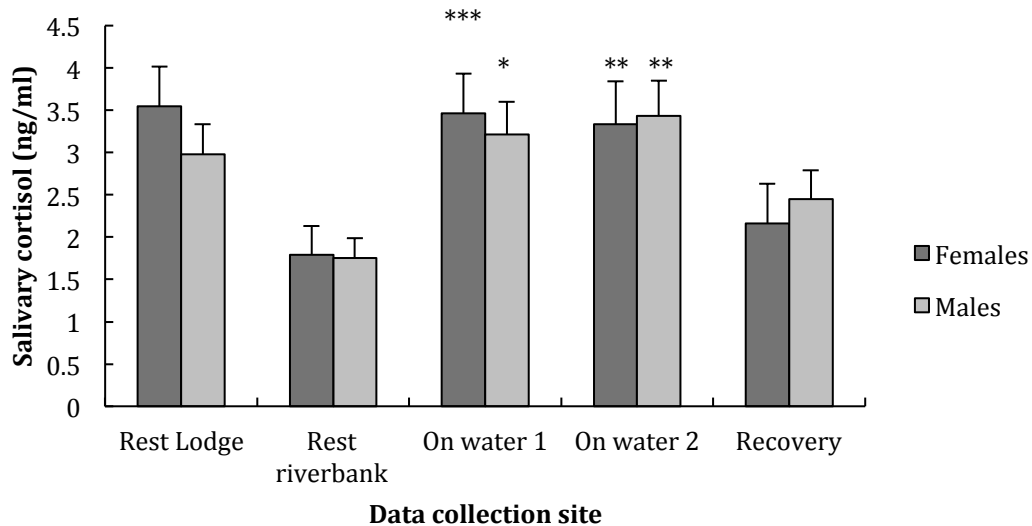


Figure 5.2. Salivary cortisol concentrations for the males and females while resting and white water kayaking. Data are means \pm SEM. * indicates $p \leq 0.05$, ** indicates $p \leq 0.01$, *** indicates $p \leq 0.001$ difference from rest riverbank. ANOVA confirms no significant difference between genders.

There is a significant rise (males $p < 0.001$, females $p < 0.05$) in salivary cortisol concentration from rest riverbank through on water one, the level is maintained at on water two with a significant decline (males and females $p < 0.05$) in levels at recovery. The salivary cortisol concentration has a large reaction to white water kayaking, rising 87% for females and 94% for males between rest riverbank and on water two.

Cognitive arousal response to white water kayak training

Figure 5.3 shows that there is no significant change in CFF between rest and on water one. Both genders have a significant decrease (males $p < 0.05$ and females $p < 0.01$) in CFF between on water one and on water two and females show a significant ($p < 0.01$) depression in CFF from rest lodge to on water two, before both genders returning to their near rest lodge CFF values at recovery.

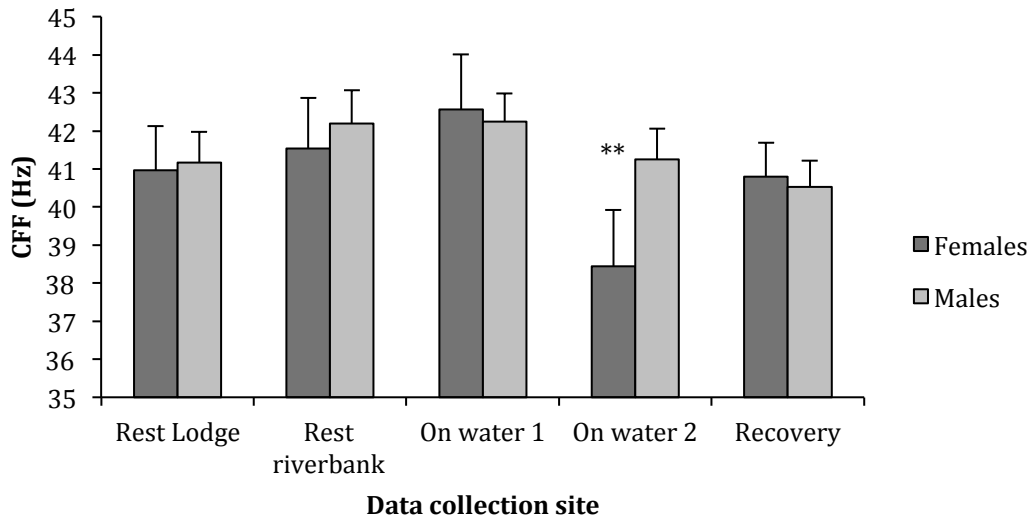


Figure 5.3. Critical flicker-fusion threshold values for males and females while resting and white water kayaking. Data are means \pm SEM. ANOVA reveals difference between genders ($p = 0.08$) and significant difference between sites ($p = 0.02$). ** indicates $p \leq 0.01$ difference between on water 1 and on water 2 for females (Tukey).

Although a similar proportion of male and female participants (91% of females, 79% of males) show a depression in CFF between the data collected at on water one compared with that collected at on water two, the females show a more marked depression in CFF than the males. The females show a mean depression of $4.1 \pm 1.2\text{Hz}$ in their CFF whereas the males show a decline of only $0.9 \pm 0.4\text{Hz}$ in their CFF. The difference of depression of CFF is shown throughout the gender groups with 64% of females showing a depression in CFF of 2.5Hz or more (with 45% showing a depression in CFF of 4Hz or more) compared to the males, of which 11% showed a depression in CFF of 2.5Hz or more (with 7% showing a depression in CFF of 4Hz or more).

Repeated measures ANOVA for the physiological arousal markers found there to be a significant ($p = 0.02$) difference for CFF and highly significant ($p < 0.0001$) difference for heart rate between sites. The highest gender/site relationship was found with CFF ($p = 0.08$), a multiple comparison test using a Tukey adjustment

found there to be a significant difference for females ($p = 0.01$) between on water one and on water two.

Somatic arousal response to white water kayak training

The quantitative somatic arousal data is displayed in Fig. 5.4. The mean of the females' reports are over one (14%) Likert unit greater than that reported by the males, which was found to reflect a significantly greater ($p = 0.005$) perception of arousal in females than in males. Of the five lowest mean scores all were males, in contrast, of the five highest scores, four were females.

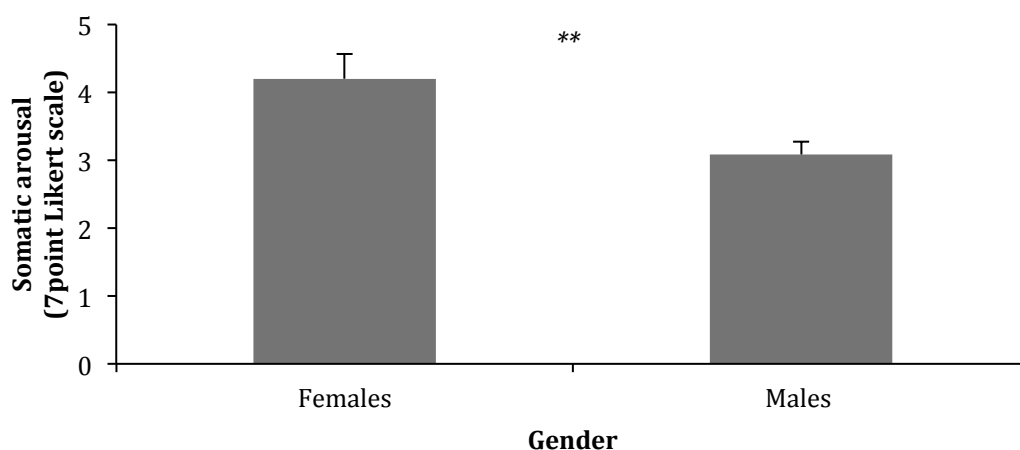


Figure 5.4. Somatic arousal for males and females prior to white water kayaking. Data are means \pm SEM. ** indicates $p \leq 0.01$ difference between males and females.

The mean of the somatic arousal quantitative data for each participant (Fig. 5.5) aligns well with their qualitative expressions. Participants ($n = 5$) whose mean Likert score was low (< 2) made expressions such as, 'I feel calm', 'normal' and 'just excited', whereas those participants ($n = 4$) that reported a mean Likert score exceeding 5, expressed feelings including, 'scared', 'sick in the stomach' and 'very nervous'. Figure 5.5 shows the percentage of participants that reported the themes identified. It should be noted that some participants expressed multiple themes. Eleven out of forty participants made expressions of both anxiety and excitement, however ten of these eleven made expressions of calm/mild anxiety with their excitement. A striking difference between the genders is in the alignment of the group along the calm/relaxed-mild anxiety-anxious-very

anxious axis. The males are predominantly aligned on the calm side of mild anxiety, whereas the females are predominantly on the very anxious side of anxious.

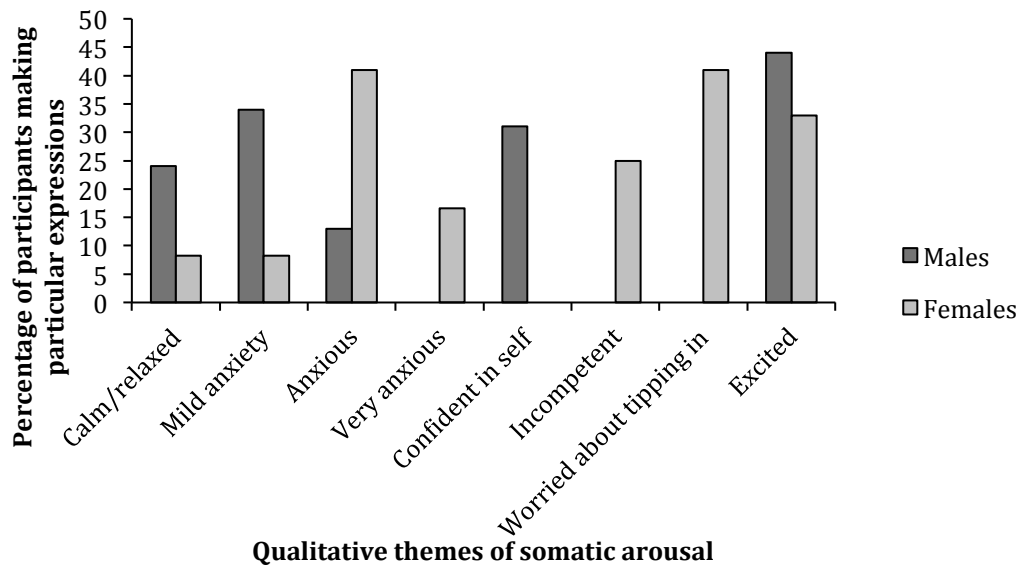


Figure 5.5. Qualitative themes of somatic arousal for males and females. Data are percentages of males and females expressing particular feelings.

There is also a difference in the reporting of confidence/incompetence, with over 30% of males reporting confidence in self but no females expressing that feeling. In contrast, 25% of females reporting feelings of incompetence but no males reported that statement. Both males and females expressed excitement but a greater proportion of males expressed that they felt that sensation (44% of males, 33% of females). Interestingly, over 40% of females were worried about tipping in (capsizing) but none of the males expressed those feelings.

Correlation between arousal markers

Regression analysis between the arousal markers used in this study reveals only small to trivial non-significant correlations between them. The only correlations identified where possible associations might occur were between somatic arousal and salivary cortisol at on water two ($p = 0.07$) and between somatic arousal and the mean heart rate calculated from the five data collection points ($p = 0.07$).

5.4 DISCUSSION

Heart rate

The notable high resting heart rates (Fig. 5.1.) would suggest that there is a very early (~90 min) anticipatory response to the white water kayaking day when compared to normal resting heart rates (Marieb & Hoehn, 2007). Psychological stress has been linked with increases in heart rate (Hackfort & Schwenkmezger, 1989). The elevated resting heart rates, compared to the previous three days, indicates the possible influence of psychological factors as this was the first time the participants were to kayak grade III- rapids. The qualitative somatic data recorded at the same time as the resting heart rates at the accommodation (rest lodge) further indicates a psychological influence on heart rate at rest lodge with participants reporting various perceptions of anxiety and excitement ~90min prior to commencing kayaking.

The on water heart rate data (Fig. 5.1) is graded with the progressive rise in difficulty of the rapids (grades I to III- (Ferrero, 1995; Ray, 1997)) the participants encounter as the run progresses, although inconsistent with the apparent exercise load (Chapt. 4). Repeated measures ANOVA confirms that a highly significant relationship exists between heart rate and site. The higher-grade rapids are characterised by bigger waves, breaking waves, faster current, steeper gradient and obstructions, which may add to the participants' perception of threat and risk. It can be seen that both males and females have a similar response in their heart rate during the different phases of the white water kayaking training day (Fig. 5.1).

The heart rate response is marked with elevations of over 50 beats/min immediately after the largest rapids (on water two). Previous video analysis (Chapt. 4) suggests that the work rate is low (~1 stroke/s) with short steerage strokes being used but with heart rates akin to maximal effort forward paddling being undertaken (Tesch & Linberg, 1984). These markedly elevated heart rates could be explained if there is a major anxiety response present, as might be

expected with the increase in grade of water and the associated threat of physical injury or capsize (Bunting et al., 2000; Fiore & Houston, 2001).

Cortisol

Cortisol has a circadian rhythm with concentrations being highest just after waking and lowering to a nadir in the late afternoon (Boyce & Barriball, 2010; Lévi et al., 1988). Indeed there is a marked decline in salivary cortisol concentrations between rest lodge and rest riverbank (Fig. 5.2). These samples were collected at ~8:30 am for rest lodge and ~9:30 am for rest riverbank. At 8:30 am, the salivary cortisol concentration would be near to its peak for the normal circadian rhythm and the lower level at rest riverbank could be accounted for by the natural circadian lowering of cortisol during the day. However, the cortisol concentrations then shown by both genders goes against the normal lowering trend of the circadian rhythm (Lévi et al., 1988) and rises significantly from rest riverbank to on water one, reaching its peak at on water two, before reducing again after a one hour break at lunch time (recovery). This suggests that the normal circadian rhythm is overlaid with an arousal effect, which may to some extent attenuate the true effect due to white water kayaking.

During exposure to the white water environment there is an increase in the cortisol concentration in the saliva consistent with the growing psychological demands that the environment places on the learner. As the rapids get bigger, the cortisol concentration rises, but when that stimulus is removed at recovery (off the water for lunch), the cortisol levels lower. These findings are in accord with other research with similar exercise demands, for example Beaven et al. (2008) reported salivary cortisol concentrations in the range 0.2 to 5.5ng/ml with intense (10m sprints) exercise and high dose (800mg) caffeine ingestion. In their study salivary cortisol concentrations did not rise significantly with exercise only, but did by 52% with high dose caffeine and exercise. In the light of this research it is suggested that the exercise induced rise in cortisol concentrations during the on water data collection would be a smaller component and that the response to other factors in the natural white water environment is similar to, or greater than, the response to high dose caffeine

ingestion. This would suggest that it is likely that there is a considerable psychological component to the observed response.

Critical Flicker-Fusion Threshold

The CFF values measured in this study are somewhat higher than those reported in comparable studies. Falk and Kline (1978) report a mean CFF of 39.2Hz from their 'young' (19.1y) study group. In the Presland et al. (2005) study, where male only data was presented, pre-exercise CFF values were $39.2 \pm 2.3\text{Hz}$ (mean \pm SD). In the present study, using only the pre-exercise data from males at rest lodge, the CFF values were $41.2 \pm 4.1\text{Hz}$ (mean \pm SD). These values are higher by 2Hz and more variable. The higher values could be attributed to greater arousal in the present study due to an anticipatory response to the presumed stressors thought to be encountered during the ensuing kayaking day. CFF does not appear to be subject to circadian rhythms (Kraemer, Danker-Hopfe, Dorn, Schmidt, Ehler & Herrmann, 2000; Parkin et al., 1997).

It would be predicted from the literature (Presland et al., 2005; Payne, 1982) that CFF and therefore cognitive arousal, would increase as the participants became subjected to progressively stronger exercise and cognitive stressors, as was the case when kayaking the Ngaawapurua run on the Waikato river. This run starts with relatively un-taxing grade I conditions and slowly progresses in size of river features and speed, through two major rapids to the biggest and last rapid immediately upstream of the egress point (Grade III- (Ferrero, 1998; Ray, 1997)). As such, the stressor demands could be seen to steadily build over the course of the run and it would be predicted that the arousal would follow suit using Payne's (1982) model, where there is a direct relationship between mental arousal and CFF. This would seem to be the case up to a certain level of stimulus (rest lodge to on water one). However, at the highest states of physiological arousal observed in this study there would appear to be a drop in CFF (Fig.5.3), this was also reported by Parrott (1982). In Parrott's (1982) study self reported anxiety was correlated to CFF and it was found that very low anxiety produced a slight depression in CFF, low to medium anxiety produced a rise in CFF and high reported anxiety was linked to lowering of CFF by 1-3Hz. This would also

correspond to the findings in the present study where males dropped 0.9Hz and females dropped 4.1Hz at the time when other markers indicated the highest states of arousal were reached at on water two. In the present study the effect was much more noticeable in the females than the males. This depression in CFF appears to be unrelated to any exercise effect of the higher grade rapids at the end of the run as Presland et al. (2005) found an increase of 2.6Hz after exercise to exhaustion, with other authors (Brozek & Keys, 1944) reporting similar results, whereas the present study found a decrease in CFF at the largest rapids. It should also be noted that females have a smaller muscle mass and therefore the work rate by females compared to males for any given physical task would be greater. This exercise response would suggest that there would be an opposite effect to the one that has been seen in this study, if the change in CFF was in fact due to exercise. This exercise component may indeed be working in opposition to the over arousal effect and the true over arousal effect may indeed be larger than that which has been recorded here.

Two studies (Ginsburg, Jurenovskis, & Jamieson, 1982; Misiak, 1947) report males perceiving higher CFF values than women, by 1.7-1.8Hz. This may be in part due to the greater visual acuity of males relative to females (Roberts, 1964), but may also be due to factors such as those seen in this study where females appear to be more susceptible to, or reactive to, possible over arousal leading to lower CFF.

When associated with performance, cognitive arousal (i.e. CFF) would seem to be subject to a catastrophe curve (Hardy, 1990) (Fig. 2.5). In this model performance falls away dramatically above a certain level of arousal and is unable to increase again until there is a significant lowering of the stressor causing increased cognitive arousal. This is unlike physiological arousal that is predicted to behave with more of an inverted U form (Figs. 2.4, 2.5); where if physical ability starts to drop off due to over arousal, a lowering of that arousal will lead directly to increased physical ability until under arousal is reached. In this present study, this marked decrease in cognitive ability is seen in both gender groups but is greater and of more significance in the female participants

(Fig. 5.3). This drop in CFF, and therefore inferred cognitive ability, would suggest that the stressors placed upon the participants at on water one were optimal or sub optimal for cognitive ability as both gender groups record their highest CFF here. This may indicate the stressors at on water one being on the cusp of optimal cognitive performance. At on water two it can be observed that an apparent depression in cognitive performance by both genders occurs, with the female participants showing a more marked decrease which possibly indicates that the females may have experienced a catastrophe event (Hardy, 1990). If the quantitative data and qualitative statements regarding the participants' somatic arousal that were reported before the participants started their second day of training are examined (Figs. 5.4, 5.5), it can be seen that there are differences between both the Likert scales and phrases used by males and females. This data gives evidence that the females felt greater arousal and felt more anxious than the males and may explain why the females appear to have gone over the edge of the upper performance surface (Fig. 2.5) and have significantly depressed CFF. Hardy (1990) predicts that once performance has descended from the upper performance surface to the lower one (Fig. 2.5) that even with subsequent lowered arousal, performance will not be regained until much lower arousal has been achieved. He terms this performance/arousal lag hysteresis. Unfortunately this phenomenon occurred at the end of the kayaking run, and therefore subsequent performance could not be recorded. These results suggest a similar phenomenon to that found by Tomasik et al. (2009), where the processing of certain cognitions were found to be reduced when participants had to attend to a heavy stimuli burden.

Alternatively, these participants may have just fallen further off the peak of optimum cognitive ability. Hanin (2000) proposes an individual zone of optimum function (IZOF). It would appear here that there has been a demonstration of reaching and exceeding that zone on a cognitive arousal level for both genders at on water two, but to a greater degree by the females. Indeed the females would appear to have reached a tipping point where cognitive ability had been significantly affected, whilst the males, it is suggested, have merely just started to decline.

Correlation between arousal markers

There is little correlation between the arousal markers used in this study as has been the case in other studies of sport related arousal (Haneishi, Fry, Moore, Schilling, Li, & Fry, 2007; Hardy, 1990; Lacey, 1967). The differing arousal markers have different control pathways that are activated in different circumstances and possibly at differing levels of activation between individuals. However, the result is similar patterns of arousal over the day for the different markers when the mean for each group is used. Indeed it would appear that there is yet to be found a singular best marker or set of measures that accurately provide an overall indication of arousal (Stemmler, 1989). The largest correlations between arousal markers in this study involved the somatic arousal marker, although they were not quite statistically significant ($p = 0.07$). Thayer (1967) suggests that arousal is better determined through self-report than through physiological means, which may infer that the somatic arousal data collected in this study give a better indication of the participant's overall level of arousal than the physiological or cortical markers do. This may be due to the individual assessing their state of arousal from a blend (their own individual mix) of physiological markers as well as some that have not been recorded here or elsewhere yet. This would concur with Hanin's (2000) notion of individual zone of optimum function, and that the individual can perceive their own individual differences better than direct measurement of physiological arousal markers.

Summary

In this chapter arousal in a natural white water setting has been studied. It has emerged that there are considerable physiological, cognitive and somatic arousal responses when kayaking in a natural white water environment. It has emerged that heart rate and cortisol become elevated when kayaking in white water. However, it is not possible to quantify with certainty the relative contributions of exercise and psychological drivers. The CFF marker does differ: after following a similar trend of increasing from rest to the first kayaking measurement (rising with exercise), the CFF value significantly falls at the most demanding section of river (grade III- (Ferrero, 1998; Ray, 1997)). This may suggest that this response

is not exercise controlled, but that psychological stress factors may have exceeded the participant's cognitive processing capacity. These data strengthen the evidence that the heart rate and cortisol responses are not solely exercise driven but that they probably have, at least in some part, a psychological stress component. Further evidence suggesting a psychological role in the arousal response comes from the somatic data collected. In these data, like the CFF data, females show a greater response than males; the qualitative data also supports this with females reporting perceptions of higher anxiety, incompetence and worry. There is also a suggestion that high states of physiological arousal are associated with a detrimental effect on cognitive ability, and more so in females than in males.

The array of markers across the known arousal pathways gives a much better appreciation of the arousal response in this environment than any one marker would have done on its own. However, the somatic arousal marker may give the best overall indication of arousal, as it affects the participant, than other more direct measurement.

Main findings from this chapter regarding arousal in white water kayaking are:

- High resting heart rates and somatic expressions suggest an early anticipatory response with a psychological component.
- High heart rates while kayaking at low exercise intensities in rapids also may suggest a strong psychological determinant of heart rate.
- Cortisol was found to be the most reactive measure used, nearly doubling between rest and the largest rapids, while heart rate increased by 50%-60%.
- Higher salivary cortisol concentrations than would be predicted by exercise alone during kayaking further suggest that psychological factors may influence the arousal response.
- The CFF values are depressed at the largest rapids where other arousal markers are highest suggesting that cognitive processing capacity may be impaired at high states of arousal.

- There is little correlation between the arousal markers used. This suggests a high degree of individual difference in the activation of arousal pathways. Somatic arousal may have emerged as the best single marker.

CHAPTER 6

SELF-EFFICACY AND AROUSAL

6.1. PURPOSE

Following from Chapter 5 where arousal and emotion in white water kayaking were characterised, the role of the participant's self-efficacy beliefs (pre) on subsequent arousal and the role of arousal on subsequent self-efficacy beliefs (post) in the main study form the basis for the present chapter. In his seminal work on self-efficacy, Bandura (1977) identified physiological state (arousal) as one of the four antecedents of self-efficacy beliefs. In his later work (Bandura, 1983) suggests that the relationship between arousal and self-efficacy is of an interactive asymmetric nature. It should therefore follow that self-efficacy beliefs regarding white water kayaking ought to influence subsequent arousal state and that arousal state ought to influence subsequent self-efficacy beliefs constructed by white water kayakers.

The aims of this chapter were to determine:

- The role of (pre) self-efficacy beliefs on the subsequent physiological, cognitive and somatic arousal response, while white water kayak training.
- The role of the physiological, cognitive and somatic arousal response on subsequent (post) self-efficacy beliefs regarding white water kayaking.
- Whether there are gender differences in the role of physiological, cognitive and somatic arousal in developing self-efficacy beliefs in white water kayakers.

6.2. METHODS

The following summary of the methods for this chapter has been included here to put the methods into context. A full description is found in Chapter 3.

Data collection

This chapter uses the same forty participants and arousal data collected from them on the second day of a three-day white water kayaking training course, as were used in Chapter 5. Data regarding the participants' self-efficacy beliefs were collected using a thirty-three item self-report questionnaire (Appendix A), which was administered on day one (pre) and day three (post) of the training course.

Data analysis

The self-efficacy values used in this chapter have been calculated from the answers given on a five-point Likert-type scale. The mean for all the questions for each participant has been calculated and used to indicate the strength of each participant's self-efficacy beliefs, since a single value was necessary for correlations to be made.

The whole participant group has been used in correlations where stated, but it has also been divided into distinct sub-groups in order to study particular groups of participants. The division of the participant group was carried out using gender, upper and lower quartiles of strength of pre or post self-efficacy, and upper and lower quartiles of change in self-efficacy values between pre and post questionnaires.

Correlations are illustrated with x - y scatter plots and use the Pearson product moment correlation coefficient (r) to signify the closeness of the correlation between the variables and probability (p) to indicate statistical significance. The pattern of r values for pairs of variables has been plotted for each of the data collection sites and is used to illustrate the changes in correlation during different phases of the training day.

6.3. RESULTS

Pre and post self-efficacy of all participants related to the arousal markers

Figure 6.1 shows the correlations between self-efficacy and somatic arousal. Lower values for self-efficacy refer to judgements of less capability for the tasks, higher values refer to judgements of greater capability for the tasks. Lower values for somatic arousal refer to feelings of relaxation and calmness with higher values referring to feelings of heightened arousal. There was found to be highly significant large negative correlations between pre self-efficacy and somatic arousal, and somatic arousal and post self-efficacy.

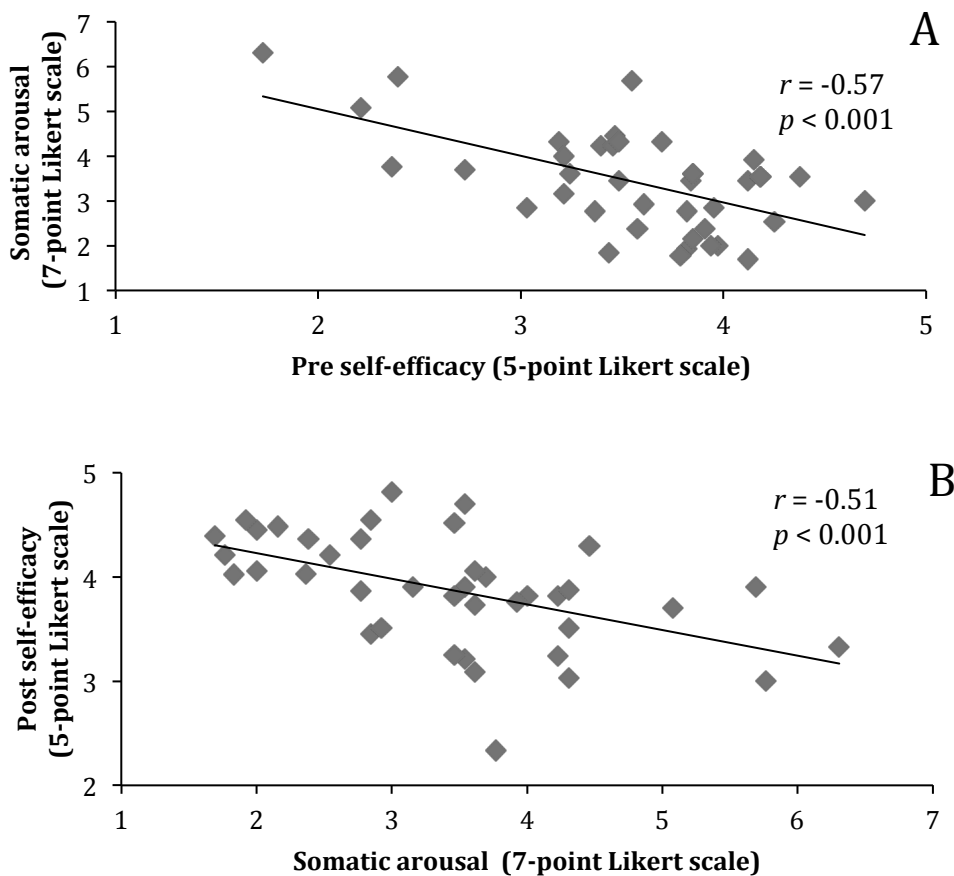


Figure 6.1. Self-efficacy correlated against somatic arousal.

Figure 6.2 illustrates the correlation found between post self-efficacy and salivary cortisol at on water one. Higher cortisol values are associated with higher arousal. The significant negative correlation shown here indicates that

participants who had higher cortisol levels reported weaker self-efficacy and vice versa.

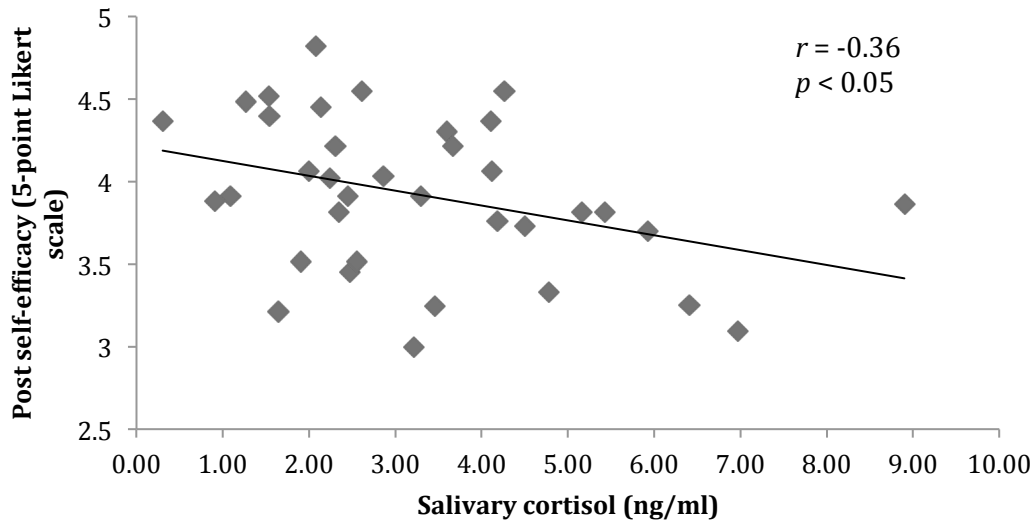


Figure 6.2. Salivary cortisol concentration at on water one correlated against post self-efficacy.

Regression analysis between pre or post self-efficacy and change in salivary cortisol concentrations from rest lodge to on water two indicates (Fig. 6.3) a significant moderate negative correlation.



Figure 6.3. Correlation between change (Δ) in salivary cortisol between rest lodge and on water two and post self-efficacy.

Gender related correlations between arousal markers and self-efficacy

The correlation between change in cortisol and post self-efficacy is consistent for both females ($r = -0.62, p < 0.05$) and males ($r = -0.38, p < 0.05$). Females ($n = 12$) also show a large negative correlation ($r = -0.5, p < 0.05$) between pre self-efficacy and somatic arousal.

When salivary cortisol concentration is correlated against self-efficacy for females (Fig. 6.4, A), there is a large ($r = 0.84, p < 0.001$ and $r = 0.82, p < 0.001$) positive correlation for post self-efficacy at rest riverbank and recovery, and a large ($r = -0.56, p < 0.05$) positive correlation between pre self-efficacy and cortisol at rest riverbank. The pattern of positive correlation, strengthening then reversing to a negative correlation, which then weakens before returning to a positive correlation, is consistent for females for both pre and post self-efficacy means.

Females have a large correlation between CFF and pre self-efficacy ($r = 0.55, p < 0.05$) and post self-efficacy ($r = 0.66, p < 0.01$) at rest lodge (Fig. 6.4, B). Post self-efficacy shows a positive correlation that weakens progressively through sites rest lodge to on water two with recovery showing a small negative correlation.

Females show a negative correlation between self-efficacy and heart rate at the sites with low heart rates (rest lodge, rest riverbank and recovery) (Fig. 6.4, C). However, at the high heart rate sites (whilst kayaking), between rapids at on water one and immediately after the biggest rapid at on water two, a small or trivial positive correlation can be seen. The only significant correlation between post self-efficacy and heart rate for females is at rest lodge ($r = -0.63, p < 0.05$). The trend is consistent for both pre and post self-efficacy correlated against heart rate.

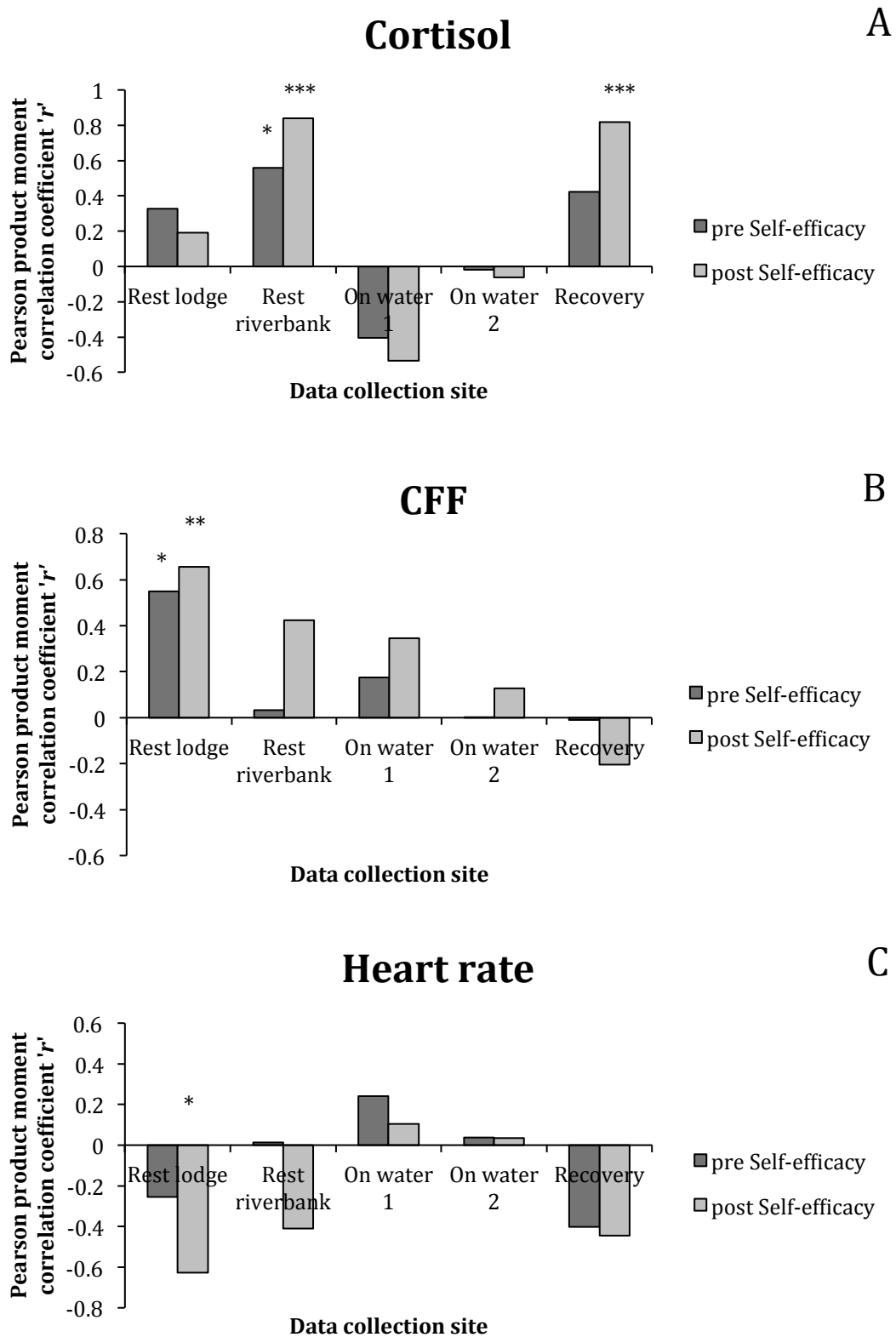


Figure 6.4 Arousal in females during different phases of the training day correlated against pre and post self-efficacy. * indicates $p \leq 0.05$, ** indicates $p \leq 0.01$ and *** indicates $p \leq 0.001$ for correlations between the arousal marker and self-efficacy.

Males show a moderate negative correlation ($r = -0.4, p < 0.05$) between pre self-efficacy and somatic arousal and a large negative correlation ($r = -0.6, p < 0.01$) between post self-efficacy and somatic arousal. Males return (Fig. 6.5, A) a small to moderate negative correlation between salivary cortisol concentration and self-efficacy through the five data collection sites with the strongest negative correlation ($r = -0.4, p < 0.05$) for post self-efficacy at on water two, immediately after the largest rapid. The males show (Fig. 6.5, B) a trivial negative correlation between pre self-efficacy and CFF at rest lodge that progressively strengthens to become significant at on water two ($r = -0.38, p \leq 0.05$), before weakening again at recovery. Post self-efficacy shows no correlation to CFF for the males. Males reveal trivial to small, mostly negative correlations (Fig. 6.5, C) between self-efficacy and heart rate except for a large significant negative correlation between pre self-efficacy and heart rate ($r = -0.5, p < 0.01$) at on water one.

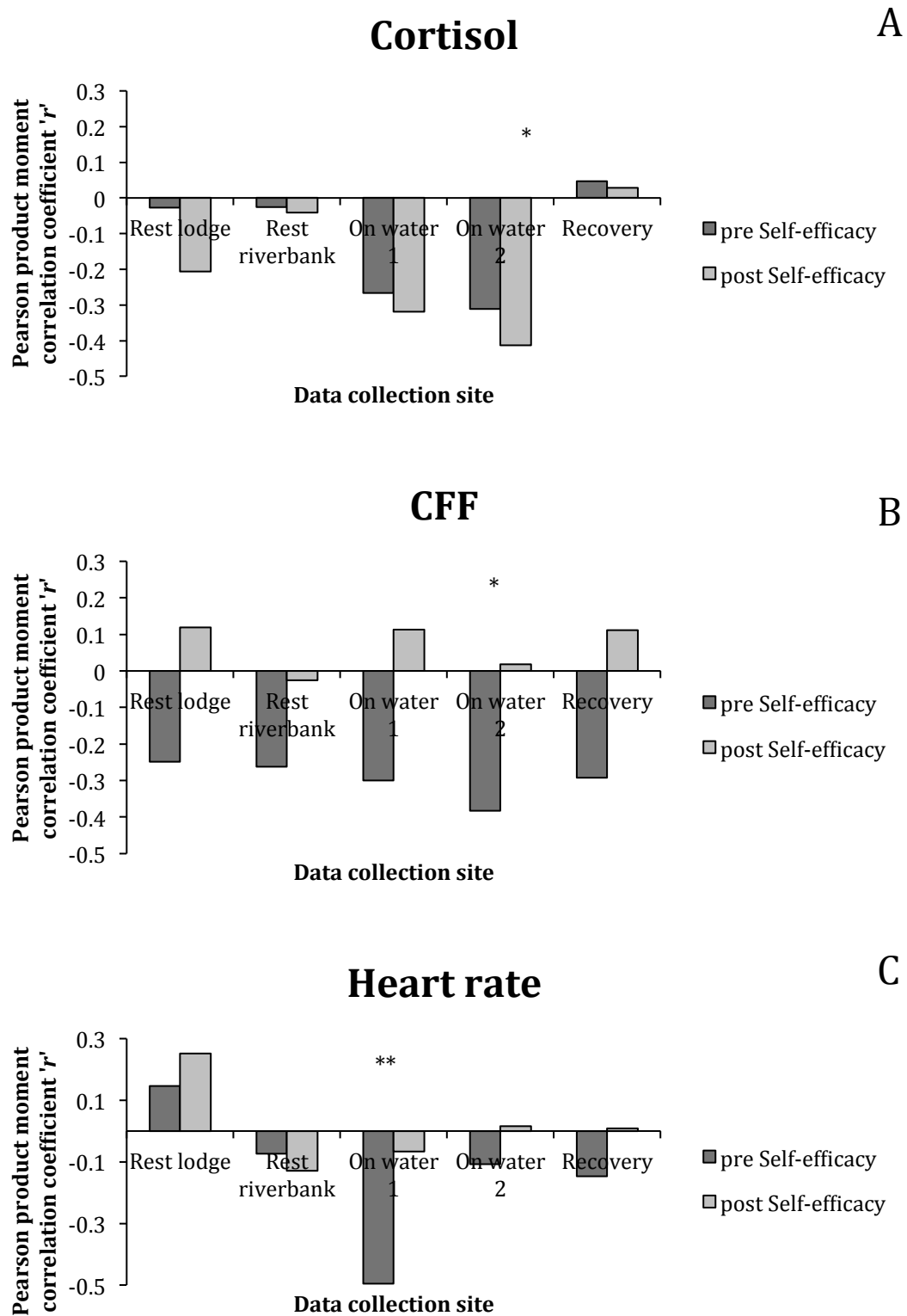


Figure 6.5. Arousal in males during different phases of the training day correlated against pre and post self-efficacy. * indicates $p \leq 0.05$ and ** indicates $p \leq 0.01$ for correlations between the arousal marker and self-efficacy.

Strength of preceding (pre) self-efficacy relationships with subsequent arousal

The lower quartile of pre self-efficacy was used to define the group of participants with weak pre self-efficacy ($n = 10$). This weak pre self-efficacy group comprised of 70% (7/10) females, showing a disproportionate representation of females from a total participant group of 70% (28/40) males and 30% (12/40) females. This group reveals a significant large negative correlation with somatic arousal ($r = -0.78, p < 0.01$). Cortisol displays a large negative correlation at recovery ($r = -0.60, p = 0.05$). The upper quartile of pre self-efficacy values was used to define a group with strong pre self-efficacy group ($n = 10$). The gender make up of this group shows a disproportionate representation of males (90%). Cortisol shows large correlation at rest riverbank ($r = 0.71, p < 0.05$). The group ($n = 20$) that lay between the upper and lower quartiles, the moderate self-efficacy group, was comprised of 20% (4/20) females and 80% (16/20) males.

Figure 6.6 shows the physiological (heart rate (A) and cortisol (B)) and cognitive (CFF (C)) arousal of the three differing strength of pre self-efficacy groups at the five data collection sites. It can be seen that strength of pre self-efficacy has little relation to subsequent heart rate as all groups have similar heart rates at each site, especially so at on water two. However, strength of pre self-efficacy would appear to have a relationship with the other physiological arousal marker, cortisol, at on water sites. Significant differences were detected between the cortisol responses of participants who previously reported weak compared to those who reported strong self-efficacy beliefs. Participants who previously reported weaker self-efficacy appear to subsequently have a greater cortisol response whilst white water kayaking. Participants with moderate pre self-efficacy beliefs appear to have the highest CFF values during the white water kayaking phases of the training day, with the subsequent CFF of the previously reported moderate self-efficacy group being significantly higher than the strong self-efficacy group. Repeated measures ANOVA reveals an interaction effect between site and pre self-efficacy on the cortisol marker ($p < 0.0001$) (Fig. 6.6B).

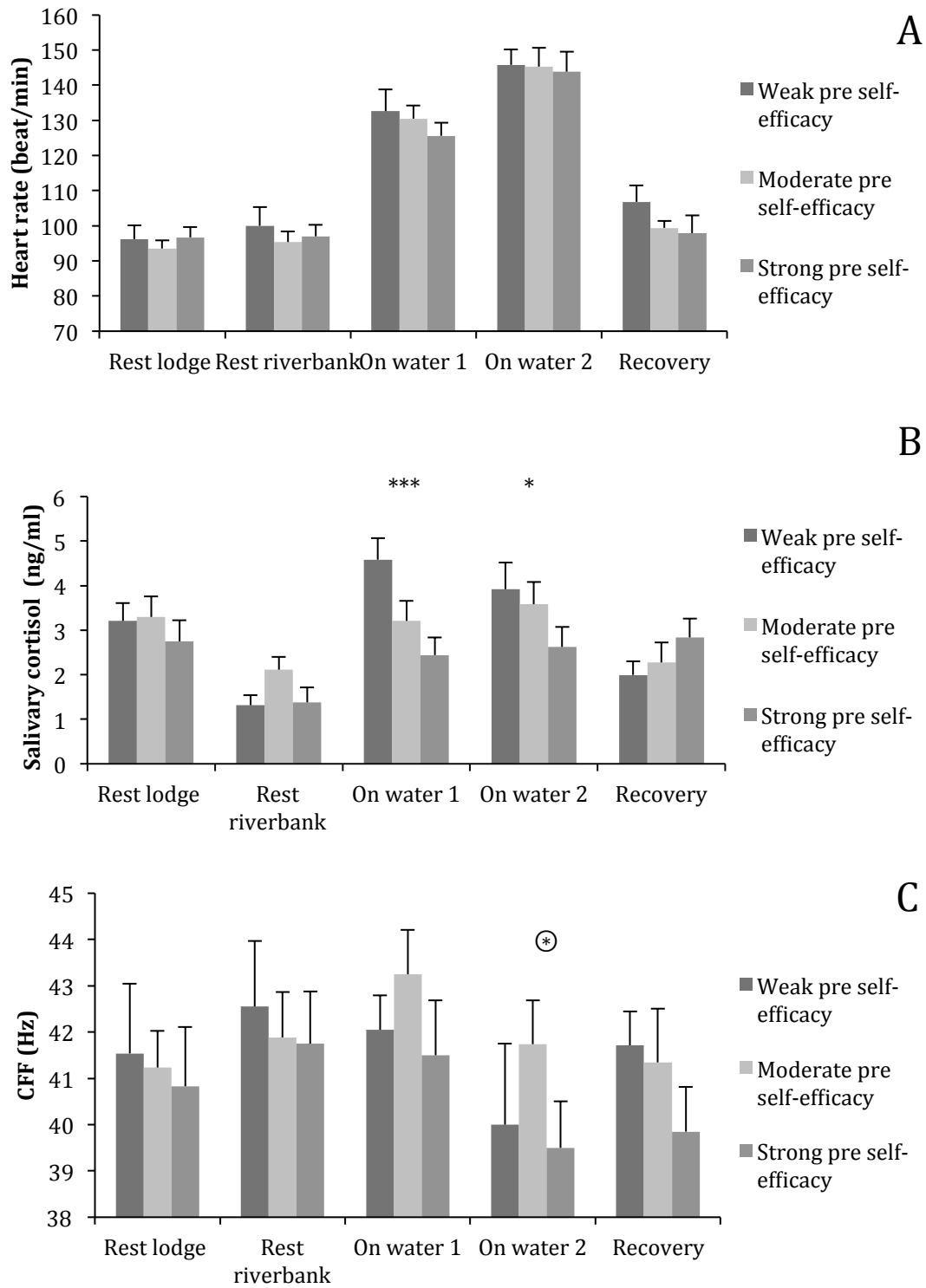


Figure 6.6 Physiological and cognitive arousal of participants with weak ($n = 10$), moderate ($n = 20$) and strong ($n = 10$) pre self-efficacy. Data are means \pm SEM. * indicates $p < 0.05$, *** indicates $p < 0.001$ difference in arousal between weak and strong self-efficacy groups. ⊗ indicates $p < 0.05$ difference in arousal between moderate and strong self-efficacy groups.

Participants who previously reported weak pre self-efficacy beliefs, later reported significantly higher (1.25/7 Likert units) somatic arousal, compared to those who reported strong pre self-efficacy beliefs (Fig. 6.7).

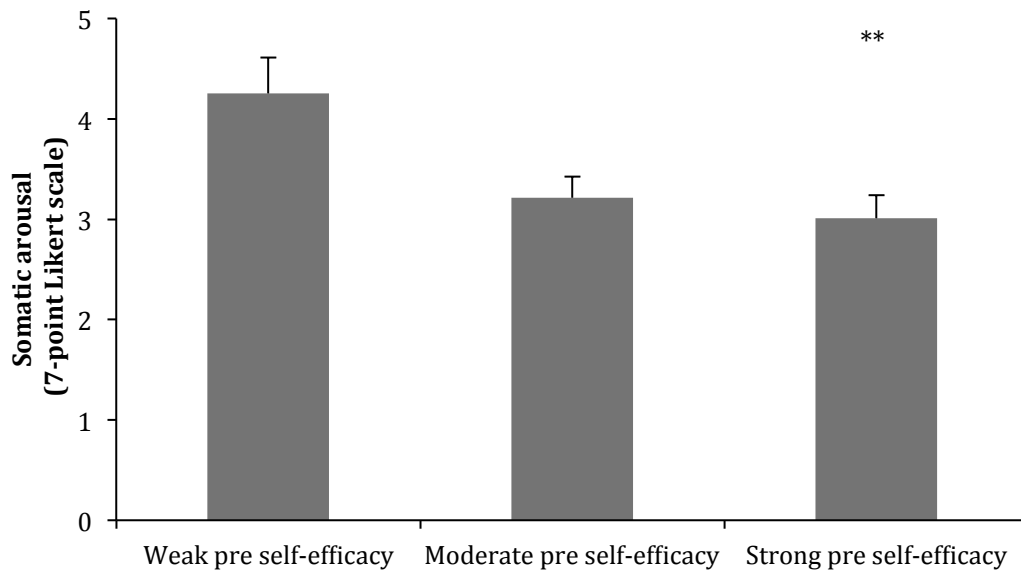


Figure 6.7 Somatic arousal of participants with weak ($n = 10$), moderate ($n = 20$), and strong ($n = 10$) pre self-efficacy. Data are means \pm SEM. ** indicates $p < 0.01$ difference in arousal between weak and strong self-efficacy groups.

Arousal relationships with strength of subsequent (post) self-efficacy

The participants below the lower quartile of post self-efficacy, the weak post self-efficacy group, are disproportionately females (6/10, 60%). The correlations between post self-efficacy and heart rate for this group are negative and largest at the lower arousal sites of rest lodge, rest riverbank and recovery ($r = -0.6$, $p < 0.05$, $r = -0.7$, $p < 0.05$ and $r = -0.6$, $p < 0.05$ respectively). CFF correlation is large and significant at rest riverbank ($r = 0.6$, $p < 0.05$). The participants who lay above the upper quartile of post self-efficacy, the strong post self-efficacy group, are disproportionately males (9/10, 90%). The correlation between heart rate at rest riverbank and subsequently reported post self-efficacy shows a large and significant positive relationship ($r = 0.6$, $p = 0.05$).

Figure 6.8 would appear to show that participants' previous somatic arousal reports have a highly significant association with subsequent strength of self-efficacy belief formation.

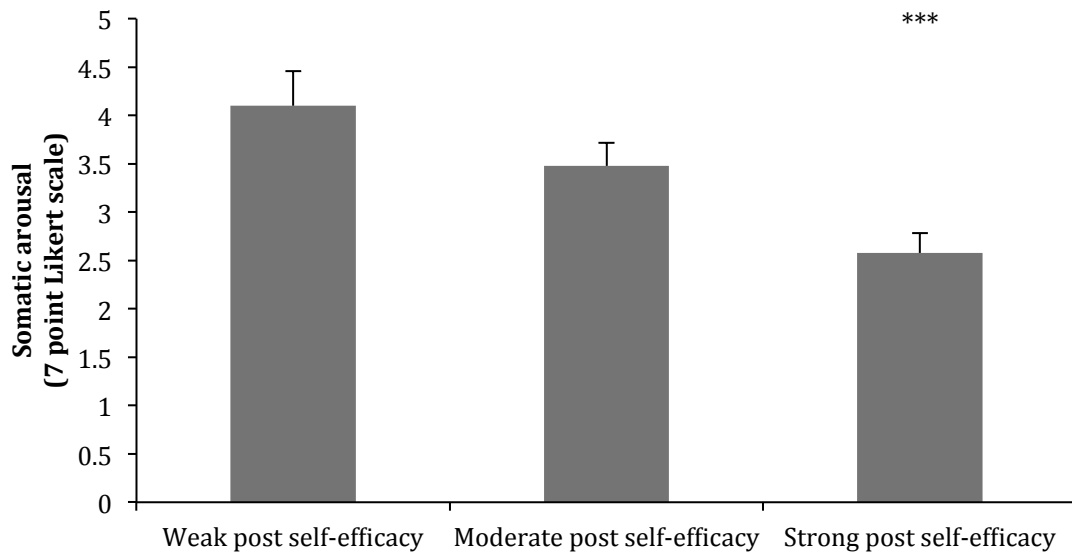


Figure 6.8 Somatic arousal of participants with weak ($n = 10$), moderate ($n = 20$), and strong ($n = 10$) post self-efficacy. Data are means \pm SEM. *** indicates $p < 0.001$ difference in somatic arousal between weak and strong self-efficacy groups.

Figure 6.9 shows the physiological (heart rate (A) and cortisol (B)) and cognitive (CFF (C)) arousal of the three differing strength of post self-efficacy groups at the five data collection sites. Heart rate appears to have little effect on subsequent self-efficacy reports, there being no significant differences detected between heart rate response and strength of subsequent self-efficacy beliefs. Cortisol however, shows significant differences at rest (rest lodge) as well as whilst kayaking (on water one), between participants who reported their self-efficacy beliefs to be weak as opposed to those reporting strong self-efficacy beliefs.

Multiple regression analysis was used to help determine the best variables to explain the variation found in the post self-efficacy variable seen in Figure 6.9. Post self-efficacy relates to heart rate at on water one ($p = 0.002$), CFF at recovery ($p = 0.045$) and pre self-efficacy ($p = 0.0005$). The R square value for post self-efficacy was 0.30 for pre self-efficacy and 0.71 for pre self-efficacy with physiological arousal (heart rate and cortisol).

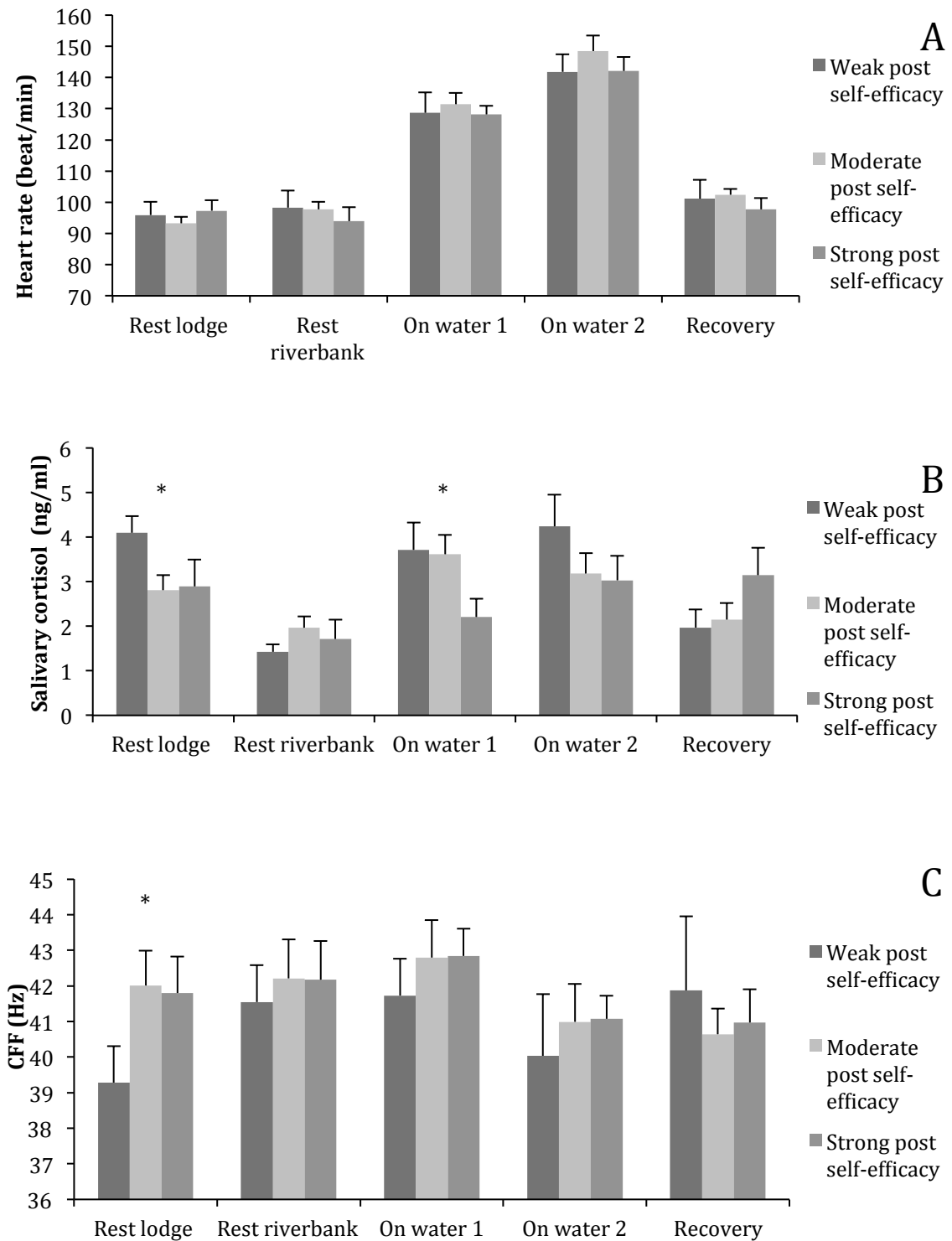


Figure 6.9 Physiological (A, B) and cognitive (C) arousal of participants with weak ($n = 10$), moderate ($n = 20$) and strong ($n = 10$) post self-efficacy. Data are means \pm SEM. * indicates $p < 0.05$ difference in arousal between weak and strong self-efficacy groups.

Correlations to changes in self-efficacy beliefs between the pre and post questionnaire

The change in the participants' self-efficacy was calculated between pre and post questionnaires, and returned both positive and negative values. The number of participants returning negative values ($n = 11$) equates roughly to a quartile and therefore those participants returning a negative change value have been defined as a group. This group has been termed the negative change group as it is not strictly a lower quartile and to identify it as such would be incorrect. The participants whose change in self-efficacy lay above the upper quartile of change have been termed the highest change group. The negative change group shows a proportionately correct representation of males and females with 70% and 30% respectively. Heart rate shows a large correlation at recovery ($r = 0.6, p = 0.05$). The correlation of cortisol to negative change values increases through the sites reaching a significant large correlation at recovery ($r = 0.7, p < 0.05$). The highest change group has a disproportionate number of females represented (50%). CFF shows its strongest correlation ($r = 0.6, p = 0.05$) at on water one with the correlation weakening on either side of this site.

6.4. DISCUSSION

Bandura's (1977) original concept of an individual's self-efficacy belief being constructed from information from four antecedents (physiological state, performance accomplishment, vicarious experience and verbal persuasion) has been revised since its first publication. Bandura himself (Bandura, 1983) subsequently described the relationship between physiological state (fear arousal) and self-efficacy as an interactive though asymmetrical relationship. He reasoned that individuals who judge themselves to have weak self-efficacy for a given task, approach that task anxiously. This anxiety results in a state of arousal that in turn further weakens the perception that they will be able to execute the task. He predicts that the relationship is asymmetric because the experiences of past performance (performance accomplishment) and social comparison (vicarious experience) carry greater influence, being more reliable indicators of future capability than the somatic perception of arousal.

In this study, pre self-efficacy shows a significant large negative correlation with somatic arousal (Fig. 6.1, A). This might be expected where participants who believe they have strong self-efficacy for white water kayaking might also be expected to have somatic feelings of a relaxed and calm nature, whereas those participants who express beliefs of weaker self-efficacy for white water kayaking might also be expected to report feelings of greater uneasiness, arousal or anxiety. This correlation might suggest that self-efficacy beliefs have an influence on subsequent somatic arousal as predicted by Bandura (1983).

Somatic arousal also shows significant large correlations with post self-efficacy (Fig. 6.1, B). This could indicate that somatic arousal may indeed be a better overall indicator of arousal, as it affects the formation of self-efficacy beliefs, than the other arousal measures used either individually or collectively as was found by Thayer (1967; 1970). A person's perception of arousal may be influenced by one or more factors not measured in this study (e.g. adrenaline, blood pressure vasodilation) and the somatic marker, as the participants expressed it, may take these other influences into account, even though the participants themselves may perhaps not be consciously aware of them and are unknowingly influenced by them. Their perceived arousal may therefore have a greater influence on their self-efficacy beliefs than their actual arousal, in a similar way to that suggested by Usher and Pajares (2008) regarding attainment and self-efficacy beliefs.

The significant correlation between post self-efficacy for all participants and salivary cortisol concentrations at on water one (Fig. 6.2) may show that the participants with lower cortisol concentrations develop stronger self-efficacy and is consistent with higher levels in the arousal markers leading to weaker self-efficacy beliefs. These findings concur with Bussey's (2011) remarks that student confidence in their capabilities is likely to be increased with less stress and anxiety. She adds, perceptions of negative affect can hinder performance and therefore weaken self-efficacy beliefs and while some arousal can be facilitative to certain performances it is the interpretation of this raised arousal that can be debilitating. Of note also is that post self-efficacy is also significantly correlated

with change in cortisol between low and high arousal sites (Fig. 6.3), indicating that strengthening self-efficacy beliefs are associated with the reactivity of the HPAC system, as was found by Wiedenfeld et al. (1990). Feelings of capability associate with small reactions in salivary cortisol and vice versa.

The *R* square values for the multiple regression analysis reveals that ~30% of the variation in post self-efficacy values can be attributed to pre self-efficacy values, but more importantly, ~70% of the variation can be attributed to the combined effect of pre self-efficacy together with physiological arousal. This suggests a more important role for physiological arousal in subsequent self-efficacy belief formation than is generally reported in the literature (Bandura, 1997; Bates & Khasawnek, 2007; Britner & Pajares, 2006; Pajares, Johnson, & Usher, 2007; Schunk & Meece, 2005; Usher & Pajares, 2008). In this literature the preeminent antecedent of self-efficacy belief formation is performance accomplishment, i.e. actually succeeding or mastering a skill or function. There could be many reasons why there is a difference between that which has been observed in this study and that observed by others. One possible reason is that the participants in this study were novices, whereas many of the studies in the literature were treating chronic conditions. Another possible reason is that the conditions under which this study took place were quite possibly more threatening, especially as there was very little chance of opting out, than the conditions under which the other studies were conducted. This may have lead to higher states stress and subsequent arousal. This heightened stress and arousal may have in turn taken a greater role in self-efficacy belief formation than has been recorded before.

Gender differences

There are gender differences in the way that self-efficacy correlates with arousal (Figs. 6.4, 6.5). When the results are taken from all participants as a whole, the differing patterns of correlation between these sub-groups cancel each other out to a greater or lesser extent leading to a lack of correlation. For example, this can be seen in the male and female correlation between post self-efficacy and salivary cortisol at rest riverbank (immediately prior to getting on the water).

The females returned an r -value of 0.84, $p < 0.01$ that was part of a pattern displaying positive correlation at sites of low arousal, and a negative correlation at sites where a high arousal was evident. The males, for the same variables, returned an r -value of -0.04 that was the lowest point of a small and trivial negative correlation. However, when taken as a whole, the correlation between post self-efficacy and salivary cortisol for all participants returns an r -value of 0.23, $p > 0.1$ which does not reflect the correlations that do exist for particular participant sub-groups, and could therefore be overlooked as a trivial non-significant correlation.

The differences between gender correlation patterns (Fig. 6.4, 6.5) suggest that self-efficacy beliefs are formulated in different ways by the two genders. This to some degree reflects the findings of Estes and Ewert (1988) that in outdoor activity settings males portray confidence, assertiveness, and athleticism, seeking excitement through high-risk activities. Whereas, females show warmth and expressiveness, seeking health and spirituality through engaging in low-risk activities. These gender differences may have an effect on the conditions that each gender uses to formulate their self-efficacy beliefs. The pattern of correlation for the two gender groups, across the five sites, is markedly different when heart rate and CFF is correlated against post self-efficacy. While the cortisol regression pattern is similar, there is a notable shift to a positive correlation in the females' pattern and to a more negative one in the males' pattern. The pattern shown by arousal in the previous chapter (Figs. 5.1, 5.2, 5.3) shows how both male and female arousal markers react over the phases of the kayak training day. It will be noticed that heart rate and cortisol markers have a very similar pattern, whilst CFF differs markedly between the genders. Given the difference in CFF response, and the lack of similarity in the regression patterns when they are correlated against self-efficacy, this is hardly surprising. Also to be expected is the similarity of the cortisol regression pattern given that the arousal response is so similar. However, since it can be seen that the male and female heart rate arousal responses are so similar (Fig. 5.1), it is surprising that the regression patterns are so different for the correlation between heart rate

and self-efficacy (Figs. 6.4, 6.5). In fact, the pattern is the opposite, although the males' pattern is somewhat less pronounced.

Females have significant correlations (Fig. 6.4) at low arousal, off water sites. Cortisol and CFF return positive correlations while heart rate returns a negative correlation for these markers at the low arousal sites, suggesting that the self-efficacy beliefs of females are predominately constructed in low arousal conditions. Females who experience higher arousal in the cortisol and CFF markers and lower arousal in the heart rate marker, would appear to form stronger self-efficacy beliefs. Males have significant negative correlations (Fig. 6.5) for heart rate, cortisol and CFF at the on water sites where arousal is high (Figs. 5.1, 5.2, 5.3). This would suggest that self-efficacy beliefs for males are formed during periods of high arousal with those participants who experience higher arousal forming weaker self-efficacy beliefs. The correlations found indicate that higher arousal is associated with weaker self-efficacy and vice versa, which is consistent with the literature (Bandura et al., 1985; Bussey, 2011). These correlations follow predictable patterns and therefore some inference can be made that the arousal markers do affect self-efficacy beliefs to some degree, particularly the markers that show a reversal of positive to negative correlation or vice versa at the on water sites. However, this study would suggest that females have stronger associations between arousal and self-efficacy beliefs and that perhaps arousal is of more importance in their self-efficacy judgement formation than for males. The two seminal studies conducted by Bandura and colleagues (1982; 1985) in this area (fear arousal and catecholamine response as a function of self-efficacy) only involved female participants, which somewhat limits the generalisability of their findings.

Lazarus (1991) suggests that stress reactions (rise in heart rate and secretion of cortisol) are part of a 'primary appraisal' that in turn trigger coping strategies or 'secondary appraisal', one of which is self-efficacy (O'Leary & Brown, 1985). It would follow, therefore, that self-efficacy is impacted by the stress response but that the stress response is not impacted by the beliefs regarding self-efficacy.

From this study it would appear that the following arousal states act upon self-efficacy beliefs in the manner described below.

- Low heart rates seem to influence the formation of strong self-efficacy beliefs, as is described by a negative correlation at low arousal states.
- High heart rates seem to influence the formation of strong self-efficacy beliefs, as is described by a positive correlation at high arousal states.
- Low salivary cortisol concentrations seem to influence the formation of weak self-efficacy beliefs, as is described by a positive correlation at low arousal states.
- High salivary cortisol concentrations seem to influence the formation of weak self-efficacy beliefs, as is described by a positive correlation at high arousal states.

This would suggest that there is not a linear relationship between self-efficacy and the arousal markers used for this study. This is supported by Bandura et al. (1985) who reported non-linear associations between self-efficacy and catecholamine secretion in varying conditions of stress. There is also a difference in the effect of the heart rate and cortisol markers on self-efficacy, with these seemingly acting in opposite ways. Wiedenfeld et al. (1990) found that the speed of self-efficacy growth had an effect on which nervous pathway was stimulated. They suggested that slow self-efficacy growth stimulated the HPAC pathway, which involves cortisol, while rapid self-efficacy growth stimulates the SAM pathway involving heart rate. This may account for the seemingly opposite stimulation of the heart rate and cortisol by the self-efficacy beliefs seen in this study.

A negative correlation between self-efficacy and arousal indicates that as self-efficacy strengthens arousal lowers and its opposite, that being, as self-efficacy weakens arousal rises. In contrast, a positive correlation indicates that as self-efficacy strengthens the level of arousal rises and as self-efficacy weakens arousal levels lower. There is however an opposite effect displayed when heart rate and cortisol are correlated against self-efficacy. Heart rate correlations trend towards positive at the sites of high arousal, whereas the cortisol results

trend towards negative correlations, at the same high arousal sites (both on water sites). This would suggest that these two factors act upon self-efficacy in different ways.

The trend of going from a large correlation to a smaller one at high arousal states can be explained by the variation in the degree of an individual's responses as would be indicated by larger standard deviations at these sites, and indeed heart rate and cortisol return their largest standard deviations at the on water sites. However, this increased spread in data does not adequately explain the trends from negative to positive correlations or vice versa that are displayed. The difference in correlation trend does nonetheless indicate that heart rate and cortisol act upon, or are acted upon by, self-efficacy in differing manners.

The patterns of correlation would suggest that differing arousal factors influence the formation of self-efficacy beliefs in differing ways or that indeed self-efficacy beliefs influence the activation of the arousal markers, depending on whether the correlation is between the arousal marker and pre or post self-efficacy. There may be two important factors governing this difference of influence, one is that the control of the markers are from differing pathways, and the other is that they affect self-efficacy at differing states of arousal. Correlation between an arousal marker and self-efficacy suggests that it may have a major influence on formulation of self-efficacy beliefs, whereas a lack of correlation at a given arousal state suggests that it is of no great importance to the formation of the individual's beliefs. Correlation at the sites associated with low arousal suggests that low arousal environments are important and help to form the self-efficacy beliefs regarding that arousal factor, whereas correlation at the high arousal sites suggests that self-efficacy is more influenced by that arousal factor when it is in an elevated state. It has been shown (Britner & Pajares, 2006) that females report experiencing greater anxiety than males for the same task and that females are prone to interpret this raised anxiety as a lack of competence, which in turn weakens self-efficacy beliefs.

Males' and females' significant correlations between pre self-efficacy and arousal and between arousal and post self-efficacy suggests a two-way interactive relationship as described by Bandura (1983). However, there seems to be little evidence of the asymmetric relationship that Bandura (1983) predicts, with only the males' heart rate correlations showing signs of asymmetry. This study has found that there is asymmetry in the correlations for arousal and self-efficacy between males and females. It can be seen (Fig. 6.4) that females have stronger associations between arousal and self-efficacy in *low* arousal conditions, suggesting that females' self-efficacy beliefs influence and are influenced by their arousal response during periods of low arousal. Conversely males can be seen (Fig. 6.5) to have stronger associations between arousal and self-efficacy in conditions of *high* arousal suggesting that males' self-efficacy beliefs influence and are influenced by their arousal response during periods of high arousal.

Heart rate is controlled by the sympathetic-adrenomedullary system (SAM), and seems to be negatively associated with self-efficacy at low states of arousal. Cortisol is controlled by the hypothalamic-pituitary-adrenocortical (HPAC) system and seems to be positively associated with self-efficacy at low states of arousal. CFF is controlled by the cerebral cortex and although it is positively associated with self-efficacy beliefs at low arousal, the pattern of regression continues to weaken as the training day continues even during recovery. The opposing correlation pattern between self-efficacy and heart rate or cortisol, particularly for females (Fig. 6.4), might suggest that self-efficacy beliefs activate or are influenced by the SAM and HPAC pathways in differing ways. This finding to some extent supports the proposition of Wiedenfeld et al. (1990) that the HPAC controlled arousal response differs in its association with self-efficacy from the SAM controlled arousal response studied by Bandura et al. (1985). However, no other studies have been found that directly compare arousal responses controlled from the two pathways with the self-efficacy beliefs for the same participants.

Strength of self-efficacy beliefs and arousal

The strength of self-efficacy beliefs appears to be related to the subsequent arousal response for all markers except heart rate (Figs. 6.6, 6.7). Weak or moderate self-efficacy beliefs would seem to invoke the largest arousal response and strong self-efficacy beliefs invoke the smallest arousal response. The highly significant interaction effect between site, pre self-efficacy and salivary cortisol, suggests a strong inter-relationship. As can be seen in Fig. 6.6(B) those participants with weak pre self-efficacy beliefs showed a marked increase in salivary cortisol while on the water. This suggests not only that cortisol may be an indicative marker for the type of arousal that exposure to the white water environment induces, but also that strength of pre self-efficacy does have an important influence on subsequent arousal in this domain. This finding is somewhat different to the findings reported by Bandura et al. (1985). In their study, participants did not attempt tasks to which they had weak self-efficacy beliefs and therefore did not have a catecholamine arousal response to them. In the present study all participants were intrinsically or extrinsically motivated to undertake white water kayaking tasks as part of their outdoor leadership training programme, even though they had weak or very weak self-efficacy beliefs for the tasks. This, it is proposed, gives a more accurate reflection of the invoked arousal response to tasks for which participants have weak self-efficacy beliefs.

The arousal response appears to be related to the subsequent strength of self-efficacy beliefs for all markers except heart rate (Figs. 6.8, 6.9). High somatic and cortisol markers are associated with weak subsequent self-efficacy beliefs, while low CFF appears to result in weak self-efficacy beliefs. This finding further supports the proposed notion that those participants with low CFF may have experienced over arousal with the resultant depression in CFF as has been discussed in Chapter 5.

Self-efficacy growth and arousal

Further validation of the proposal of Wiedenfeld et al. (1990) that rapid self-efficacy growth eliciting SAM pathway responses and slower growth eliciting

HPAC pathway responses was not found in this study. Slow self-efficacy growth, as indicated by the negative change in self-efficacy sub-group, showed large correlations for both heart rate and cortisol at recovery, giving a marker for both SAM and HPAC pathways. Rapid self-efficacy growth, as indicated by the positive change in self-efficacy sub-group, shows a large correlation with CFF at on water one, which has been linked with neither SAM nor HPAC pathways, although possibly partly influenced by both. It is of note that the correlations for the two self-efficacy change sub-groups occur at different arousal levels. The correlations found for the negative change group occurring at low arousal sites (recovery) while the positive change sub-group's correlation occurs at a relatively high arousal site (on water one). This suggests that there is a relationship between self-efficacy growth and arousal.

Main findings from this chapter regarding self-efficacy and arousal are:

- Participants with weak or moderate pre self-efficacy beliefs show the largest subsequent cortisol arousal response.
- Participants with high somatic arousal and high cortisol levels and low CFF subsequently reported weak post self-efficacy beliefs.
- Females, have greater association between arousal and self-efficacy beliefs in low arousal conditions. This suggests that females' arousal may have an influence on self-efficacy beliefs formation when participants are in low stress environments.
- For males, greater association is found between arousal and self-efficacy in high arousal conditions. This indicates that, for males, arousal may have an influence on self-efficacy beliefs formation when participants are in high stress environments.

CHAPTER 7

SELF-EFFICACY AND LEARNING

7.1 PURPOSE

To enable the later investigation into the effectiveness of a self-efficacy augmentation intervention on learning, it was first necessary to consider the relationships that exist between self-efficacy and learning. Testing the participants' attainment in specific core white water kayaking skills and gaining an indication of their self-efficacy beliefs at the start and then again at the end of the training programme allows the learning, and changes in self-efficacy, that took place whilst undertaking the training to be assessed. If self-efficacy has an effect on skill development then the initial stages of that skill development will occur under the influence of the pre self-efficacy judgements and the latter stages of skill development will occur under the influence of the developing post self-efficacy beliefs. However, skill attainment may have a stronger influence on self-efficacy than self-efficacy does on skill attainment, as predicted by Bandura (1983), in which case self-efficacy beliefs may be somewhat transient and open to change depending on the actual performance at the time. Cervone (1993) describes the self-efficacy-performance, performance-self-efficacy relationship as reciprocal. Therefore it is necessary to investigate the influence of both pre and post self-efficacy on skill development (learning).

The aims of this chapter were to investigate:

- The relationships between participants' judgements of capability (self-efficacy) for core white water skills and their attainment in those skills.
- The relationship between change in self-efficacy and change in skills (learning).
- Whether all self-efficacy antecedents have similar relationships to all skills.

7.2 METHODS

The following is a brief summary of the particular methods used in this chapter. A full description is found in Chapter 3.

Data collection

Forty participants, comprising 28 males and 12 females, took part in this study. Skill data were collected in a pretest conducted on day one and a posttest on day three. Attainment was graded from 1 (incompetent) to 10 (mastery) for three core kayaking skills.

The self-efficacy data was collected using a self-report questionnaire (Appendix A) at the start of day one (pre) and at the end of day three (post). For self-efficacy a score of 1 represents not capable at all and 5 represents totally capable.

Data analysis

The data collected for the three core skills (rolling, eddy turns and ferry gliding) have been combined in some instances to give an overall pre and post skill level for white water kayaking and have also been used separately, as stated in the text, to give a skill level for each of the three skills.

The mean of each participant's self-efficacy data for all questions has been used to indicate an overall strength of self-efficacy belief for white water kayaking but has also been separated into its constituent skill areas and antecedents where appropriate. When the self-efficacy for specific skills has been used for analysis, the mean of the responses to the following questions has been used.

- Eddy turn self-efficacy: Questions 1a, 1d, 1g, 2a, 3a, 4a, 4d, 5a, 5d and 7.
- Ferry glide self-efficacy: Questions 1b, 1e, 1h, 2b, 3b, 4b, 4e, 5b, 5e and 8.
- Staying upright self-efficacy: Questions 1c, 1f, 1i, 2c, 3c, 4c, 4f, 5c and 5f.

When analysing the role of the four antecedents of self-efficacy, the mean of the responses to the following questions have been used.

- Physiological arousal: All parts of question 2
- Performance accomplishment: All parts of question 3

- Vicarious experience: All parts of question 4
- Verbal persuasion: All parts of question 5

Pearson product moment correlation coefficients (r) have been calculated for the regression analysis and probability (p) stated.

7.3 RESULTS

Table 7.1 shows the correlations between self-efficacy and post skills. It was found that large and extremely significant ($r < 0.5$, $p < 0.001$) correlations occurred between both pre and post self-efficacy and the post skill means. The individual core white water skills correlate significantly with pre and post self-efficacy except for the correlation between post eddy turn skill and post self-efficacy ($r = 0.21$). Post rolling skill returns moderate to large ($r = 0.4$ to 0.5) highly significant ($p < 0.01$) correlations with pre and post self-efficacy and pre and post rolling self-efficacy.

Table 7.1 Self-efficacy correlated against post skills. * indicates $p \leq 0.05$, ** indicates $p \leq 0.01$, *** indicates $p \leq 0.001$.

	Post ferry glide skill	Post eddy turn skill	Post rolling skill	Post skill mean
Pre self-efficacy	$r = 0.38$ *	$r = 0.36$ *	$r = 0.50$ **	$r = 0.54$ ***
Post self-efficacy	$r = 0.47$ **	$r = 0.21$	$r = 0.45$ **	$r = 0.51$ ***
Pre ferry glide self-efficacy	$r = 0.14$			
Pre eddy turn self-efficacy		$r = 0.24$		
Pre rolling self-efficacy			$r = 0.40$ **	
Post ferry glide self-efficacy	$r = 0.43$ **			
Post eddy turn self-efficacy		$r = 0.12$		
Post rolling self-efficacy			$r = 0.49$ **	

Post ferry glide skill has a moderate ($r = 0.43$) and highly significant ($p < 0.01$) correlation with post ferry glide self-efficacy but returns a small and non-significant correlation with pre ferry glide self-efficacy. Post eddy turn skill does not correlate significantly with pre or post eddy turn self-efficacy.

Figure 7.1 shows a negative correlation between pre ferry glide self-efficacy. This reflects a trend that participants with high pre ferry glide self-efficacy tended to change their skills less than those with lower pre ferry glide self efficacy.

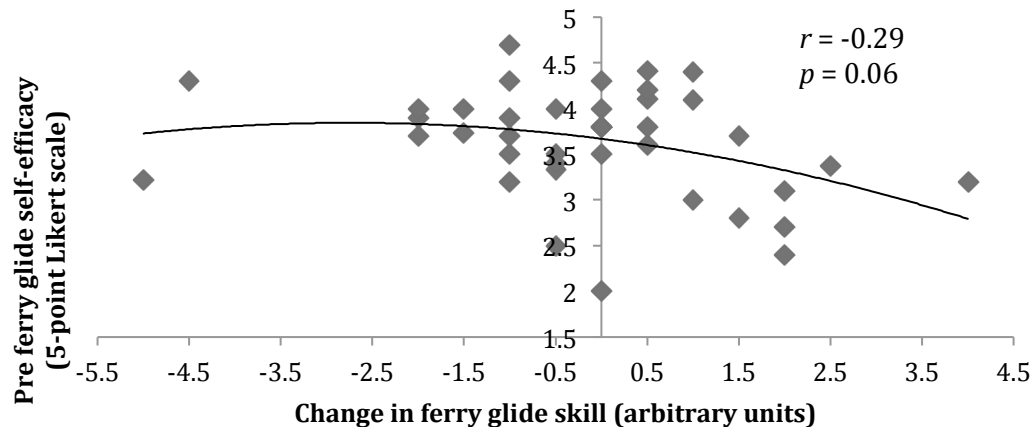


Figure 7.1. Change in ferry glide skill correlated against pre ferry glide self-efficacy.

Table 7.2 shows the correlation between self-efficacy and the change in skills (learning). This table shows that change in ferry glide skill correlates ($r = 0.41$, $p = 0.01$) with change in ferry glide self-efficacy, moderately and significantly, while change in the other skills correlate trivially with the change in their respective self-efficacies. Pre self-efficacy does not correlate significantly with change in skills, the largest correlation being between pre ferry glide self-efficacy and change in ferry glide skill ($r = -0.29$, $p = 0.06$). Post self-efficacy does not significantly correlate with change in skills. The largest correlation for post self-efficacy occurs between post eddy turn self-efficacy and change in eddy turn skill ($r = -0.23$, $p = 0.13$).

Table 7.2 Self-efficacy correlated against Δ (change) skills. ** indicates $p \leq 0.01$.

	Δ skill mean	Δ ferry glide skill	Δ eddy turn skill	Δ rolling skill
Δ self-efficacy	$r = 0.13$	$r = 0.27$ $p = 0.07$	$r = 0.02$	$r = 0.13$
Δ ferry glide self-efficacy		$r = 0.41$ **		
Δ eddy turn self-efficacy			$r = -0.01$	
Δ staying upright self-efficacy				$r = 0.13$
Pre self-efficacy	$r = 0.01$	$r = 0.05$	$r = -0.09$	$r = 0.02$
Pre ferry glide self-efficacy		$r = -0.29$ $p = 0.06$		
Pre eddy turn self-efficacy			$r = -0.13$	
Pre staying upright self-efficacy				$r = -0.06$
Post self-efficacy	$r = -0.06$	$r = 0.005$	$r = -0.22$	$r = 0.01$
Post ferry glide self-efficacy		$r = 0.01$		
Post eddy turn self-efficacy			$r = -0.23$	
Post staying upright self-efficacy				$r = 0.05$

Table 7.3 shows the correlations between the four self-efficacy antecedents and post skill attainment, skill change, post self-efficacy and self-efficacy change. It can be seen that post skill is significantly correlated with all antecedents except vicarious experience and is most strongly correlated with performance accomplishment (pre $r = 0.37$, $p < 0.01$ and post $r = 0.53$, $p < 0.001$) and physiological arousal (pre $r = 0.48$, $p < 0.01$ and post $r = 0.37$, $p < 0.05$).

Table 7.3. *Self-efficacy antecedents correlated against skill and self-efficacy.** denotes $p < 0.05$, ** denotes $p < 0.01$, *** denotes $p < 0.001$.

	Pre physiological arousal	Pre performance accomplishment	Pre vicarious experience	Pre verbal persuasion	Post physiological arousal	Post performance accomplishment	Post vicarious experience	Post verbal persuasion
Post skill	$r = 0.48$ **	$r = 0.48$ **	$r = 0.25$	$r = 0.27$ $p = 0.07$	$r = 0.37$ *	$r = 0.53$ ***	$r = 0.25$	$r = 0.39$ *
Δ Skill	$r = 0.04$	$r = -0.18$	$r = -0.09$	$r = -0.2$	$r = -0.03$	$r = -0.005$	$r = -0.04$	$r = -0.19$
Post self- efficacy	$r = 0.47$ **	$r = 0.64$ ***	$r = 0.41$ **	$r = 0.32$ *	$r = 0.79$ ***	$r = 0.90$ ***	$r = 0.84$ ***	$r = 0.76$ ***
Δ Self- efficacy	$r = -0.56$ ***	$r = -0.38$ *	$r = -0.60$ ***	$r = -0.59$ ***	$r = 0.29$ $p = 0.06$	$r = 0.18$	$r = 0.33$ *	$r = 0.19$

All antecedents have a non-significant correlation with skill change. The largest correlation is found with verbal persuasion (pre $r = -0.20$, $p = 0.20$ and post $r = -0.19$, $p = 0.23$).

The performance accomplishment antecedent has the largest correlation with post self-efficacy (pre $r = 0.64$, $p < 0.001$ and post $r = 0.90$, $p < 0.001$). However, performance accomplishment has the lowest correlation with self-efficacy change (pre $r = -0.38$, $p < 0.05$ and post $r = 0.18$, $p > 0.1$). Vicarious experience has the largest correlation with change in self-efficacy (pre $r = 0.60$, $p < 0.001$ and post $r = 0.33$, $p < 0.01$).

7.4 DISCUSSION

Self-efficacy beliefs as a predictor of skill attainment

The skill level that the participants attained at the end of their training course correlates with their pre and post self-efficacy beliefs (Table 7.1). Large highly significant correlations are seen for overall pre and overall post self-efficacy when correlated against overall post skills. Multon et al. (1991) found that in a meta-analysis of pre and post self-efficacy for academic achievement, both pre and post self-efficacy predicts academic achievement, but post self-efficacy was a stronger predictor. This present study also found, in accordance with the academic literature (Multon et al., 1991), that post self-efficacy was a stronger predictor of skill outcome than pre self-efficacy. These findings are in accordance with those of other authors working in more academic fields of education. Schunk and Hanson (1985) and Schunk et al. (1987) found that student perceived self-efficacy for learning correlated positively with their ability in mathematics. Zimmerman (1995), however, reports that students with strong self-efficacy beliefs are likely to participate more readily and to work harder and for longer periods on difficult educational tasks than those with weaker beliefs. Linnenbrink and Pintrich (2003) state that students who have high and positive self-efficacy will be engaged in academic processes to a higher degree in terms of their behaviour, cognition and motivation for the educational tasks. Self-efficacy beliefs can therefore be seen as a determinant of motivation and persistence and these factors may account for the correlation between the pre self-efficacy and post skills scores found in this study.

Self-efficacy growth and change in skills (learning)

In contrast, the overall change in self-efficacy between the pre and post questionnaires does not correlate significantly with the overall change in skills, whereas the change in self-efficacy related to ferry glides and the change in ferry glide skills (Table 7.2) do correlate moderately. A number of authors (Bandura, 1977, Maddux, 1995) state that self-efficacy beliefs are not of a general nature, but rather, are more accurate as predictors of actual ability when the beliefs are of a very specific nature and are about a particular action, at a specified time, in a

defined place. It is therefore to be expected that self-efficacy beliefs for one skill would not necessarily correlate with beliefs about the other two. The more dissimilar the task at hand is to the tasks which were used to formulate the self-efficacy beliefs, the less strength those beliefs will have as predictors of success for that task. Of the three white water kayaking skills tested for this study, rolling and eddy turns are in some ways similar to each other, but neither is similar to the skill of ferry gliding. Rolling and eddy turns rely a great deal on prior planning of position and paddle strokes and then executing the skill in a pre-planned manner with little feedback or adjustment as the skill is performed; this may be seen as a closed skill (Schmidt & Lee, 1999). Ferry gliding, however, requires some level of pre-planning but mainly requires constant adjustment and control of the speed and angle of the kayak over a longer period of time in the moving water as the skill is performed, and may therefore be viewed as an open skill (Schmidt & Lee, 1999). It is suggested that the greater level of control and reaction to feedback necessary to successfully complete the ferry glide task allows participants who have greater motivation and persistence to achieve a better grade, whereas motivation and persistence are unlikely to change the result for a pre-determined and neuro-muscular patterned skill like rolling a kayak. These two skills would also be consistent with the two types of tasks described in Humphreys and Revelle's (1984) information processing model. Ferry gliding would be consistent with a sustained information transfer task while rolling would correspond to a short-term memory task. Their model would predict that ferry gliding performance would vary directly with arousal while rolling performance would have an inverse relationship with arousal. This may account for the larger correlation between ferry glide skill change (learning) and ferry glide self-efficacy change. These two factors may suggest that self-efficacy beliefs are a stronger predictor of performance in open skills and sustained information transfer tasks than in closed skills and short-term memory tasks.

Antecedents of self-efficacy as predictors of skill attainment and development

The question of whether all the antecedents have an equally dominant role in future predictions of white water skills is an important one. The consensus in the

literature is that of the four antecedents, performance accomplishment self-efficacy has the greatest influence on performance (Bandura, 1983; Bandura, 1997; Bates & Khasawnek, 2007; Britner & Pajares, 2006; Pajares, Johnson, & Usher, 2007; Priest & Bunting, 1993; Schunk & Meece, 2005; Usher & Pajares, 2008). Table 7.3 shows the Pearson correlation coefficients for the questions that apply to the four central antecedents of self-efficacy beliefs (Bandura, 1977). The mean of the responses that refer to each antecedent has been correlated against post skill, skill change, post self-efficacy and self-efficacy change. Large correlations suggest that questionnaire responses could be used as a strong predictor of either self-efficacy or skill. The largest significant correlations with post skill scores are from pre performance accomplishment, pre physiological arousal and post performance accomplishment. These findings concur with those of Priest and Bunting (1993) and suggest that performance accomplishment has a large determining factor on eventual physical ability. Bandura (1983) reasons that this is because past concrete experiences are a considerably better indicator of capability than the other more subjective indices. Post self-efficacy has large and extremely significant correlations with all antecedents in the post questionnaire with what appears to be a scale of influence from the pre questionnaire, with performance accomplishment having the largest, physiological arousal and vicarious experience having moderate and verbal persuasion having the smallest, significant correlations, which concurs with general research consensus regarding potency of self-efficacy antecedents (Bandura, 1997; Bates & Khasawnek, 2007; Britner & Pajares, 2006; Pajares, Johnson, & Usher, 2007; Schunk & Meece, 2005; Usher & Pajares, 2008). Therefore, successful accomplishments and optimal physiological arousal would appear to have the greater influence on strengthening self-efficacy beliefs. The correlations with self-efficacy change return poor correlations, the only significant correlation being with the post vicarious experience questions. However, all the pre antecedent questions show a significant large negative correlation except for performance accomplishment, which shows a small negative correlation. These negative correlations are very likely due to the ceiling effect to which Zimmerman (1995) refers. The ceiling effect is produced where those with strong pre self-efficacy cannot further strengthen their self-

efficacy, but can only maintain or weaken their self-efficacy. While those with weak pre self-efficacy are limited in how far they can further weaken and can only maintain or strengthen their beliefs, therefore creating a negative correlation between self-efficacy change and pre self-efficacy scores.

Pre ferry glide self-efficacy (Fig. 7.1, Table 7.2) has a negative correlation with ferry glide skill change. This suggests that those with the lowest pre self-efficacy gained the most in skill (learning) between the pre and post skill tests. This correlation cannot adequately be accounted for by a ceiling effect for higher attainment participants as Zimmerman (1995) suggests, as those participants with higher attainment had as far to drop in attainment as the low attainment participants had to improve. However, as self-efficacy and skill correlate well for both pre and post assessments, it is probable that the participants with weaker pre self-efficacy beliefs and weaker kayaking skills have caught up to some extent with those participants who had stronger self-efficacy beliefs and stronger kayaking skills. This is a strong indicator that self-efficacy augmentation is potentially an important factor in skill development, which in turn may allow increased learning to take place.

Summary

The high degree of correlation that has been found between self-efficacy and skill suggests that the two factors may be dependent on each other. However, the lack of correlation between the degree of change in the two variables, rather than suggesting the two variables are not dependent on each other, may show that the relative change between individuals is not proportional. Some participants making large skill improvements with little change in strength of self-efficacy and others making small improvements in skill with greatly strengthened self-efficacy.

Main findings from this chapter regarding self-efficacy and learning are:

- Pre and post self-efficacy *do* highly correlate with post skill indicating that self-efficacy could be a useful predictor of skill attainment.

- Change of self-efficacy *does not* correlate with change in skill except for ferry glides, suggesting that there is not in general a proportional change between these two factors especially in closed skills and short-term memory tasks.
- Pre and post self-efficacy *do not* correlate with change in skill, suggesting that while self-efficacy may be a determinant of skill, there may not be a proportional relationship between strength of self-efficacy beliefs and skill change (learning).
- The performance accomplishment antecedent appears to be the best predictor of post skill, suggesting that self-efficacy beliefs for actually performing the tasks may have greater influence on skill attainment than physiological arousal, vicarious experience or verbal persuasion.

CHAPTER 8

AROUSAL, EMOTION AND LEARNING

8.1 PURPOSE

This part of the study was instigated by anecdotal evidence of a relationship between students' arousal level, their emotional state and their learning. This evidence suggested that high levels of arousal and, or, feelings of anxiety were associated with depressed learning and a lack of progress through the white water element of the students' instructor training programme.

The aim of this chapter was to find whether empirical evidence existed to show the relationships between arousal, emotion and learning in novice white water kayakers.

8.2 METHODS

The following is a brief summary of the particular methods used to collect the data used in this chapter, a full description of the methods can be found in Chapter 3. This chapter uses the same arousal and emotion data as used in Chapters 5 and 6 and the same skill data used in Chapter 7.

Data collection

The novice kayaker participants' ($n = 40$) arousal was measured with the use of four separate markers on day two of a three-day white water kayaking training course. Somatic arousal and emotion were measured once only with a questionnaire (Appendix B) at the accommodation at the start of the day, the other three arousal markers, heart rate, cortisol and CFF, were measured at five sites aligned to different phases of the preparation, kayak training and recovery. The participants were tested for three kayaking skills (eddy turns, ferry glides and rolling) on day one (pre) and day three (post). Learning was assessed by calculating the change in skill from pre to post tests.

Data analysis

The data sets used to calculate the change in arousal scores would ideally be from rest lodge (lowest) to on water two (highest). However, as demonstrated in Chapter 5, the cortisol and CFF arousal markers do not follow the trend of progressive increase of level in the arousal markers through the data collection sites from rest lodge to a peak at on water two as might be predicted from the progressive increase in size and difficulty of the rapids negotiated. These variations were accounted for in Chapter 5 by circadian rhythm effects in cortisol and possible over arousal effects in CFF. To account for these variations and still be able to show the change from rest to kayaking, the lowest rest value (rest lodge except for cortisol which used rest riverbank) is subtracted from the highest on water (kayaking) scores (on water two except for CFF which uses on water one). The resultant change-value reflects the change from rest to kayaking without the confounding influence of time of day effects (cortisol) and over arousal (CFF), both of which have been further investigated in Chapter 5.

The level of learning was derived from a skill test administered on the first and third days of training. The first test score was subtracted from the second test score and the change in skill level has been used to indicate the amount that had been learned through the training course.

As has been discussed in Chapter 5 there is widely reported dissonance between arousal markers (Lacey, 1967; Jones & Hardy, 1990), and it would appear that particular stimuli evoke activation of differing arousal responses between individuals. To take account of the differences in the mix of arousal symptoms presented by any given participant, the participant group was divided into three, using the upper and lower quartile of change in each arousal marker. The group above the upper quartile of change in the arousal marker have been termed upper quartile group, those that lay between the upper and lower quartile have been termed the inter quartile group and those that lay below the lower quartile have been termed the lower quartile group. For these three groups the mean skill change was calculated to study the effects that changes in activation of the different arousal systems have on learning.

Emotional state has been derived from the participants' answers to the qualitative question at the end the somatic arousal questionnaire (Appendix B) which invited participants to describe their sensations. Where participants responded with the word 'excited' they were placed in the excited group. The anxious group is comprised of those participants who used one of a collection of terms indicating heightened anxiety, including 'very nervous', 'feeling sick', 'very worried', 'scared' and 'anxious'.

8.3 RESULTS

Figure 8.1 illustrates the association between change in the arousal markers and change in skill (learning). In this figure, the mean of skill change for the group delimited by the upper ($n = 10$) and lower quartiles ($n = 10$) of change in each arousal marker is shown. The mean skill change of the participants between the upper and lower quartile (the inter quartile group, $n = 20$) has been included in order to show all the data. A comparison between the mean change in skill of the upper and lower quartiles of arousal change has been made, with asterisks marking where statistically significant differences are found between them.

The trend shown by all arousal markers is that greater change in the arousal marker is associated with lower or negative change in skill (learning) and lower change in arousal marker is associated with higher positive skill change (learning). This trend has been found to be statistically significant for the CFF ($p = 0.05$) and heart rate markers ($p = 0.01$).

The levels of arousal (physiological and cortical) for the group expressing heightened anxiety and the group expressing excitement are shown in Fig. 8.2 for the five data collection sites on day two. Significant differences in CFF and cortisol were detected between the anxious and excited groups at the two on water data collection sites, but not at the three off water (rest and recovery) sites (Fig. 8.2, A, C). The anxious group was found to have significantly higher salivary cortisol levels showing ~double (i.e. 4.6 ng/ml verses 2.4 ng/ml) the cortisol level of the excited group at on water one and on water two. The CFF of the anxious group was found to peak earlier at rest riverbank as opposed to on water one, where the excited group records their peak CFF. The anxious group's CFF was also found to be significantly lower than that of the excited group at the two on water sites. The anxious group shows ~three times the depression in CFF of the excited group (2.3Hz to 0.7Hz), between peak values and those recorded at on water two. However, the heart rates of the anxious and excited groups show

no significant difference with both groups' heart rates increasing ~50% from resting values to kayaking (on water) values.

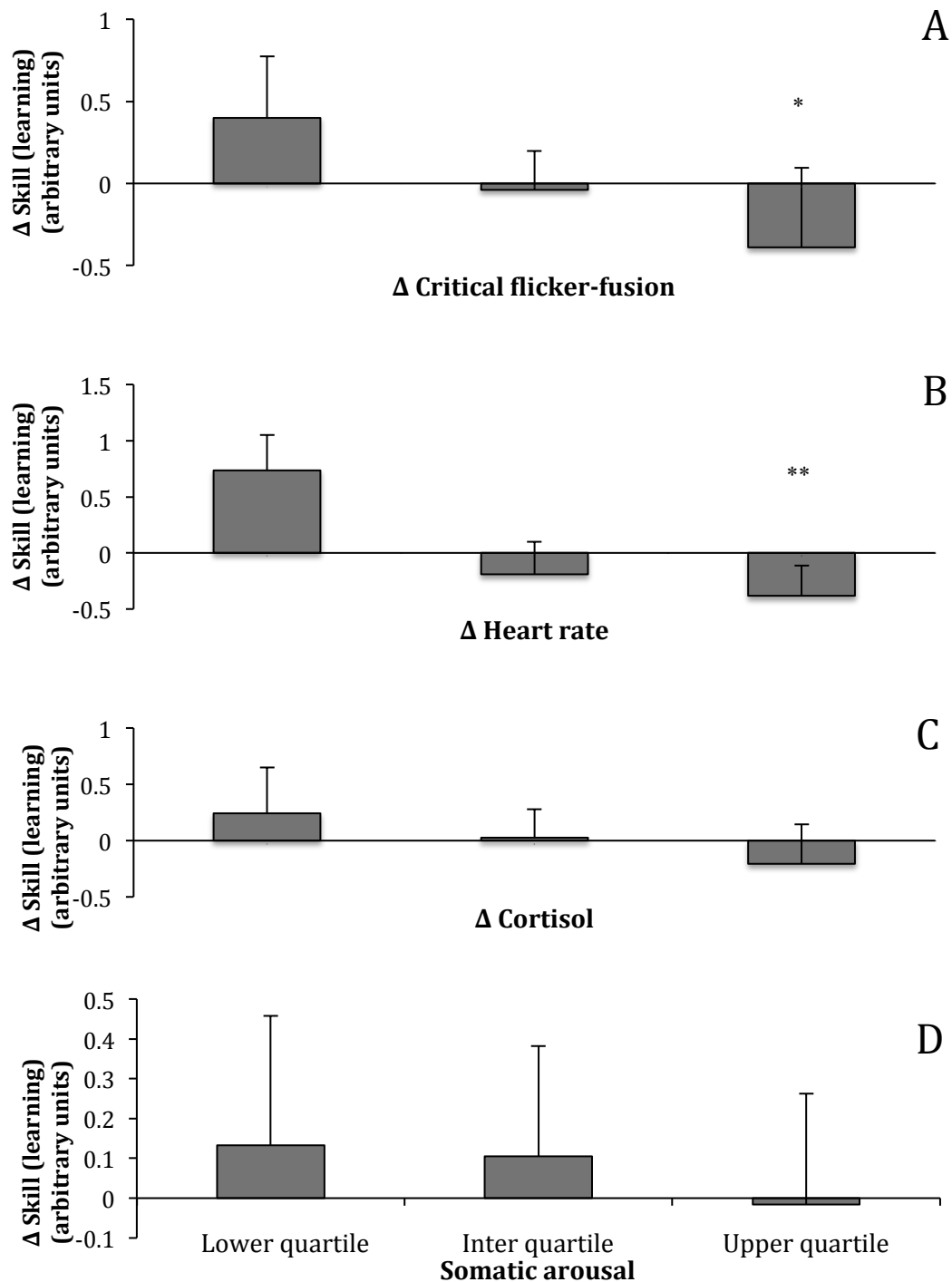


Figure 8.1 Change in skill (learning) for upper quartile ($n = 10$), inter quartile ($n = 20$) and lower quartile ($n = 10$) of change in arousal. Data are mean skill change (learning) for upper and lower quartile of change in each arousal marker \pm SEM. * indicates $p \leq 0.05$, ** indicates $p \leq 0.01$ for the difference in learning between upper and lower quartiles of change in arousal.

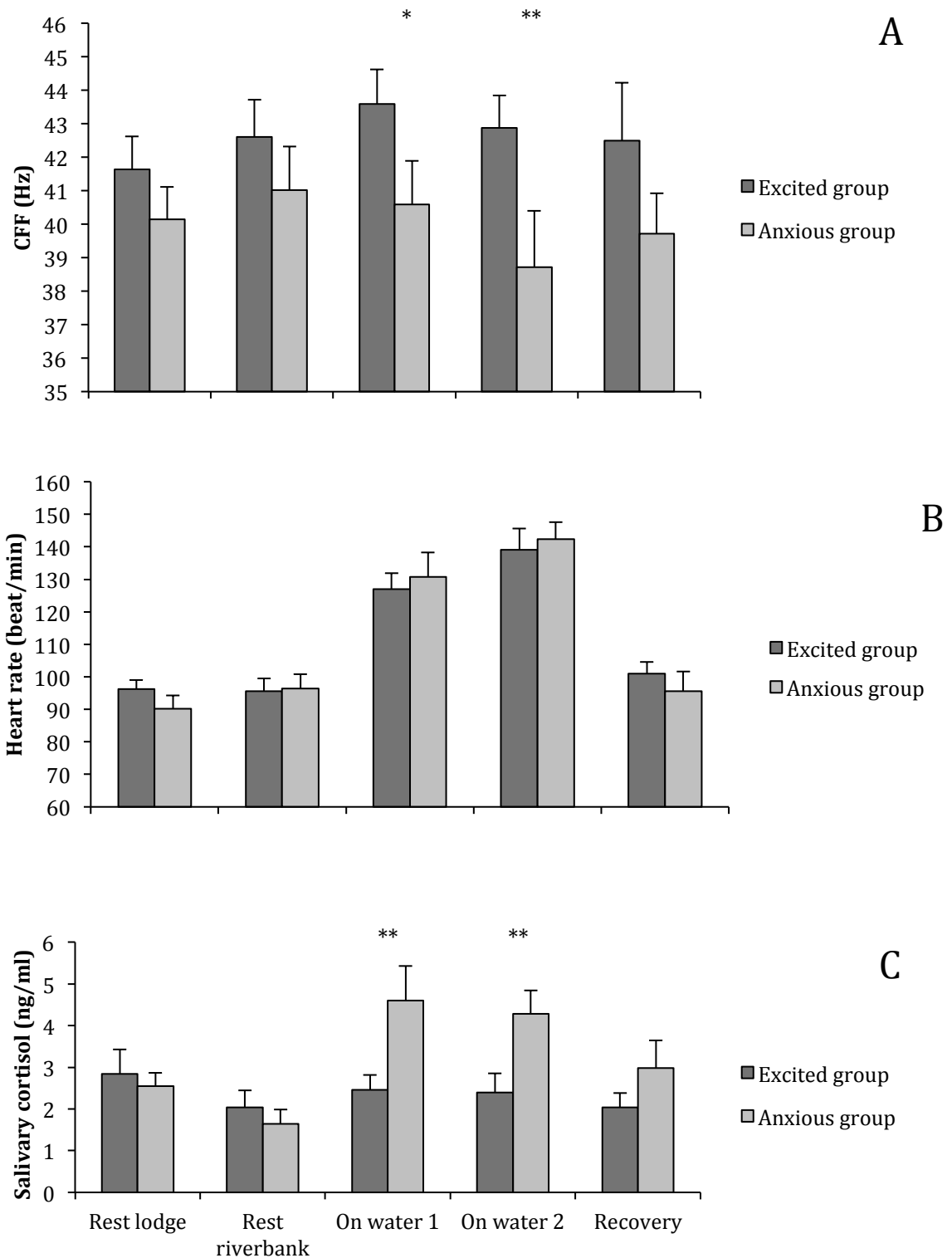


Figure 8.2 Physiological and cortisol arousal for participants who expressed excitement ($n = 12$) or heightened anxiety ($n = 9$). Data are means \pm SEM. * indicates $p \leq 0.05$, ** indicates $p \leq 0.01$ for difference between groups.

Figure 8.3 shows the change in arousal markers for the excited group and the anxious group. The trend for somatic arousal, heart rate and cortisol is that the anxious group have a greater change in arousal markers. The somatic arousal and cortisol markers (Fig. 8.3, A, C) show statistically significant ($p < 0.01$) differences between the excited and anxious groups. CFF however shows the opposite effect (Fig. 8.3, D) where the anxious group shows less, or negative, change in this arousal marker than the excited group. The difference between the two emotional state groups for change in CFF shows a non-statistically significant difference ($p = 0.1$).

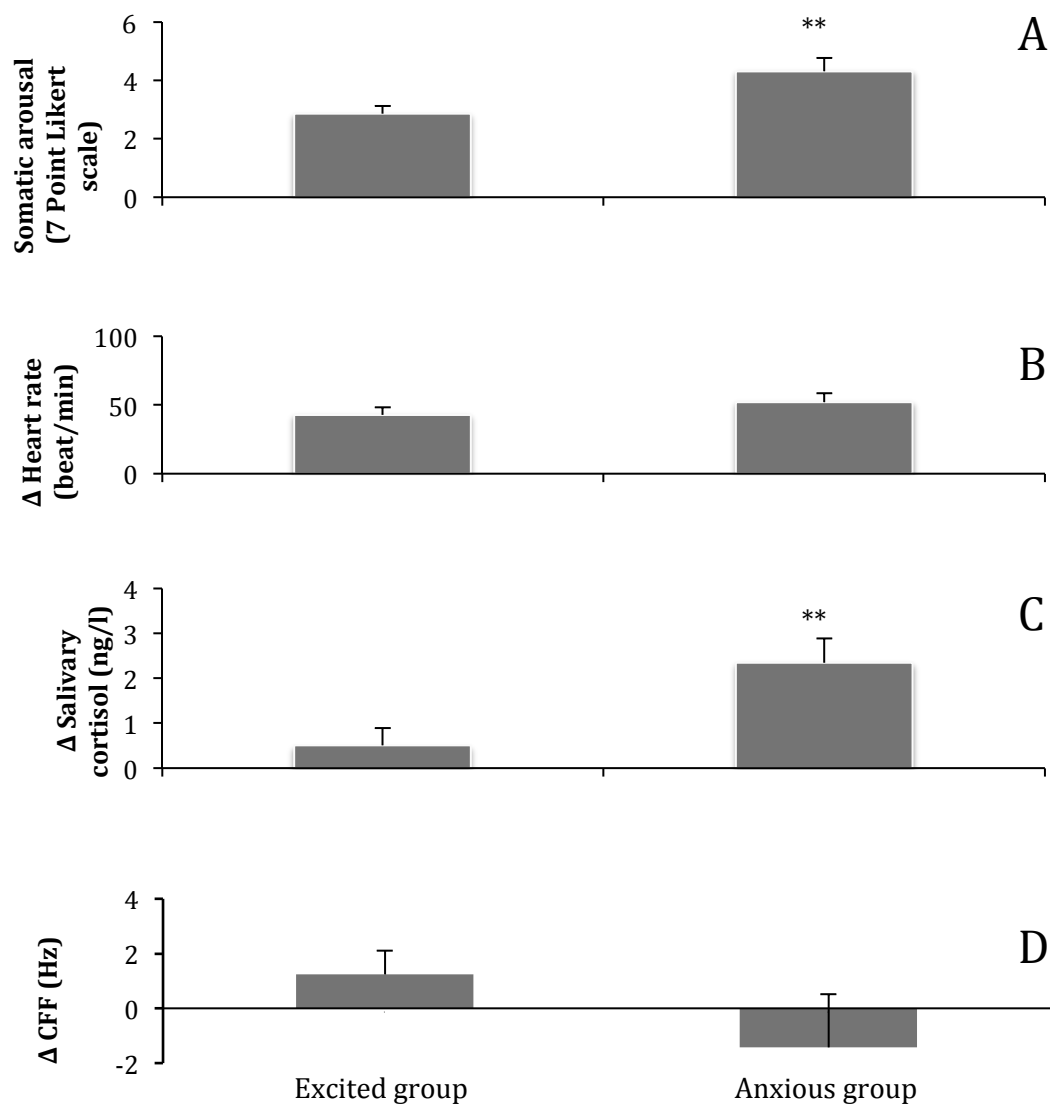


Figure 8.3 Change in arousal for participants who expressed excitement ($n = 12$) or heightened anxiety ($n = 9$). Data are means \pm SEM. ** indicates $p \leq 0.01$ for difference between groups.

Figure 8.4, shows the change in skill (learning) for participants grouped by those who expressed excitement and those that expressed heightened anxiety. The group means for skill change would suggest that participants who expressed excitement had a 5% greater positive change in skill indicating more was learned than by those participants who expressed heightened anxiety, however this difference was not statistically significant ($p = 0.1$).

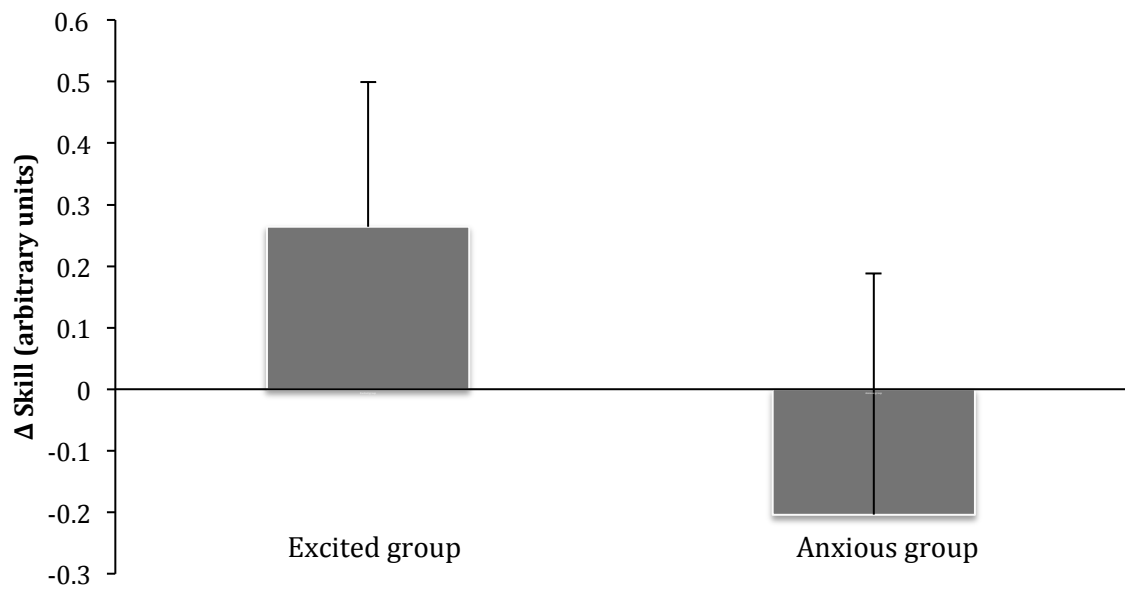


Figure 8.4 Change in skill (learning) for participants who expressed excitement ($n = 12$) or heightened anxiety ($n = 9$). Data are means \pm SEM.

8.4 DISCUSSION

Arousal markers have been widely reported to show little correlation with each other (Haneishi et al., 2007; Jones & Hardy, 1990; Lacey, 1967) and therefore it would not be expected to get wide correlation across the markers when correlated against learning. It has been suggested that individuals differ in their response to stressful situations and therefore their arousal is expressed in differing ways (Hanin, 2000). Further confounding influences are that the pre and post skill tests were performed on a different day to that in which the arousal measures were taken. This was to allow the learning that had taken place whilst under the influence of the arousal state to be measured. The longer learning time frame also allowed a greater degree of learning to take place.

Change in arousal and learning

When analysing the arousal measures separately (Fig. 8.1), significant relationships between change in arousal and learning were identified. Individuals with higher arousal have lower learning scores with this trend extending across all arousal markers, although only the heart rate and CFF markers (Fig. 8.1, A, B) reach statistical significance. These results would suggest an inverse relationship between change in arousal and change in skill (learning). Indeed, both the inverted U model (Fig. 2.4) (Yerkes & Dodson, 1908) and the catastrophe model (Fig. 2.5) (Fazey & Hardy, 1987) predict this relationship if it is assumed that the participants have reached or exceeded their individual zone of optimum function (Hanin & Syrja, 1995). Indeed, Males & Kerr (1996) found that participants who had small discrepancies between reported somatic arousal and preferred level of arousal before white water kayak competition, produced their best performances. The skills of rolling and eddy turns fit Humphreys and Revelle's (1984) description of short-term memory tasks (see section 2.6), for which they predict the same inverse relationship between arousal and performance (skill). As Hanin and Syrja (1995) point out, individuals vary in their response to each arousal marker and so by analysing the data in this way the participants who have high or low response in each arousal marker can be identified and differences in learning noted. The data found in this study would

appear to support the theoretical perspectives found in the literature regarding the relationship between arousal and performance.

Emotion and arousal

The emotions of excitement and anxiety seem to have a bearing on the physiological and cognitive arousal of participants during the white water kayaking phases of the training day (Fig. 8.2). There were found to be significant differences for CFF and cortisol between the excited group and the anxious group at the on water one and on water two sites (Fig. 8.2, A, C). Anxious participants showed elevated cortisol levels which are consistent with the physiological arousal response to anxiety as described by (Zaichkowsky & Baltzell, 2001) and activation of the HPAC pathway (Miller & O'Callaghan, 2002). The anxious group also showed a depressed CFF, which is consistent with the selective attention theory (Braunstein-Bercovitz, 2003), whereby, anxious thoughts take up a limited cognitive processing capacity. Conversely the lower cortisol and higher CFF of the excited group could indicate that they were less physiologically stressed and had greater cognitive processing capacity. These findings are similar to those found by Holden and Barlow (1986) in their study of anxious patients. However, unlike Holden and Barlow's (1986) results, heart rate was seemingly unaffected. The fact that the two physiological arousal markers differ gives some indication that the increased arousal response is not due to differences in exercise intensity, as this would have likely affected heart rate as well. Therefore another factor must be responsible with anxiety being a likely candidate. Slower habituation to stressful tasks in anxious participants has been demonstrated in various studies (Lader & Wing, 1964; Maple, Bradshaw, & Szabadi, 1981), and may account for the higher arousal in the white water environment found in the anxious participants.

In Holden and Barlow's (1986) experiment arousal was higher in anxious participants, yet the reaction of the arousal marker was found to be similar. The anxious participants, although showing higher arousal during the stress task, also had higher base line arousal. These patients they suggest, show symptoms of chronic hyper-arousal. The changes in arousal or arousal reactivity for the

present study are shown in Fig. 8.3 for heart rate, cortisol and CFF. Also shown in this figure is the level of self-report somatic arousal, this being a once only measurement. The anxious participants show a significantly higher somatic arousal level (Fig. 8.3, A) and significantly greater cortisol reactivity (Fig. 8.3, C). If the term eustress (Selye, 1950) is linked to excitement and distress linked to anxiety then it can be seen from Fig. 8.3 that there are differences in arousal between these two emotional states. It is likely that both, perceptions of anxiety and perceptions of excitement, are triggered by and, in turn, trigger further activation of the pathways that lead to increased somatic arousal and activation of the HPAC pathway (cortisol). However, it would appear that the emotion of anxiety has a greater effect upon arousal or, indeed, that greater arousal leads to perceptions of anxiety forming. Maslach (1979) concluded that unattributed arousal leads to fearful emotion; this theory would support both the observed effect (increased arousal associated with the emotion of anxiety) and also suggests a possible mechanism for the observed effect (unattributed arousal leading to anxious cognitions).

In reference to Apter's (1982) reversal model (Fig. 2.7), it is noted that there is no change in arousal level between an individual switching from perceptions of excitement to perceptions of anxiety, and the individual may flip (reverse) from one perception to the other with only a change in hedonic tone. The results shown here (Fig. 8.3) suggest that there is a difference between the arousal level of participants experiencing excitement and those experiencing anxiety. In order to accommodate Apter's (1982) theories, the change in arousal must take place after the reversal between excitement and anxiety has occurred and it may be postulated that the perception of anxiety further increases the previous automatic arousal responses. If this were the case it would appear that the emotion of anxiety has a greater effect in increasing arousal than excitement does. This notion would however, preclude the reversal back to excitement, making the pathway from the state of excitement to anxiety a relatively one-way shift, unless arousal levels can be reduced whilst experiencing this emotional state. These results would support a model such as the catastrophe model (Fig. 2.5) posited by Hardy and Fazey (1987) if performance is replaced with learning.

Their model theorises on the relationship between physiological arousal, cognitive anxiety and performance, where with an increasing cognitive anxiety component it becomes more and more difficult to reduce the physiological arousal component from beyond optimum arousal in order to maintain peak performance.

Emotion and learning

It might be expected from the literature that anxious participants would have shown less change in skill. Certainly in Woodman & Hardy's (2003) meta-analysis of the impact of anxiety and self-confidence on sport performance, they found that both variables are significantly related to performance. Anxiety showing a negative relationship, and self-confidence showing a positive relationship, with performance. Eysenck and Calvo's (1992) processing efficiency theory suggests that the necessary learning resources of memory and information processing are taken up by worries and are therefore not available for learning and hence learning may be adversely effected when conditions are such that the participants are caused to worry. Also, the conscious processing hypothesis (Masters, 1992, Pijpers et al., 2003) proposes that as anxiety increases there is a regression to earlier stages of learning, with performance becoming, amongst other characteristics, clumsy and jerky. However, although a small difference was noted between the anxious and excited groups (the anxious group showing 5% lower skill change) this difference was not found to be statistically significant.

Summary

The results shown in this chapter suggest that there is an association between arousal and emotion and arousal and learning. Smaller change in physiological arousal is associated with greater skill development, while anxiety is associated with greater change in arousal. However, arousal and emotion are only part of the jigsaw of facilitating the most productive conditions for learning, but this data would suggest that optimum conditions for learning should include measures that optimise arousal.

Main findings from this chapter regarding arousal, emotion and learning are:

- Greater learning appeared to occur in participants with smaller changes in arousal (CFF and heart rate), which might suggest that either a participant who is learning well becomes less aroused, or that greater arousal reduces the capacity of the participant to learn.
- Anxious participants seem to show elevated change in arousal (cortisol), suggesting that emotional responses affect stimulation of arousal systems and therefore arousal can in part be controlled through control of emotions.
- Excited participants had lower cortisol and higher CFF suggesting they are less physiologically stressed and have greater cognitive processing capacity.
- Emotion did not seem to significantly affect learning.

CHAPTER 9.

ATTRIBUTIONAL RE-TRAINING, LEARNING AND SELF-EFFICACY

9.1 PURPOSE

The primary objective of this thesis was to investigate a way to provide a more productive teaching and learning regime for white water kayak training in a natural environment as there was mounting anecdotal evidence that learning was compromised under the regime presently being utilised. One way to achieve this objective is to provide the students with resources that strengthen their self-efficacy beliefs regarding learning and performing in the given environment. This might be achieved with attributional re-training that the teacher can provide to the learner in order for the learner to augment their self-efficacy and potentially improve their learning.

This chapter presents the results from the use of an attributional re-training intervention, designed to augment the participant's self-efficacy, with the view to improving the productivity of teaching and learning of kayaking skills in a white water environment.

The aims of this chapter were to investigate:

- The influence of attributional re-training on learning.
- The influence of attributional re-training on self-efficacy.

9.2 METHODS

The following is a brief summary of the particular methods used to collect the data used in this chapter, a full description of the methods can be found in Chapter 3. This chapter uses the same participants that have been used in Chapters 5-8 and the same skill data used in Chapter 7.

Participants and intervention

The participants ($n = 40$) were put into homologous groups by random selection from homogenous clusters. These groups were then randomly assigned to either receive the intervention (attributional re-training) ($n = 24$, comprised of 18 males and six females) or normal instruction (non-intervention) ($n = 16$, comprised of 10 males and six females) (see section 3.4 for details). The two groups were taught separately throughout the training programme, but received the same time input from the teachers both in briefing, kayak training and feedback. The attributional re-training was administered on day one of a three-day white water kayak training course and then referred to throughout the remaining two days, to ensure that the participants were using the suggested re-training techniques and thought processes. In brief, the re-training technique used both misattribution and re-attribution approaches. This encouraged them to attribute somatic arousal feelings to positive notions and attribute causation of success and failure to controllable, internal and unstable factors (see section 3.6 for details).

Data Collection

The data for this chapter was collected on day one and day three of the training course. Self-efficacy beliefs were collected using a self report questionnaire (Appendix A) during day one (pre) and again at the end of day three (post). In order to measure learning of white water kayaking skills, a skills test was administered during day one and the same test, albeit at a different venue, administered at the end of day three. The skills test recorded the degree of competence in performing three key skills for white water kayaking, namely: rolling the kayak, eddy turns and ferry glides on a 10 point scale (see section 3.5 for details).

Data analysis

Of the statistical methods for measuring change and difference, two are useful here; the paired t test and the independent samples t test. The paired t test has been used to distinguish changes *within* a group from pre to post skill tests or questionnaires, while the independent samples t test has been used for

distinguishing whether or not there is a difference *between* groups at the time of taking the pre test or the post test. Change (Δ) has been calculated by subtracting the pre score from the post score, while relative difference of change has been calculated by subtracting the change score of the non-intervention group from the change score of the attributional re-training group. In this analysis, where the attributional re-training group has a greater change than the non-intervention group, the result is positive. Where the non-intervention group has a greater change than the attributional re-training group, a negative result is displayed.

9.3. RESULTS

Independent samples *t* test between the attributional re-training and the non-intervention group return non-significant ($p > 0.2$) differences for pre self-efficacy and all three pre skills.

Learning

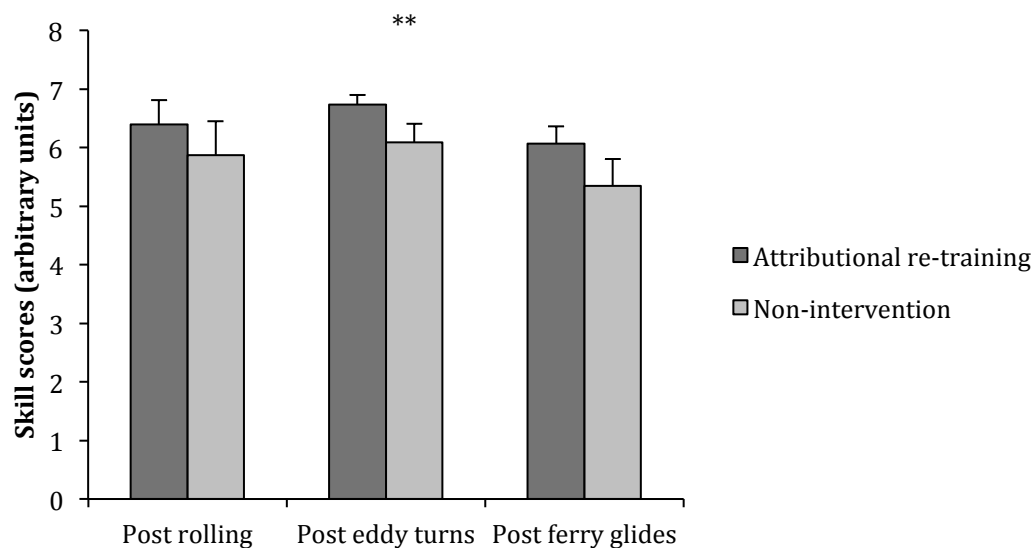


Figure 9.1 Post skills scores for attributional re-training and non-intervention groups. Data are means \pm SEM. ANOVA confirms that post skills are dependant on intervention ($p = 0.006$), the intervention group showing a 7% greater mean post skill.

Analysis of post skills (Fig. 9.1) reveals a significant difference in eddy turn skill between the attributional re-training group and the non-intervention group.

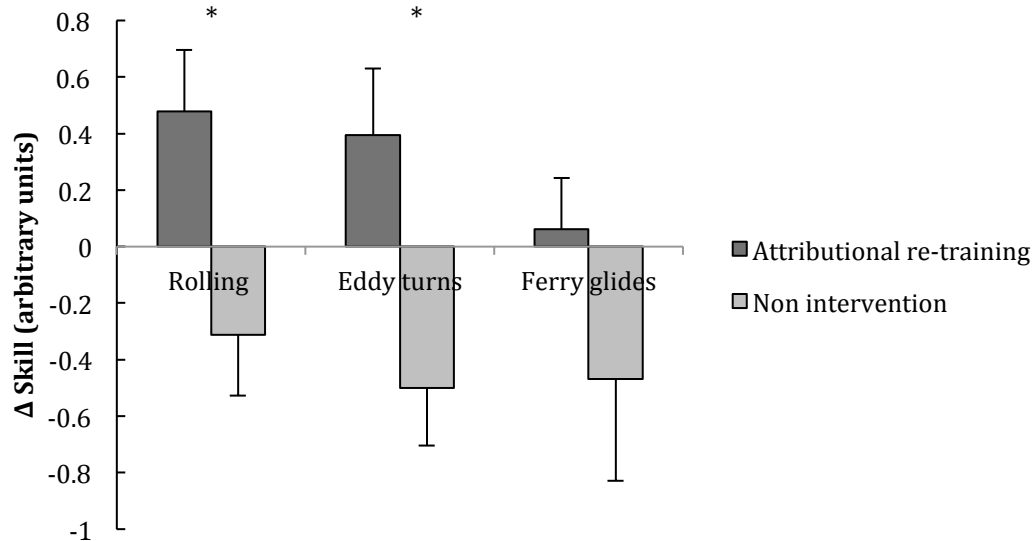


Figure 9.2. Change in skills between pre and post tests. Data are means \pm SEM. * indicates $p < 0.05$ for difference between attributional re-training group and non-intervention group.

Independent samples t test analysis for change in skill between pre and post tests for the attributional re-training against the non-intervention group (Fig. 9.2) reveals the attributional re-training group significantly improved their rolling and eddy turns skills compared to the non-intervention group.

Self-efficacy

Paired t test analysis for the attributional re-training group's self-efficacy between the pre and the post self-efficacy questionnaire returns a highly significant positive difference ($p < 0.01$).

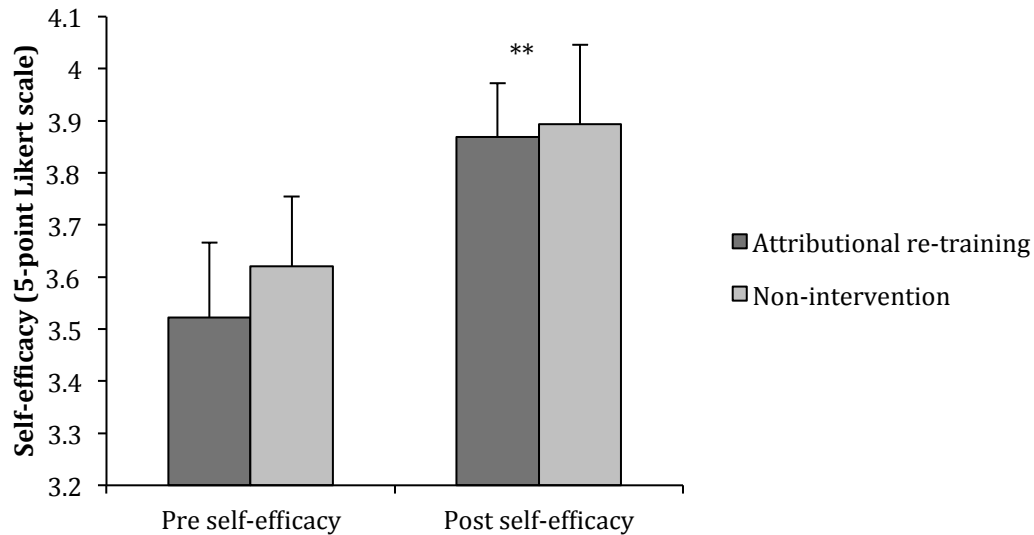


Figure 9.3 Overall pre and post self-efficacy for the attributional re-training and non-intervention groups. ** indicates $p < 0.01$ difference between pre and post scores.

Figure 9.3 indicates that there was a significant increase in self-efficacy beliefs for the attributional re-training group and a non-significant increase in self-efficacy beliefs for the non-intervention group, between the pre and post questionnaires. However, Fig. 9.4 indicates where the difference in increase in self-efficacy beliefs, relative to the two groups, may occur.

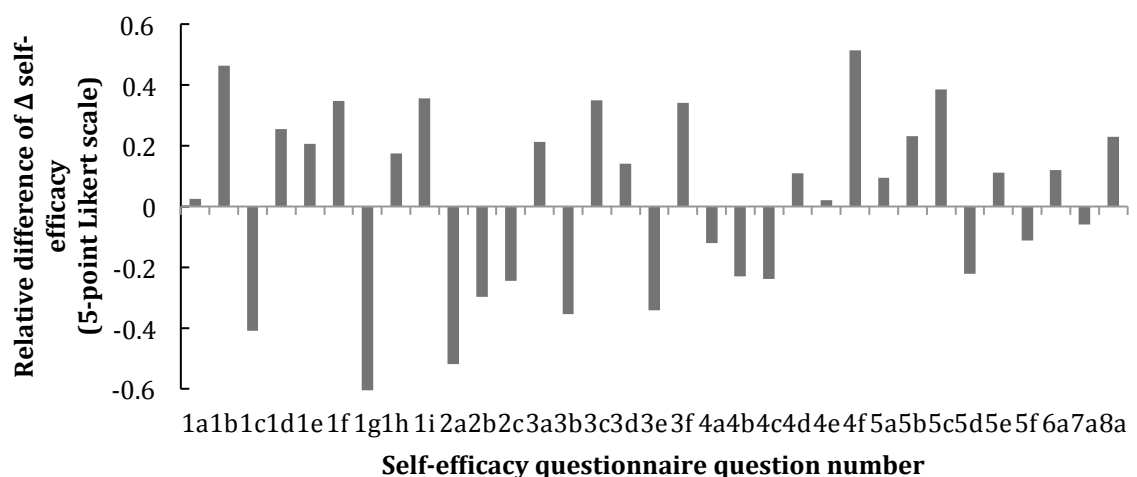


Figure 9.4. Relative difference of change for individual question self-efficacy scores between the attributional re-training group and the non-intervention group.

Figure 9.4 displays the relative difference in change of self-efficacy scores between pre and post questionnaires and between the attributional re-training group and the non-intervention group. This data was calculated by subtracting the post score from the pre score, for each question, for both the attributional re-training and the non-intervention groups, to get the absolute change for each group and then by subtracting the absolute change value for the non-intervention group from the absolute change value of the attributional re-training group. In this analysis positive values reveal greater strengthening of self-efficacy beliefs for the attributional re-training group while negative values show greater strengthening of self-efficacy beliefs for the non-intervention group. From this analysis it is indicated that the attributional re-training group strengthened their self-efficacy in 20/33 questions to a greater degree than the non-intervention group, and that the non-intervention group strengthened their self-efficacy in 13/33 questions to a greater degree than the attributional re-training group. The sum of the resultant change scores is 0.95, indicating an overall relative greater strengthening of self-efficacy beliefs for the attributional re-training group over the non-intervention group of nearly 1/7 Likert scale units or ~14%.

It can be seen from Fig. 9.4, that in all parts of question 1, where the parameter is control, the attributional re-training group strengthens their self-efficacy beliefs to a greater extent relative to the non-intervention group over the course of the training programme in seven of the nine questions. With respect to all three parts of question 2, where the parameter is identified as arousal, the balance of relative change is in the non-intervention group's favour. The six parts of question 3, where the parameter is identified as 'my success', are split between the groups. The attributional re-training group has the greater relative change in four questions, while the non-intervention group has greater relative change in only two. All parts of question 4, where the parameter is identified as 'peer success', are evenly split between the groups. With the six parts to question 5, where the parameter is identified as 'criticism', the attributional re-training group has the greater relative change in four questions, while the non-intervention group has greater relative change in two. With respect to the last

three questions, which are of a more general nature regarding self-efficacy towards white water kayaking, the balance of relative change once again is in the attributional re-training group's favour; two questions to one. Of particular note is the fact that in two groups of three questions with the same parameter, the non-intervention group has a greater relative strengthening of self-efficacy beliefs, namely 2a, 2b and 2c, and 4a, 4b and 4c, while the attributional re-training group has three sets of three questions of the same parameter, where their self-efficacy beliefs strengthen relative to the non-intervention group, namely, 1d, 1e and 1f, 4d, 4e and 4f, and 5a, 5b and 5c.

The only question where the attributional re-training group's self-efficacy beliefs weaken is question 3e, in which past failures is the parameter and ferry glides is the context. In all other questions, the attributional re-training group has a strengthened perception of self-efficacy in the post questionnaire relative to the pre questionnaire. However, the non-intervention group's self-efficacy weakens or stays the same in five questions: 1b, 1e, 3f, 5b and 5c.

Table 9.1 shows all questions that return a significant ($p < 0.05$) improvement in self-efficacy between the pre and the post questionnaire. The attributional re-training group has a statistically significant positive change in self-efficacy beliefs in twelve questions, compared to the non-intervention group's ten questions. Both groups have a similar collection of parameters that pertain to questions where self-efficacy beliefs significantly changed, however, there are notable differences. The most common parameter for change in self-efficacy for the attributional re-training group was peer failure, while this parameter did not feature on the non-intervention group's list. Furthermore the joint equal most common parameter on the non-intervention list of arousal, did not feature on the attributional re-training group's list. Interestingly, the most common context of change for the attributional re-training group, staying upright in rapids, with five occurrences is the lowest of the three contexts for the non-intervention group with only two occurrences.

Table 9.1 Questions that show a significant ($p < 0.05$) positive difference between the pre and the post self-efficacy questionnaire.

Non-intervention group		
Question	Parameter	Context
1c	Control cortical arousal	Staying upright
1g	Control kayak	Eddy turns
2a	Arousal	Eddy turns
2b	Arousal	Ferry glides
3a	My success	Eddy turns
3b	My success	Ferry glides
4b	Peer success	Ferry glides
5d	Receiving criticism	Eddy turns
5f	Receiving criticism	Staying upright
7a	Capability	Eddy turns
Attributional re-training group		
Question	Parameter	Context
1i	Control kayak	Staying upright
3a	My success	Eddy turns
3c	My success	Staying upright
4d	Peer failure	Eddy turns
4e	Peer failure	Ferry glides
4f	Peer failure	Staying upright
5c	Receiving praise	Staying upright
5d	Receiving criticism	Eddy turns
5e	Receiving criticism	Ferry glides
6a	Capability	White water kayaking
7a	Capability	Eddy turns
8a	Capability	Staying upright

Interaction between intervention, self-efficacy and skill

Analysis of the three variables (intervention, self-efficacy and skill) with an ANOVA reveals a highly significant interaction. Post learning is dependant on, pre learning ($p = 0.001$), intervention ($p = 0.01$) and on post self-efficacy ($p = 0.002$). The ANOVA also revealed combined interaction effects, with post self-efficacy combined with the intervention showing the effect on post skill. This interaction reveals a 7.2% increase in skill after adjustment for pre learning has

been made. The R square for group (intervention-non intervention) and pre learning on post skill is 0.47, which rises to 0.60 when group, pre learning and post self-efficacy are combined. Effect size was calculated for the change in skills and change in self-efficacy between the intervention and non-intervention groups (Thomas, Salazar, & Landers, 1991). This analysis revealed a standardised effect size of 0.58 for change in skill and an effect size of 0.14 for change in self-efficacy between the intervention group and non-intervention group.

9.4. DISCUSSION

To enable direct comparisons to be made between the group receiving the attributional re-training intervention and the group receiving normal instruction, with as little bias due to pre existing group differences, measures were taken to make the groups homologous, through randomised selection of participants from homogenous clusters into the teaching groups (see section 3.4 for details). The pre self-efficacy questionnaire and pre-skills test measured the self-efficacy and skills of the participants in each group at the start of the training course. The results of these pre tests show that there was no significant difference between the two groups. The two groups therefore started at a similar point in terms of self-efficacy and skill as well as participant age, gender and pre course confidence and are therefore largely homologous. Furthermore, this inter-group similarity permits a stronger case to be put forward for the relative influence of the two instruction styles (attributional re-training and normal instruction) to account for any changes in skill and self-efficacy during the training course and the resultant self-efficacy and skill attainment as seen in the post questionnaire and post skill tests.

Learning

The results for the post skill tests are seen in Fig. 9.1. The attributional re-training group's scores have increased relative to the non-intervention group in all skills. However, due to the large intra group variation and small change, only eddy turns skill returns a statistically significant increase compared with the

non-intervention group. This would suggest that the attributional re-training, which encourages participants to attribute failure to unstable, controllable and internal causes as suggested by Rees et al. (2005), has had a positive effect on the learning of these skills and the subsequent implementation of those learned skills to real world contexts.

Of greater interest and use however, is the absolute change in skills from the pre to the post skill tests as this analysis takes into account any minor differences in start point or end point that are not revealed with the previous analysis based on absolute pre and post attainment. These changes in skill are represented in Fig. 9.2. The relative difference between these absolute changes is fundamental in observing the effect of the attributional re-training over the effect of normal instruction on the learning of skills. Here it is shown that there are significant differences between the change in skills between the groups for rolling and eddy turns, both skills showing a higher positive change in attainment for the attributional re-training group. An effect size analysis using the change in skills data helps to control for any differences in pre skills. This analysis reveals a moderate effect size in change of skills, which here has been equated to learning of white water skills. This would suggest a moderate positive effect of attributional re-training on learning. Holschuh et al. (2001) suggest that making attributions to strategy use, leads to greater motivation to seek and experiment with new strategies for future success, and this may account for the greater attainment in the two kayaking skills seen here. It is a little misleading that in Fig. 9.2 the non-intervention group appears to have regressed in skills. The two skill tests were completed at different venues; the pre test was undertaken on a grade I river and the post test was conducted on a grade II section of a river to meet with the ethical requirements (see section 3.3) of normal programming. Learning is the increase in an individual's ability to execute a skill (Cocker, 2009) but must be inferred from performance, retention and the transference of skills (Utley & Astill, 2008). The score achieved in the post test takes into account all three of these factors. It would appear that the attributional re-training group had more robust skills that could be implemented in a more difficult grade of white water than the non-intervention group.

Self-efficacy

Self-efficacy beliefs were similar in the pre questionnaire between the two groups. Although no significant difference between the two groups was found at the post questionnaire, further analysis revealed a significant difference, when change between pre and post questionnaire is considered, for the attributional re-training group (Fig. 9.3). An effect size analysis using this change in self-efficacy data helps to control for any differences in pre self-efficacy between the intervention and non-intervention groups. This analysis reveals a small effect size, this would suggest a small but positive effect of attributional re-training on participant's self-efficacy beliefs.

The sum of the relative change scores (Fig. 9.4) between the two groups returns a positive value of 0.95 on a 5-point scale. The positive result for the sum of relative change indicates that the attributional re-training group's self-efficacy strengthened towards white water kayaking, more than the non-intervention group's self-efficacy. These differences in self-efficacy beliefs suggest that natural attributions (made by the non-intervention group) possibly to external causes for failure (Bradley, 1978; Zuckerman, 1979) augment self-efficacy less than when attributions are encouraged to be made to internal causation as suggested by Ingledew et al. (1996). The groups have been shown to be similar in the pre questionnaire; therefore this change can be attributed to be a result of the attributional re-training intervention and that it may have been successful in its aim of augmenting self-efficacy beliefs. The result suggested by Marlatt and Gordon (1985) that attribution of internal causation for failure leads to a weakening in self-efficacy beliefs was not found in this study. It is clear that judgements of self can be harmed by attributions of internal causation, where blame and guilt can damage perceptions of self-efficacy (Marlatt & Gordon, 1985). However, if the causation is well managed, so as to protect the individual's perception of self, while at the same time allowing control of change through internal attribution, as is the case when attributions to strategy are used, successful augmentation of self-efficacy can occur as is suggested by this study.

It is of great interest to examine where this change took place; whether it was in one particular area, or more generally distributed across all sections of the questionnaire. Figure 9.4 allows an overview of the relative changes in self-efficacy to be observed across the whole questionnaire for both the attributional re-training and the non-intervention groups. It can be noted that patterns exist in the relative change graph (Fig. 9.4) that reflect how the combination of parameter and context interrelate to relatively strengthen or weaken the attributional re-training group's and the non-intervention group's self-efficacy beliefs. This relative change analysis amplifies the differences in change between the two groups, especially where one group's self-efficacy is strengthened while the other's is weakened.

The questions regarding my success (all parts of question 3) sought to assess the participants' performance accomplishment antecedent of their self-efficacy beliefs. Priest and Bunting (1993) and Rutter (1987) suggest that in outdoor activities, especially where there is some notion of risk involved, that performance accomplishment is the dominant antecedent governing the development of self-efficacy beliefs. It is therefore of note that the balance of change, in this critical area for formation of self-efficacy beliefs, is in the favour of the participants who received the attributional re-training intervention.

Attention should be drawn to the parameter and context of the questions that saw greatest improvement in the self-efficacy beliefs of the two groups, and particularly the difference in these parameters and contexts between the two groups (Table 9.1). It should be noted that the question parameter and context that has a significant change is not necessarily the parameter or context that carries the most importance in the formation of self-efficacy beliefs, but is the factor that has the most significant effect on change in self-efficacy beliefs. As has been stated, both groups have higher mean self-efficacy in the post questionnaire than the pre questionnaire indicating that over the period of the training course they strengthened their self-efficacy beliefs towards white water kayaking; only the attributional re-training group however, strengthening their beliefs to a

significant degree (Fig. 9.3). The areas in which they gained that greater strength of beliefs that must now be considered.

The context of peer failure is an area where the attributional re-training group had a significant positive change in self-efficacy beliefs in three questions (Table 9.1), which differs from the findings of Marlatt and Gordon (1985) who found that attributions made to internal causation lead to a weakening in self-efficacy beliefs. However, this may be due to the differing effects of particular internal causations. If attributions are made to the internal cause of effort, self-efficacy may be weakened. However, in this study, the internal cause was encouraged to be made to strategy choice, the slight distancing of the cause, whilst still keeping the cause internal and in the sphere of control of the attributor, may have enabled self-efficacy to be maintained and even strengthened.

Although control as a parameter is clearly important in self-efficacy augmentation as it is seen in both groups table of significant change in self-efficacy (Table 9.1), the attributional re-training process ought to make the participants feel in control of their learning to a greater degree. As through the attributions they were encouraged to make, they could make evaluations and choose the steps they needed to take to improve their performance. Manstead and van Eekelen (1998) assert that perceived control in stressful situations is a strong predictor of academic achievement. The data in this study would similarly suggest that this notion of control is a strong predictor of the learning of kayaking skills in a stressful situation.

Further, it may be suggested from these results that the attributional re-training intervention had the effect of making the group that received it somewhat impervious to criticism and less concerned with capsizing, whereas the non-intervention group were less concerned about arousal after their normal instruction. If the somatic arousal data is referred to (Fig. 5.5), it will be recalled that the fear of tipping in (capsizing) featured particularly strongly with 41% of females expressing that this factor had a major influence on how aroused they perceived themselves to be. It is suggested therefore, if the attributional re-

training technique had a positive effect on participants' ability to stay upright in rapids, this may possibly then lead to their self-efficacy being augmented through the performance accomplishment antecedent. Similarly, greater ability or less worry about capsizing could lead to a more optimum physiological or emotional state leading potentially to greater gains being made regarding the strength of their self-efficacy beliefs.

The attributional re-training technique gives the participant who receives it a tool to think positively about and plan for success during their next attempt at a skill. With this technique they are encouraged to not only analyse their shortcomings, but to find a solution to their problems. Miller and Brinkman (2004) suggest that helping students to acquire new physical and cognitive skills, that encourage positive attributions to be made, will strengthen their self-efficacy beliefs and this would appear to be supported by this research. Through this self-analysis and planning process, participants would appear to have become less affected by criticism, as seen in the post self-efficacy questionnaire. Any criticism or ridicule participants do receive, is given the short shrift it deserves as they have already undertaken an evaluation and developed a strategy to correct their failure. Participants have already planned what they have to do, or what they will try next, to gain a better performance, rendering the unwanted criticism meaningless and able to be ignored.

Summary

In conclusion, the attributional re-training intervention has a positive effect on learning and self-efficacy augmentation over the period of a three-day white water kayaking training course, the ANOVA revealing greater skills for the intervention group. Nearly half of this variation can be accounted for by the intervention and pre skills, while the greater part of this variation can be accounted for by a combination of pre skills, intervention and post self-efficacy. The effect size calculations reveal that these are moderate (learning) to small (self-efficacy) but are non-the-less positive and desirable effects. Furthermore, it would support Wilson and Linville's (1985) reports that attributions made to unstable causes reduce anxiety about performance, increase the expectancy

about future performance as well as increase the actual future performance not only in academic work, but as seen here in high stressed white water kayak learning environments too.

The main findings in this chapter regarding attributional re-training, learning and self-efficacy are:

- The attributional re-training group has a significantly higher attainment in eddy turn skill in the post test, suggesting that the attributional re-training group may have learned more during the training course.
- The attributional re-training group has a significantly greater positive change in rolling and eddy turn skills, that indicates attributional re-training may be more effective at changing skills than normal instruction.
- The attributional re-training group has a significantly greater positive change in self-efficacy, suggesting that attributional re-training could have an augmenting effect on self-efficacy beliefs.
- The attributional re-training group has a increase in more aspects of self-efficacy (20/33) than the non-intervention group (13/33), that suggests that the gains in self-efficacy are distributed across a broad array of factors contributing to self-efficacy belief formation.
- The attributional re-training group has a significant strengthening of self-efficacy beliefs in the parameters of peer failure and capability and the context of staying upright in rapids. This suggests that the attributional re-training process had most effect and augmentation on these areas of resilience to negative vicarious experience and in their own ability to white water kayak.
- The attributional re-training group has a significant strengthening of self-efficacy beliefs in the critical self-efficacy antecedent of performance accomplishment, the antecedent that has been assigned as the most important in subsequent self-efficacy belief formation.

CHAPTER 10.

ATTRIBUTIONAL RE-TRAINING, AROUSAL AND EMOTION

10.1 PURPOSE

The previous chapter showed that the attributional re-training intervention increased kayaking skills and strengthening self-efficacy beliefs to a greater extent than normal instruction. This chapter examines the potential mechanisms by which attributional re-training exerts the effect on learning and self-efficacy. Strong self-efficacy beliefs have been found to be strong predictors of good performance (academic achievement) (Manstead & van Eekelen, 1998) and good performance (performance accomplishment) strengthens self-efficacy beliefs (Bandura 1977) forming a rather circular argument. Regardless, it is clear that if attributional re-training augments either performance or self-efficacy then the other will be enhanced, even if not directly by the intervention.

Factors that lead to both improved performance and strengthened self-efficacy beliefs are arousal and emotion. These two factors are both antecedents of self-efficacy beliefs (Bandura, 1977; Schunk, 1995) and are related to peak performance in models such as Hardy and Fazey's (1987) catastrophe model and Hanin and Syrja's (1995) individual zone of optimum function. The extent to which an individual believes they can exert a controlling influence over a stressful situation has also been shown to vary directly with arousal and performance (Averill, 1973; Bandura, 1983; Folkman, 1984), while perceptions of a lack of control have been associated with increased anxiety (Endler et al., 2001; Glass et al., 1973; Geer & Maisel, 1972). Both perceived control in stressful situations and strength of self-efficacy beliefs are strong predictors of academic achievement (Linnenbrink & Pintrich, 2003; Perry, Hall, & Ruthig, 2007).

It is therefore predicted that an intervention which augments self-efficacy might act through changes in physiological arousal and, or, emotional state. However, the relationship may be asymmetric, in that self-efficacy exerts a greater influence on emotion, than emotion does on self-efficacy (Williams, 1995).

The aims of this chapter were to determine whether attributional re-training enhances self-efficacy and learning through:

- Reduced physiological, cognitive and somatic arousal.
- Reduced emotional expressions of anxiety and increased excitement.

10.2 METHODS

The following is a brief summary of the particular methods used to collect the data used in this chapter, a full description of the methods can be found in Chapter 3. This chapter uses the same participants that have been used in Chapters 5-9 and the same arousal and emotion data used in Chapters 5 and 6.

The participants ($n = 40$) were divided into a group that received the intervention (attributional re-training) ($n = 24$, comprising of eighteen males and six females) and another to receive normal instruction (non-intervention) ($n = 16$, comprising of ten males and six females) (see Chapter 9, section 9.2 and Chapter 3, section 3.4 for details). Measurements of heart rate, salivary cortisol concentration (cortisol), critical flicker-fusion threshold (CFF) and somatic arousal were taken during day two of a three-day kayak training programme (see Chapter 5 methods and Chapter 3, section 3.5). Qualitative data regarding expressions of emotion were collected with a question on the somatic arousal questionnaire (Appendix B).

Data analysis

Data shown are means \pm standard error of the mean (SEM). Difference *between* groups is calculated with independent samples *t*-test and ANOVA, *p* values are quoted in the text and shown on graphs with asterisks. Change (Δ) in arousal markers has been calculated by subtracting a rest level from an on water level. Emotional expressions were analysed for common phrases and the percentage of participants making common expressions has been shown.

10.3 RESULTS

The level of physiological and cognitive arousal for the attributional re-training and non-intervention groups are shown in Fig. 10.1. Physiological arousal is shown with heart rate (Fig. 10.1, A) and salivary cortisol concentration (Fig. 10.1, B). Cognitive arousal is indicated with critical flicker-fusion threshold (CFF) (Fig. 10.1, C). For heart rate, all preparation and kayaking sites return non-significant differences ($p > 0.1$) between the two groups. However, at recovery the attributional re-training group showed a significantly higher heart rate than the non-intervention group. For salivary cortisol concentration (Fig 10.1 B) the ANOVA reveals an intervention effect ($p = 0.03$). The intervention group has a mean salivary cortisol concentration of 0.76ng/l higher than the non-intervention group. Effect size analysis on the cortisol marker reveals an effect size of 0.8. The t test at the on water two site reveals the attributional re-training group had a significantly higher level than the non-intervention group, while the remaining sites return a non-significant difference between the two groups. The cortical arousal (CFF) marker returns no significant differences between the attributional re-training group, and non-intervention group at any of the five data collection sites.

In Chapter 5 it was suggested that somatic arousal was a better indicator of overall level of arousal than any of the other markers and indeed felt or perceived arousal may be of more importance to the participants' self-efficacy beliefs or skills development than actual levels in any one of the physiological markers used in this study. To examine this, somatic arousal was calculated for the two groups and compared. No significant difference ($p > 0.1$) was detected for somatic arousal between the attributional re-training and non-intervention groups.

Whilst the absolute level of arousal at each site (with the exception of cortisol at on water two and heart rate at recovery) is similar, the change or response of the arousal markers from rest to kayaking is also a useful indicator of the relative reaction of the two groups to white water kayaking. The change (response) of the arousal markers is shown in Fig 10.2.

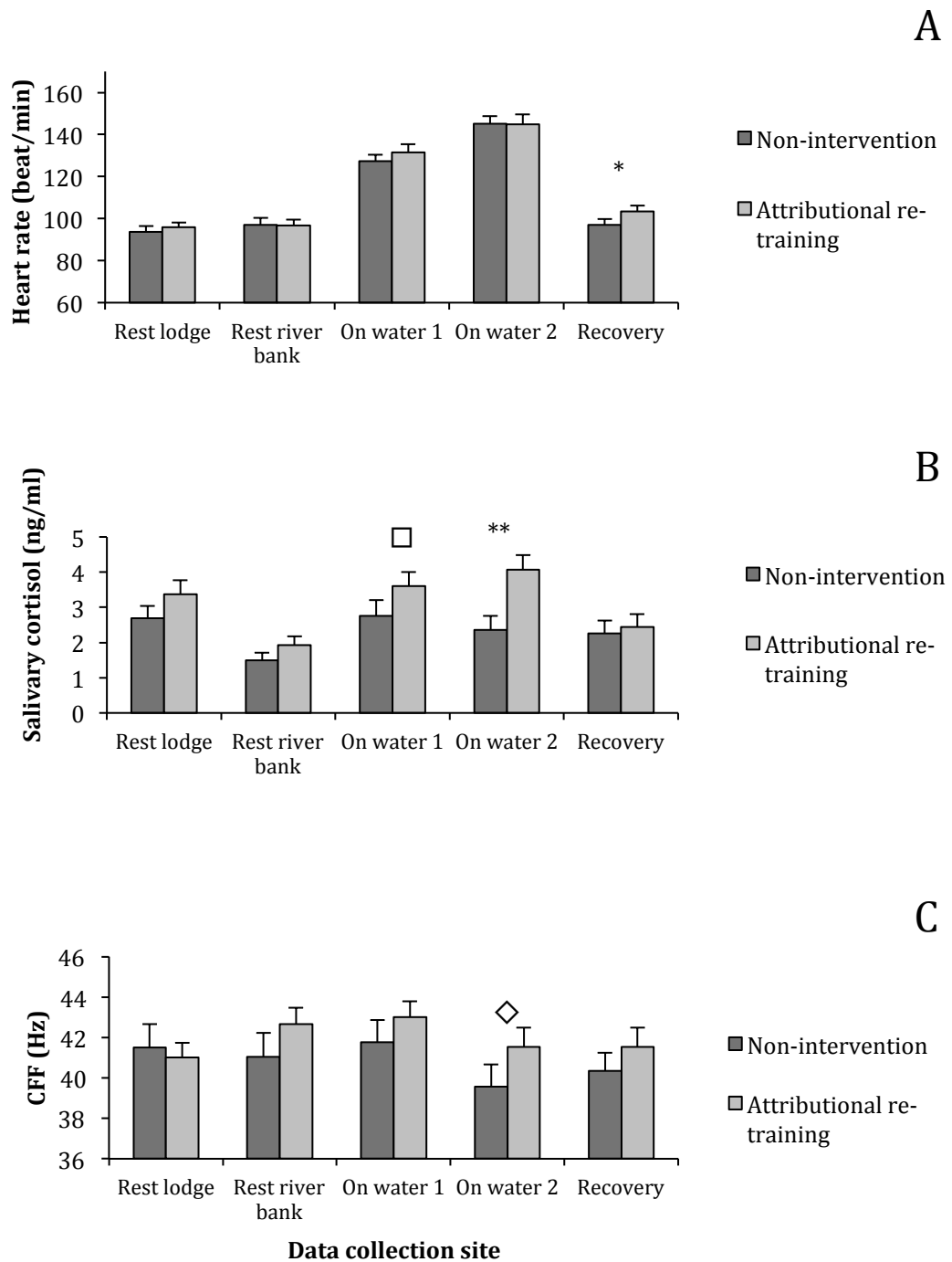


Figure 10.1 Physiological and cognitive arousal during rest, kayaking and recovery for attributional re-training and non-intervention groups. Data are means \pm SEM. \square indicates $p = 0.08$, \diamond indicates $p = 0.09$, * indicates $p \leq 0.05$, ** indicates $p \leq 0.01$ for differences between groups.

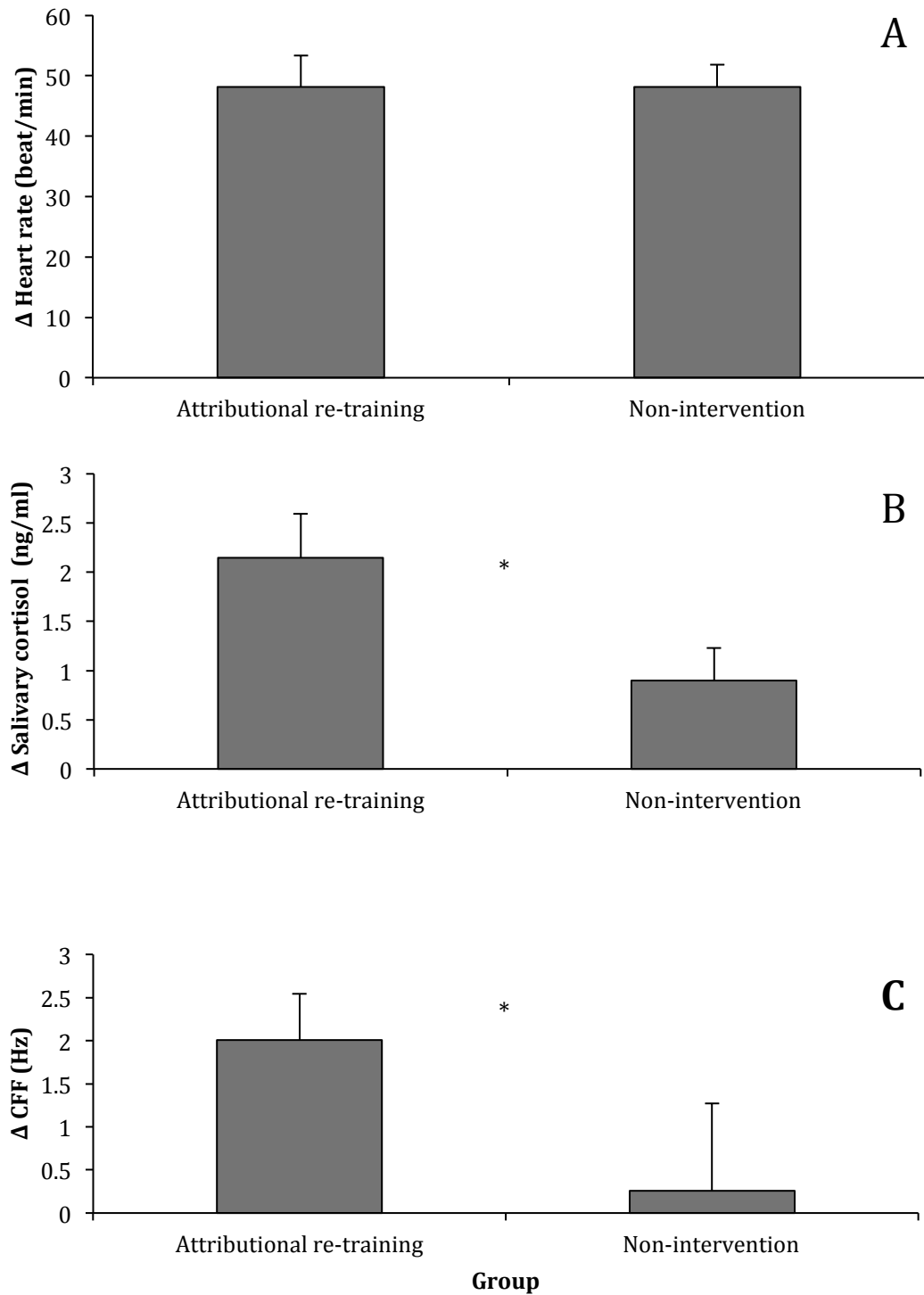


Figure 10.2 Change in physiological and cognitive arousal markers from rest riverbank to on water two (heart rate and cortisol) and rest lodge to on water one (CFF) for attributional re-training and non-intervention groups. Data are means \pm SEM. * indicates $p \leq 0.05$ difference between groups.

The change in arousal from a rest value to an on water kayaking value is shown in Fig. 10.2. Change in cortisol and change in CFF reveals a statistically significant difference between the two groups, while change in heart rate shows no detectable statistically significant difference, indeed the two group means are remarkably similar at 48 beat/min.

Differences in gender proportion between the two groups may have influenced the results in Fig. 10.2, therefore, the change in CFF for the males and females in each group has been calculated (Fig 10.3)

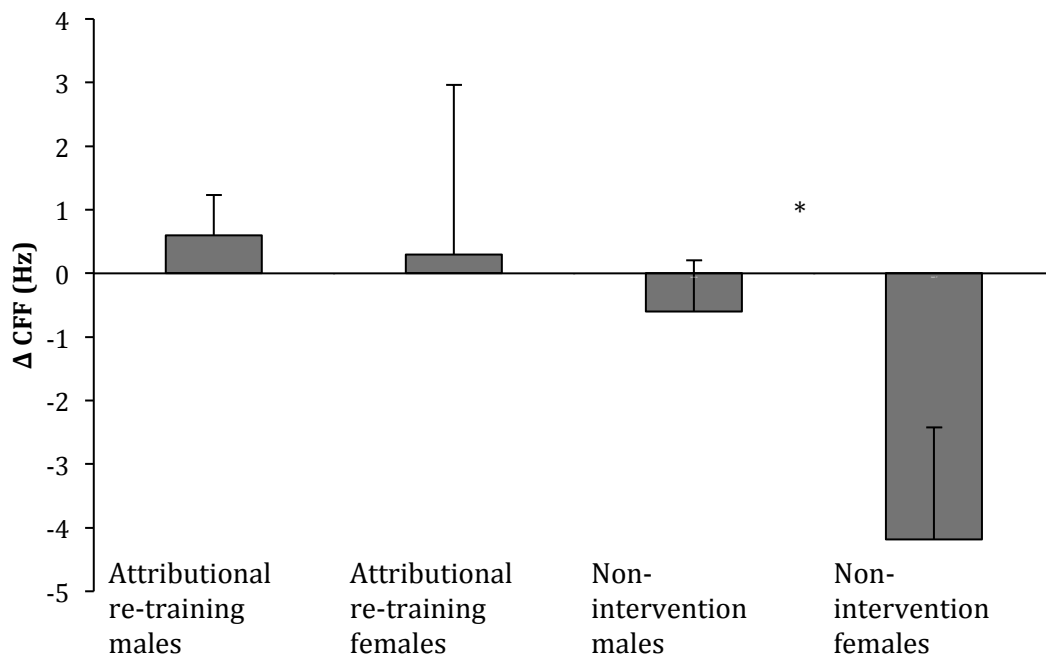


Figure 10.3 Change in CFF from rest lodge to on water two for males and females from the attributional re-training and non-intervention groups. Data are means \pm SEM. * indicates $p < 0.05$.

Both female groups show a large spread in the data compared to the males. The females in the non-intervention group show the largest depression of CFF. The difference in change of CFF between the males and females in the non-intervention group is significant ($p = 0.02$). The difference in change of CFF between attributional re-training females and non-intervention females shows a large difference but intra-group variation and small sample size ($n = 6$ for each group) renders the result statistically non-significant ($p = 0.09$).

Figure 10.4 shows the percentage of attributional re-training and non-intervention participants expressing various feelings when answering the qualitative question (Please describe the sensations you experience and why you think this is, and its effect on you) at the end of the somatic arousal questionnaire, administered at the first data collection site (rest lodge) at the start of the second white water training day.

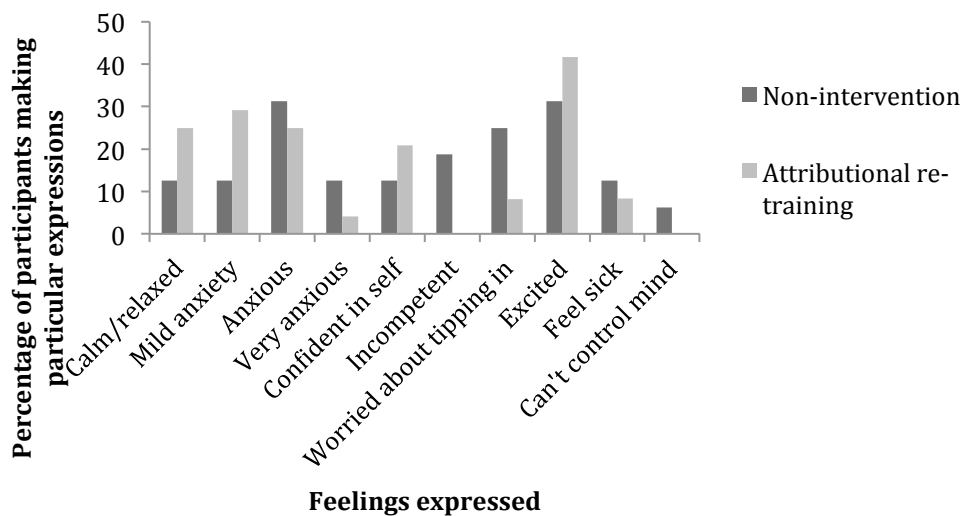


Figure 10.4. Qualitative expressions of emotion for attributional re-training and non-intervention groups. Data are the percentage of each group making similar expressions.

Not all participants made expressions regarding all themes and 11/40 made expressions of both anxiety and excitement. Of those eleven, 10/11 made expressions of mild anxiety and excitement. Several notable differences in the expressions made by the two groups have been identified. Of the attributional re-training group who expressed feelings regarding anxiety, the majority expressed calm/relaxed to mild anxiety, whereas the majority of the non-intervention group expressed feelings of anxious to very anxious. A greater percentage of the attributional re-training group expressed confidence (21% of attributional re-training group compared to 12% of the non-intervention group) while a greater number of the non-intervention group expressed feelings of incompetence (19%

to 0%). A higher percentage (25%) of the non-intervention group expressed worry (regarding capsizes) compared to only 8% of the attributional re-training group. In contrast, 42% of the attributional re-training group expressed feelings of excitement compared to only 31% of the non-intervention group.

10.4 DISCUSSION

Attributional re-training and arousal

The heart rate recorded at each site shows no significant difference between the two groups (Fig. 10.1, A) with the exception of the attributional re-training group showing significantly higher heart rates at recovery. This would suggest that the two groups have a largely similar response to the environment and the activity, although the higher heart rate at recovery suggests higher arousal at this point. The reactivity of heart rate (Fig. 10.2, A) and participant perceptions of somatic arousal also shows no difference between the groups, this would indicate that the intervention did not effect arousal in these markers and that the exercise stress of each group was similar.

The attributional re-training group's salivary cortisol concentrations (Fig. 10.1, B) show statistically significant elevated levels at on water two (immediately after the biggest and last rapid), and the reactivity of the cortisol marker was found to be statistically greater in the attributional re-training group (Fig. 10.2, B). The effect size for difference in salivary cortisol concentrations between the intervention and non-intervention group is regarded as large (Cohen, 1969). This would seem to be a clear indicator that the attributional re-training group is at a higher state of arousal than the non-intervention group particularly during the activity phase of the training day.

The results from the CFF marker (Fig. 10.1, C) are less clear than the other arousal markers due to a potential confounding influence of over arousal possibly leading to depressed levels of CFF at the two on water sites, as discussed in Chapter 5. Females appear to be more susceptible to a depression in CFF during high arousal conditions (see Chapter 5) and therefore the result

presented in Fig 10.1, C given the slightly differing proportions of gender 6/16 (37.5%) females in the non-intervention group as opposed to 6/24 (25%) females in the attributional re-training group) might be influenced by this factor. However, Fig. 10.3 suggests that gender proportions do not greatly influence the data in Fig 10.1. Both males and females from the non-intervention group have depressed CFF at on water two compared with rest lodge and the females have significantly greater depression than the males in the non-intervention group. The participants' critical flicker-fusion threshold measurements across the data collection sites show no statistically significant differences between the groups, however there is a statistically significant difference in the reactivity of the CFF marker between rest lodge and on water one. This implies that the attributional re-training group had a higher level of cognitive arousal.

As illustrated in Chapter 5, there is evidence that CFF rises as arousal rises, and would certainly seem to be the case when the stressor is exercise (Presland et al., 2005), but may become depressed when participants are aroused beyond a certain threshold or possibly when there is psychosocial stressor component. CFF, although used quite successfully as a marker of cognitive arousal, actually measures cognitive processing capacity (Parrot, 1982), and in over aroused cognitive states this capacity is reduced and therefore a depression in CFF may be detected. This is suggested by the information processing model (Humphreys & Revelle, 1984), selective attention (Braunstein-Bercovitz, 2003) and the processing efficiency theory (Eysenck & Calvo, 1992). Although in Humphreys and Revelle's (1984) model if we assign the ability to discern a rapidly flashing light as a sustained information transfer task then increased arousal will, as is suggested by this theory, lead to improved performance and is therefore desirable. The difference in CFF at the site of highest arousal could be as a result of the attributional re-training group being aroused to a greater level, increasing their cognitive processing ability, or conversely it may indicate that the non-intervention group has become over aroused and has therefore a reduced information processing capacity. Certainly Fig 10.4 suggests that the females in the non-intervention group, in particular, suffer from the largest depression in CFF. Hardy (1990) suggests that cognitive arousal behaves differently to

physiological arousal and that cognitive arousal has a catastrophe curve whereby at a certain arousal state performance drops markedly, rather than the slow decline in performance from physiological over-arousal.

Overall, the quantitative data (heart rate, salivary cortisol, somatic arousal and CFF) collected present some mixed evidence. The heart rate and somatic arousal data suggest that there is no difference in arousal between the two groups, while the cortisol and CFF data suggest that the attributional re-training group has higher arousal. These results could suggest that the intervention itself has been not only unsuccessful, but may have been partly responsible for the opposite of the desired effect of reducing over arousal, if in fact higher arousal does negatively affect performance. This effect could be due to the process of attributional re-training causing the participants to process their performance to a greater degree and therefore this re-living of the stressful activity keeps the arousal levels higher as was found by Chao et al. (2005).

Attributional re-training and emotion

To understand the apparent phenomenon of attributional re-training leading to higher arousal, or at least not significantly attenuating the arousal response, the qualitative data must be referred to in order to gain further insight into why this may be the case. Figure 10.5 shows the results from a qualitative question on the somatic arousal questionnaire that asked the participants to describe the sensations they experienced and why they think this is, and the effect of these sensations on them. It is here that we may find some explanation for the small, but apparently undesirable, arousal results. The comments the participants made regarding expressions of anxiety have been categorised into a scale from relaxed/calm to very anxious/fearful. It should be noted that on this scale, the attributional re-training group's responses are centred at the lower half, with the highest percentage of participants describing their somatic arousal in the calm and mild anxious categories, whereas the non-intervention group's responses are centred further up the scale in the mid and highly anxious/fearful states. This would seemingly contradict the quantitative data collected surrounding level of arousal, if anxiety and arousal are indeed linked.

There is an obvious difference in the expressions of competence and incompetence with the attributional re-training group's feelings centred on confidence, whereas the non-intervention group's responses centred on incompetence. The non-intervention group also expresses worry, particularly about capsizes, whereas the attributional re-training group don't express such feelings of worry. These factors also support the qualitative arousal data with feelings of competence associated with feelings of lower anxiety in the attributional re-training group. These should have led to lower arousal in the quantitative section of the questionnaire as well as the other arousal markers used.

However, potentially the most telling factor that may explain the apparent antagonism between the qualitative and quantitative data, and hence the discord with the aims of the intervention, is the expressions of excitement. Both Apter's (1982) reversal theory and Schachter's (1964) two factor theory of emotion allow for anxiety or excitement to be associated with similar arousal responses and for emotion to change between one form and another with no change in arousal. Similarly, Kerr's (1993) adaptation of the reversal model allows high arousal to be perceived as excitement or anxiety with a change from telic (non-evaluative) to para-telic (evaluative) cognitions. Over 40% of the attributional re-training group expressed feelings of excitement. Being excited would lead to obvious heightening of arousal levels in the attributional re-training group as would the feelings of incompetence and worry (anxiety) in the non-intervention group. Both factors (excitement and worry) could lead to similar arousal levels, but one could be seen to be debilitating and the other facilitative in a learning environment.

Mechanism for enhanced performance and learning

The present study was initiated by anecdotal perceptions of the debilitating levels of arousal and negative affect, seemingly shown by students during the white water kayaking element of their course. The intervention was designed to optimise the level of arousal and increase positive affect in these students. The

results from this study would suggest that the overall level of both physiological and cognitive arousal stays much the same or is increased with the attributional re-training intervention. However, it is the nature and possible cause of this arousal that differs. Certainly an individual feeling confident and excited is in a very different position to start learning compared to another individual feeling incompetent and worried, even though both parties may show the same level of arousal in the markers used in this study. The terms eustress and distress (Selye, 1950) differentiates between positive and negative arousal. It is proposed here that both these forms of stress can affect the arousal markers used for this study in a similar way, with the distinction between them seen in qualitative reporting of somatic arousal. These findings illustrate the importance of not only measuring arousal but also measuring the perceived direction of affect (Jones, 1995) that a given state of arousal engenders.

Arousal due to, or perceived to cause, excitement about entering the learning environment is much more desirable than arousal due to, or perceived to cause, anxiety about entering that same learning environment. Feelings of eustress are far more likely to result in perseverance and motivation towards educational goals than feelings of distress and are therefore much more desirable in teaching and learning contexts. Therefore the state of eustress should lead to a more productive environment for teaching and learning. Interventions that provide for this state to be nurtured should be encouraged and used in any educational situation.

The information processing model (Humphreys & Revelle, 1984), selective attention (Braunstein-Bercovitz, 2003), processing efficiency theory (Eysenck & Calvo, 1992) and conscious processing hypothesis (Masters, 1992) all suggest that higher cognitive arousal leads to lower performance, but here we find that participants with higher physiological and cognitive arousal (attributional re-training group) have stronger self-efficacy and greater skill (Chapter 9). These data would appear to not support the proposed models from the literature unless it is considered that over cognitive arousal in the non-intervention group has led to a depression in the CFF marker. However, what is shown is that the

attributional re-training group appears to show heightened physiological (cortisol) and cognitive (CFF) arousal but without the debilitating effects of this higher arousal on performance and learning, while the non-intervention group shows lower arousal (physiological (cortisol) and cognitive (CFF)) but that this does not enhance performance and learning. It is proposed that the intervention allows the participants to withstand higher levels of arousal and still learn and perform in high stressed outdoor environments. It would appear that the level of arousal is not necessarily the cause of the debilitating effects, but rather it is how the participant perceives that arousal. The attributional re-training approach used in this study may allow the participants to view arousal as facilitative and encourage perceptions of positive affect (Tellegen, 1985) while strengthening judgements of capability, and it is these factors that support the performance, retention and transference of kayaking skills.

Main findings from this chapter regarding attributional re-training, arousal and emotion are:

- Attributional re-trained participants appear to have higher physiological arousal (cortisol) than non-intervention participants, which may suggest that the attributional re-training intervention increases physiological arousal.
- Attributional re-trained participants show greater reaction (change) between rest and kayaking for both physiological arousal (cortisol) and cognitive arousal (CFF). This suggests that the attributional re-training technique coupled with environmental stimuli in the white water environment may stimulate the arousal pathways to a greater extent.
- Non-intervention group females show the largest depression in CFF at on water two compared with rest, suggesting that females may be most negatively affected and may benefit most from the attributional re-training techniques to increase cognitive processing capacity in the white water environment.
- More non-intervention participants report perceptions of worry, incompetence and anxiety, which suggest that lower levels in the arousal markers may be due negative emotions. This supports Maslach's (1979)

findings that unattributed arousal leads to negative emotions but does not support Schachter's (1964) theory that unattributed emotion causes heightened physiological arousal.

- More attributional re-trained participants report perceptions of calm, confidence and excitement. This indicates that heightened levels in the arousal markers may be due to positive emotions, also supporting Maslach's (1979) findings as this group has been trained to find attributions for their arousal and is therefore less likely to have unattributed arousal.

CHAPTER 11.

GENERAL DISCUSSION

Significant rises in physiological arousal markers were found between the first data recording sites (before getting on the water) and the on water sites (between and after rapids). The level of these markers was extreme, being the same or greater than that induced by elite kayak racing (Tesch & Lindberg, 1984) (Fig. 5.1) or intense exercise with drug stimulants (Beavan et al., 2008) (Fig. 5.2) even though exercise intensities appear to be moderate. There was evidence to suggest a large psychological influence on the heightened state of arousal, as there was a low to moderate exercise level, a large and early anticipatory response (Fig. 4.1) and a slower recovery (Fig. 4.4) than could be accounted for by kayaking exercise alone. The physiological arousal markers behaved as predicted by the literature, with the highest levels found between or just after major rapids (Figs. 5.1, 5.3) where the risk of capsizing and injuries are greatest (Bunting et al., 2000; Fiore & Houston, 2001).

Attributional re-training and self-efficacy augmentation had an inconsistent effect on physiological arousal, some markers being unaffected whereas others showing heightened arousal. There was a clear difference in the reports of emotional status that suggests that the measured arousal was linked to differing emotions, as predicted by the emotion/arousal models of Kerr (1983), Apter (1982) and Schachter (1964). Participants who received the attributional re-training intervention more often reported feelings of calmness, mild anxiety and excitement, whereas the non-intervention group more often reported feelings of worry, anxiety and incompetence. (Fig. 10.4) It is suggested that both these mixtures of emotions have a similar effect on states of physiological arousal, with somatic perceptions leading to negative affect (anxiety) in the non-intervention group and positive affect (excitement) in the attributional re-training group. The perception of anxiety is a purely cognitive construct; the body cannot be anxious, it can merely be aroused. It is the somatic perception of positive or negative affect for the state of the body and of the mind that in turn is processed as a cognition of anxiety or excitement. If an individual is worried about the somatic

perceptions they associate with the heightened arousal they are experiencing, because they perceive them to be negative and detrimental to their ability to function in the learning environment, this may lead to cognitions of anxiety and may in turn trigger additional physiological arousal as they summon the resources to meet the challenge of the stressor. If these perceptions of physiological arousal are perceived not to be detrimental, but instead as necessary and desirable in order to function at the highest level, then these feelings of arousal will be perceived as excitement, or rather, merely the state of heightened arousal that they actually are. The disconnection of heightened physiological arousal with the mental state of anxiety is a desirable ability and one which attributional re-training helps achieve. It is suggested that the cognition of state of arousal is seen through an attributional lens, it is to what the arousal is attributed that leads to the various possible resultant cognitions. The attributional re-training techniques used in this study reframe the causality of the arousal into positive and desirable factors as well as enabling the participant to seek controllable, internal and unstable causality for failure. Being in control of, and able to make changes to causality is central to conditions promoting optimum arousal and superior performance (Averill, 1973; Bandura, 1983; Folkman, 1984; Rees et al., 2005).

One of the most interesting findings was that seen in the CFF data. CFF is widely reported to be a measure of cognitive arousal and it would appear that the physiological markers and this cognitive marker act in parallel up to a certain point of arousal and then after this point is reached the cognitive arousal marker drops away while the physiological markers continue to rise suggesting continuing physiological arousal stimulation (Fig. 5.3). This follows the prediction made by Fazey and Hardy (1987) with their catastrophe model (Fig. 2.5), which has been difficult to validate with empirical data. In this model, a three-dimensional performance surface is created with function on the vertical axis and physiological arousal and cognitive arousal taking up the two horizontal axes. Physiological arousal manifests as a traditional inverted U curve, but with an increasing cognitive component influence, this modifies the inverted U to become an overhanging waveform, the catastrophe surface. Much of the work in

this field has been undertaken in the competitive sport arena and laboratory where the anxiety levels may not have been induced to a sufficiently elevated level for the catastrophe phenomenon to be seen. Certainly in outdoor and adventure activities, where the real or perceived threat of risk or injury is ever present (Priest & Bunting, 1993; Fiore & Houston, 2001), the catastrophe phenomena would be more likely than when making set shots in basketball for example.

The measurement of arousal in real world environments is a minefield of confounding effects and stimuli. Presented here is a wide ranging net which it is hoped has put the various measures into comparative focus. It has been found that somatic arousal is perhaps the most appropriate single measure to reflect arousal's effect upon self-efficacy. Somatic arousal correlates well with self-efficacy, whereas the other arousal markers do not. The greater influence on self-efficacy would appear to be how someone feels about their state of arousal, not the actual arousal level attained. As Thayer (1967) contends, self-report (somatic) arousal is a better indicator of overall arousal than can be gained from physiological means.

The notion of self-efficacy and the ability of outdoor educational experiences to enhance it have been widely used by the proponents of the outdoor education industry to validate the use of the outdoors in educational contexts. Unfortunately, until now, there has been little empirical evidence to support it. Self-efficacy has been shown in this study to be a good predictor of arousal and attainment in white water kayaking; arousal displaying a negative correlation with self-efficacy, and attainment showing a positive correlation with self-efficacy. Self-efficacy augmentation can therefore be seen as a potentially important and useful tool to improve attainment in outdoor educational tasks. Of the antecedents of self-efficacy, performance accomplishment seems to be the strongest predictor of skill level (Table 7.3). This study provides evidence on the importance of the style of feedback and actual physical experiences in the development of self-efficacy and outdoor pursuit skills.

The model of attributional re-training that has been used in this study has been shown to have a positive effect on skill attainment with the individuals who received it less adversely affected by criticism and peer failure. There has also been a shift towards perceptions of low anxiety and greater excitement. There is evidence that the individuals who received the attributional re-training intervention developed more robust and resilient skills that could be transferred to more challenging environments. The intervention tool is not only portable but also, more importantly, enables the learner to continue regulating perceptions of self when out of reach of the educator. This allows continued improvement in self-directed personal practice.

Of great interest is the potential to investigate the tipping point where the level of arousal begins to affect performance. This was potentially seen in the measurement of critical flicker-fusion threshold where a depression in CFF suggested that cognitive processing ability was impaired at the highest state of physiological arousal (Fig. 5.3). This depression in CFF was most marked in females in the non-intervention group (Fig. 10.3) who also experienced greater anxiety and attained lower skills. This tipping point may be seen as the point where excitement turns to anxiety. It is proposed that this is when anxiety, a cognitive construct, feeds off somatic perceptions of arousal, and the learner perceives these sensations as negative or out of their control. This may in turn trigger further arousal with an ensuing downward spiral of increasing arousal and increasing anxiety with declining performance. The construct of anxiety could be seen as the worry about being aroused. Attributional re-training might break this destructive cycle, therefore allowing people to be aroused, ready for physical work and be excited about the prospect, and has been shown in this study to delay or reduce the onset of the depression in cognitive ability at states of heightened arousal. CFF, in conjunction with the other arousal markers used in this study, allows the point to be identified where arousal negatively impacts on performance. Having a measure that allows the point of maximum stress to be identified, before performance is impacted, is vital in the hot-house environment that is prevalent in tertiary outdoor educator programmes. This knowledge has a wide application for course design, structure and student monitoring.

Potentially the most striking findings from this research are the gender differences found. Females tended to have a greater depression in CFF than males for the same activity in the most physiologically arousing environments (Fig. 5.3). This would suggest that females are more susceptible to depressed cognitive processing capacity and its inferred effect on depressed learning than are males. There were also gender differences in the arousal conditions that develop self-efficacy beliefs. Males tend to develop self-efficacy beliefs under high arousal conditions (Fig. 6.5), whereas females tend to develop their self-efficacy beliefs under low arousal conditions (Fig. 6.4). These two factors have significant pedagogical and programming implications for the development and training of outdoor leaders. Being mindful of this evidence may help ensure that both genders develop skills and self-efficacy beliefs optimally.

The findings from this thesis, in relation to what is already known in this subject area, have led to the proposed model of the psychophysical-pedagogical pathway (Fig. 11.1). The key element of this model, over previous models, is that it integrates the disciplines of physiology, psychology and pedagogy together. In this model, the initial stressor could be a task set by the educator or an environmental stressor with which the learner has to interact in order to carry out a set task. This leads to an autonomic nervous response resulting in a physiological and cortical arousal response. The arousal response has been characterised in Chapters 4 and 5, with early and large anticipatory arousal responses, and broad arousal activation. This initial physiological arousal response has also been described by Lazarus (1991) as a response to a primary appraisal, in which the individual assess what is at stake. The arousal response triggers a cognitive appraisal to be undertaken, which is largely based on: previous experience, the attribution of the causality for the arousal response and self-efficacy beliefs for the chosen coping strategy. This is the secondary appraisal to which Lazarus (1991) refers, in which the individual assesses their resources to cope with the stressor, and the cognitive component that Gould and Udry (1994) posit then forms part of the physiological arousal response. It is proposed that the arousal response is viewed through the lens of the attribution made to the causality of the arousal. This attribution is then filtered through the

self-efficacy beliefs the individual has regarding their capability to control and cope with the demands of the stressor. This cognitive appraisal stage results in a cognitive perception of positive or negative affect that in turn leads to an emotional label being applied (excitement or anxiety). This stage takes into account the theories of emotion proposed by Apter (1982), Schachter and Singer (1962) and Mandler (1984). If there has been a previous successful experience/performance accomplishment, the attribution for the arousal response is seen as positive i.e. it is necessary and useful. When the learner believes they have the resources to be successful (self-efficacy), they will be excited by the task. If, however, the learner has had a failed previous experience, they attribute the arousal response as harmful and negative. When the learner believes they do not have the resources to be successful at the task, they will perceive the same set of primary responses as feelings of anxiety. This set of propositions, that if matched, trigger a pre-set emotional response is similar to that proposed by Lang (1985).

The subsequent performance will be under the influence of the emotion, attribution and self-efficacy beliefs in the box on the left or the right of the model. Multon, Brown and Lent (1991) in accord with this research found that self-efficacy beliefs are a good predictor of subsequent performance. Self-efficacy is also linked with emotion through the perceptions of control and capability to cope; Endler et al. (2000) found that perceptions of a lack of control over stressors were associated with feelings of anxiety. This subsequent performance is of primary importance in forming future self-efficacy beliefs, arousal and emotional responses. This performance will be viewed through the attributional lens. Those participants who attribute failure to unstable, internal, controllable factors (as they have been re-trained to do) are likely to view the future as positive as even after a failed attempt they will have a different strategy with which to attempt the next trial. Furthermore, they will be efficacious about their chance of success in the future and feel as if they can exert some degree of control over the future.

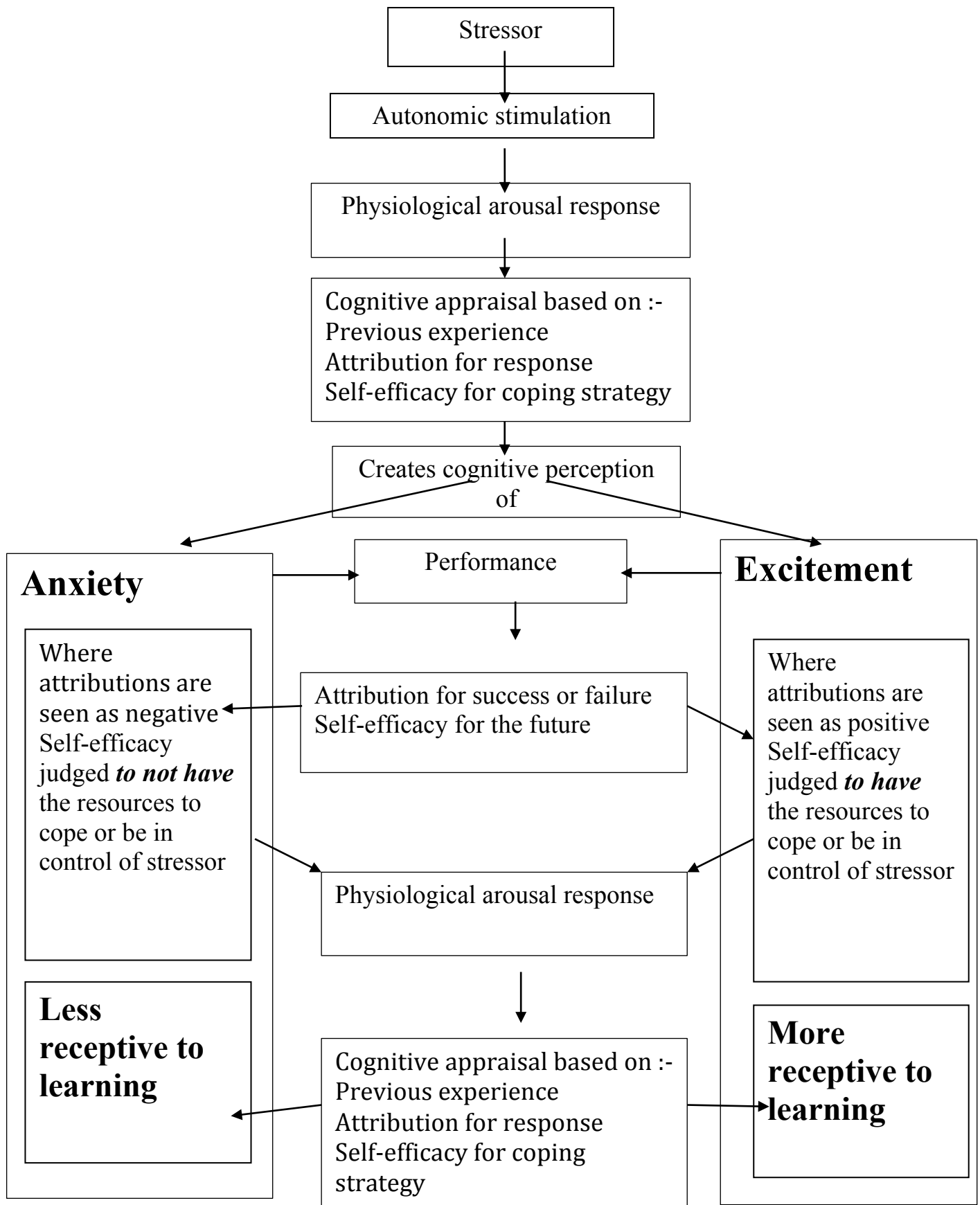


Figure 11.1 Proposed model of the psychophysical-pedagogical pathway.

Conversely, those who attribute failure to stable, external, uncontrollable factors, are likely to feel negative, have weaker beliefs of self-efficacy and greater perceptions of helplessness (Seligman, 1975) about the future. These attributions are then filtered through the individual's self-efficacy beliefs.

Performance accomplishment was found in this research to be an important predictor of subsequent skill and is the primary antecedent of subsequent self-efficacy belief formation, it being a much more unequivocal factor than other antecedents (Bandura, 1983; Priest & Bunting, 1993). The arousal response was found in this study to vary indirectly with strength of self-efficacy beliefs in accord with Bandura (1983), suggesting that strength of self-efficacy has an effect on subsequent arousal stimulation. This arousal response is then appraised cognitively based on previous experience (performance accomplishment), the attributions made for the causality of that arousal and the self-efficacy beliefs held by the individual. The attributional re-trained participants in this study who were trained to view arousal as facilitative, reported stronger self-efficacy beliefs and developed greater skill which indicates that they were more receptive to learning.

Attributional re-training can therefore be seen as a vital tool to break the negative, anxiety inducing cycle. The attribution of cause for the arousal response and the failed performance to positive notions will shift the cognitive appraisal from the left (anxiety) to the right (excitement). Once a person is on the right side of the model they will become more efficacious and learn nearer their potential. This will make successful performance accomplishment more likely and the right side cycle will be perpetuated. A further key role of attributional re-training is to make the participant more resilient to failure. This is especially true if they are encouraged to make attributions for failure to unsuitable strategy choice. This attribution allows for many unsuccessful attempts to be made whilst trialling new strategies, each successive trial being deemed likely to produce success by the participant and so promote feelings of efficaciousness. Therefore, an attributionally re-trained individual is not only more likely to start on the right side of the model, but is more likely to stay there,

even after a failure compared to an individual who initially starts on the right but who has a negative performance later and attributes this failure to stable, external, uncontrollable factors.

The role of attributional re-training and self-efficacy augmentation can therefore be clearly seen at the centre of producing excited and engaged learners in a positive and productive outdoor educational environment. It is vital that educators make this tool available to learners in order that maximum productivity is attained.

CHAPTER 12.

CONCLUSIONS

12.1 INTRODUCTION

This research was initiated by the seemingly debilitating effects of over arousal and anxiety in some outdoor teaching environments. These debilitating effects effectively debarred some students, and hampered others, from certain elective choices within outdoor leadership programmes. There was a gap in the knowledge regarding arousal and emotion in these outdoor pursuit teaching conditions and on the regulation of arousal to provide optimum learning conditions so that all students could reach their potential.

12.2 RESEARCH OBJECTIVES

Firstly, this research set out to firstly characterise the arousal response in the natural setting in which white water kayak training takes place. For the first time, an array of physiological markers, including cortisol, as well as cognitive and somatic arousal markers were used in the natural white water setting. Secondly, this research trialled the utility and effectiveness of self-efficacy augmentation as a means of improving learning in the white water kayak training context. Thirdly, an attributional re-training technique was developed and trialled as an augmentation tool.

The research was centred around six main research questions:

1. What level of arousal do students have while participating in white water kayak training courses?

One of the main findings regarding this question was that arousal levels in the parameters measured were very high (with the exception of CFF) when kayaking rapids. These levels of arousal were similar to those experienced during elite kayak racing or when undertaking intense exercise with high dose caffeine ingestion (Beavan et al., 2008; Tesch & Lindberg, 1984), however, they were evoked by low to moderate exercise intensities. Heart rates showed large and

early anticipatory responses and were slower to return to resting values at cessation of kayaking when the participants had been kayaking in the natural environment. The CFF marker was depressed when other arousal markers were at their zenith (on water two), indicating a possible depression in cognitive processing capacity at high levels of physiological arousal (Fig. 5.3). The levels of arousal could not adequately be explained by exercise alone and it is suspected that there is a large psychological component present.

2. What are the relationships between self-efficacy beliefs and arousal (physiological, cortical and somatic) in white water kayaking?

Self-efficacy and arousal were seemingly found to have an interactive two-way relationship. Participants with weak or moderate self-efficacy beliefs showed the largest subsequent arousal response, while participants with high somatic and cortisol responses and low CFF responses subsequently developed weak self-efficacy beliefs. The formation of self-efficacy beliefs appears to occur at differing levels of arousal for males and females; females' self-efficacy beliefs would appear to be developed at low arousal states while males' self-efficacy beliefs may develop at high arousal states.

3. What is the relationship between self-efficacy beliefs and the learning of kayak skills?

Pre and post self-efficacy correlate well with skill attainment and therefore could be used as a useful predictor of skill. However, the relationships between change in self-efficacy and change in skill or pre and post self-efficacy with change in skill were not found to be proportional and therefore self-efficacy or self-efficacy beliefs change may not be a good predictor of skill change. The performance accomplishment antecedent of self-efficacy was found to be the best predictor of subsequent skill.

4. What are the relationships between arousal (physiological, cortical and somatic), emotion and the learning of kayaking skills?

Greater learning seemed to occur when there are smaller changes in arousal, which infers either that participants who learn well may have a smaller

reactivity of arousal, or, that greater arousal negatively impacts learning. Although emotional state did not seem to significantly affect learning directly, anxious participants appeared to show greater change in arousal, which may lead to depressed learning.

5. What are the relationships between attributional re-training, the change in participants' kayaking skills (learning) and their self-efficacy beliefs?

Attributional re-training seemed to have a positive effect on skill attainment and positive skill change. It also appeared to have a positive influence on the development of stronger self-efficacy beliefs. The positive effects on self-efficacy, although distributed across the parameters of self-efficacy measured, seemed to have most effect on the parameters of responses to peer failure and general capability and in the context of not capsizing in rapids. The participants who received the attributional re-training also seemed to have significant strengthening of the critical antecedent of performance accomplishment, which other authors have suggested is the primary self-efficacy antecedent Bandura, 1983; Priest & Bunting, 1993).

6. What are the relationships between attributional re-training and arousal (physiological, cortical and somatic)?

Attributionally re-trained participants appeared to experience higher physiological arousal (cortisol) and greater increase of cortical arousal which suggests that the re-training intervention in the environment of white water rapids, possibly stimulates arousal to a greater extent. There is evidence to suggest that attributional re-training may dampen the depression of CFF (Fig. 10.2,C) and therefore the inferred decline in cognitive processing capacity, especially for females (Fig. 5.3). Attributional re-training appears to stimulate notions of high positive affect (excited, confident) and low negative affect (calm, relaxed) (Fig. 10.4).

12.3. CONTRIBUTION TO RESEARCH

The literature revealed that little was known of the situational arousal response to white water kayaking and in outdoor pursuit leader training. Published techniques for optimising arousal and emotion to augment learning of white water kayak skills in natural outdoor settings for training outdoor pursuit leaders had not been undertaken. This study has gone some way to fill the void in our knowledge of the arousal and emotional response to outdoor leader training and how this can be managed. The findings have significant implications for pedagogical practice and programme design. Most notably, the finding that suggests females have their cognitive processing function depressed in environments that evoke high arousal to a greater degree than males, indicates that unless programmes are well structured and incremental exposure to more advanced and oppressive conditions is carefully managed, learning for females may suffer. The data have revealed that, for females, strategies to augment self-efficacy and learning are best placed in environments that evoke lower physiological arousal than for males, which suggests that teaching males and females together may not be wholly appropriate, in terms of maximising learning and strengthening self-efficacy beliefs for both genders.

Proponents of outdoor education have made many claims regarding the strengthening of self-efficacy, as well as other self-concepts, through exposure to risk, learning new skills and successful completion of novel tasks. However, the mechanism for this to actually take place, as well as the empirical evidence to support it, has thus far been rather vague (Priest & Bunting, 1993): the evidence largely being of a subjective and anecdotal nature. This study has given the outdoor education sector empirical data that supports those claims. The model of attributional re-training utilised in this study has been shown to augment self-efficacy. Those who received re-training had stronger self-efficacy and displayed a greater positive skill level at the conclusion of training, demonstrating that they had learned more during the training phase compared to others who did not receive the re-training and who, subsequently, had lower self-efficacy.

The protocols developed for, and used in, this study have given the outdoor education industry a tool for attributional re-training and self-regulation that is portable, easy to administer and allows the process to continue even when the learner is not under the direct influence of the teacher. It has a positive effect on self-efficacy and on learning, therefore increasing productivity in the stressful learning environment.

This study is the first to combine the array of physiological, cognitive and somatic arousal markers with attributional re-training to study the effects on self-efficacy and learning in the white water kayak training environment and thus brings the approaches from education, physiology and psychology together.

12.4 LIMITATIONS OF THIS RESEARCH

Participant characteristics

The participants studied were all university students aged 18-31y, mean 20.1y. The group was predominantly male with a male-female ratio of 7:3 and was predominantly NZ European. Conclusions drawn from this particular population may, or may not, transfer to a wider population.

Sample size

Although all available participants over a 2-year period were involved the sample size was still relatively small ($n = 40$), particularly for sub-group analysis. Larger participant numbers would allow greater strength of probability to be drawn.

Intervention characteristics

The data collection and intervention period were short term, lasting three days. Longer time frames would have allowed for greater changes to have eventuated and long term effects to be monitored.

Arousal Measures

The arousal data collected, although covering the major known arousal pathways, were limited in both frequency of sampling and breadth of arousal responses measured. A greater number of arousal markers monitored at a greater frequency may have given a more complete assessment of the participants' state of arousal.

Timing of somatic arousal measure

Somatic arousal has been suggested as the best single marker for arousal as it affects self-efficacy and emotion. To date, however, a non-intrusive measure of this marker has not been developed to enable it to be measured in a timely manner with the other arousal markers that were measured in this study. This limited the inferences that could be made between perception of and the actual arousal level evoked.

Location of skill tests

The location for the post skill test was different to that used for the pre test due to ethical requirements. This made the direct comparison of skill and learning not possible from the pre test to the post test. However, it did allow assessment of transference of skill that is a key element in assessing learning.

Confounding variables

In research conducted in the field with a group exposed to real risks there are many confounding variables that can only be factored for to a certain degree. Therefore until further research using a much larger sample size has been undertaken these results and conclusions must be used with caution.

12.5. APPLICATION OF THIS RESEARCH

There are many fields of educational endeavour where situational stressors can obstruct productive teaching and learning. This research has involved an in-depth study of one particular environment, literally flowing with actual and potential stressors. These factors make teaching and learning in this

environment both exciting and fun, but certainly stressful. There will be many similarities and commonalities with other educational fields, most notably in the emergency services and in military training, where the stakes are high and the learning of skills in short time frames is imperative. The use of self-efficacy augmentation via attributional re-training is one important step that can make learning in these situations a positive and rewarding one.

The use of self-regulation techniques that can be used and drawn upon even when the learner is out of direct reach of the teacher are very helpful in today's teaching and learning environments. This technique provides such a tool for use in any high stressed learning conditions as well as others of a calmer nature. It is a useful technique to impart on any learner where stress levels may negatively influence the productivity of the educational situation. The findings from this research have implication for outdoor leader training programme design, males and females appearing to learn best and strengthen their respective self-efficacies under differing conditions and so the one hat fits all approach may now be shown to be somewhat limited.

12.6. FUTURE DIRECTIONS

Gender differences

Of particular interest from this study has been the gender difference in arousal response, particularly in CFF at heightened states of physiological arousal. Further study, with the investigation of this phenomenon as its central aim with a greater number of participants, would allow more certainty over the effect and validation of the precise circumstances of the catastrophe cusp that has been indicated. Further investigation of female specific learning in this specialised environment would be most welcome. Women are under represented in the outdoor industry as a whole and the more that can be done to support them with appropriate teaching and learning strategies the better. Male dominated teaching styles may simply not be appropriate to enable both genders to learn outdoor skills effectively.

Tipping point

Further study to identify the peak learning and performance thresholds, the point at which student learning becomes compromised, for other arousal markers would be most welcome. This is vital for course design and to understand when students can progress to more challenging environments and tasks and is of particular importance in the hot-house learning environments where progress rates are paramount. A seemingly fertile area for further work would appear to be the development of a non-invasive (on time) measure of somatic arousal as a predictor of the tipping point for impaired learning. This somatic arousal measurement tool must incorporate the ease of use of Pijpers et al.'s (2003) anxiety thermometer with the detail gained from a more involved questionnaire, but without the time burden. A possible solution is to use a three dimensional scale involving perception of arousal on one axis as well as positive and negative affect scales on the other two.

There is much more to learn about the use of predictors to enable suitable teaching strategies and groupings to be implemented. This present study has identified some potential issues that must now be specifically tackled to ensure that future pedagogies do not simply repeat the limitations now known to have existed in the past.

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Pre/ Post

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White water kayaking self-efficacy questionnaire

This questionnaire is designed to indicate your self-efficacy for white water kayaking. Self-efficacy is your judgement about your capability to do a certain task in a given situation. This questionnaire will ask you about your judgement of your capability to do certain tasks (eddy turns, ferry glides and staying upright) and how various factors effect your beliefs. These factors include your arousal (the continuum between calmness and anxiety), the effect of your success and failure, seeing your peers perform and the effect of things said to you. Two variables are used in each of the questions and these are in **bold type**. Each question asks you to consider the effect of the first variable (in bold type) on your capability to perform the second variable (in bold). The questions that ask you about control of your arousal are asking about both mental and physical symptoms of arousal. The questions about control of your body are asking about the physical control of your body's movements **not** about arousal. Please ensure that you answer all questions by ticking the box you think best describes you.

Control

Question 1a.

When I consider my capability to **control my cortical arousal** when doing **eddy turns**, I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 1b.

When I consider my capability to **control my cortical arousal** when doing **ferry glides**, I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 1c.

When I consider my capability to **control my cortical arousal** when trying to **stay upright in rapids**, I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 1d.

When I consider my capability to **control my body** when doing **eddy turns**, I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 1e.

When I consider my capability to **control my body** when doing **ferry glides**, I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 1f.

When I consider my capability to **control my body** when trying to **stay upright in rapids**, I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 1g.

When I consider my capability to **control my kayak** when doing **eddy turns**, I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 1h.

When I consider my capability to **control my kayak** when doing **ferry glides**, I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 1i.

When I consider my capability to **control my kayak** when trying to **stay upright in rapids**, I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Physiological arousal**Question 2a.**

When I think of my level of cortical **arousal** when doing an **eddy turn** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 2b.

When I think of my level of cortical **arousal** when doing a **ferry glide** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 2c.

When I think of my level of cortical **arousal** when trying to **stay upright in rapids** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Performance accomplishment**Question 3a.**

When I think of my past **successes** when doing **eddy turns** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 3b.

When I think of my past **successes** when doing **ferry glides** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 3c.

When I think of my **successes** at **staying upright in grade 2 rapids** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 3d.

When I think of my past **failures** when doing **eddy turns** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 3e.

When I think of my past **failures** when doing **ferry glides** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 3f.

When I think of my past **failures** at **staying upright in grade 2 rapids** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Vicarious experience**Question 4a.**

When I see my **peers, who I see as most similar in capability to me, succeed** when doing **eddy turns** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 4b.

When I see my **peers, who I see as most similar in capability to me, succeed** when doing **ferry glides** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 4c.

When I see my **peers, who I see as most similar in capability to me, succeed** at **staying upright in grade 2 rapids** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 4d.

When I see my **peers, who I see as most similar in capability to me, fail** when doing **eddy turns** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 4e.

When I see my **peers, who I see as most similar in capability to me, fail** when doing **ferry glides** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 4f.

When I see my **peers, who I see as most similar in capability to me, fail** at **staying upright in grade 2 rapids** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Verbal persuasion**Question 5a.**

When I receive **encouragement or praise** before I do an **eddy turn** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 5b.

When I receive **encouragement or praise** before I do a **ferry glide** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 5c.

When I receive **encouragement or praise** before I try to **stay upright in a rapid** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 5d.

When I receive **criticism or ridicule** before I do an **eddy turn** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 5e.

When I receive **criticism or ridicule** before I do a **ferry glide** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Question 5f.

When I receive **criticism or ridicule** before I try to **stay upright in a rapid** I believe I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Self-efficacy for whitewater kayaking**Question 6**

When I think about how capable I am at whitewater kayaking in grade 2 rapids, I would say that I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Please state what makes you feel the way you do.....

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Self-efficacy for eddy turns**Question 7**

When I think about how capable I am at doing eddy turns, I would say that I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Please state what makes you feel the way you do.....

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Self-efficacy for staying upright in grade 2 rapids**Question 8**

When I think about how capable I am at staying upright in grade 2 rapids, I would say that I am

Totally capable	More capable than not capable	Neither not capable nor capable	More not capable than capable	Not capable at all

Please state what makes you feel the way you do.....

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Thank you very much for completing this questionnaire your help has been invaluable for this research

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Pre/ Post

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White water kayaking Somatic arousal Questionnaire

Somatic arousal is your feeling of how aroused you are. Please answer these questions by circling the number you think best describes the way you feel about the statement, using the scale shown below with

1= strongly disagree and 7= strongly agree.

1. My stomach feels normal

Strongly Disagree

Strongly Agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

2. My breathing is normal

Strongly Disagree

Strongly Agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

3. My mind is racing

Strongly Disagree

Strongly Agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

4. I have strong feelings of butterflies

Strongly Disagree

Strongly Agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

5. I find it easy to concentrate on the job as hand

Strongly Disagree

Strongly Agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

6. I feel nauseous (sick)

Strongly Disagree

Strongly Agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7. My mind is settled

Strongly Disagree

Strongly Agree

1	2	3	4	5	6	7
---	---	---	---	---	---	---

8. My body feels calm and relaxed

Strongly Disagree

Strongly Agree

1 2 3 4 5 6 7

9. I can feel my heart beating strongly

Strongly Disagree

Strongly Agree

1 2 3 4 5 6 7

10. My mind flits from one subject to the next

Strongly Disagree

Strongly Agree

1 2 3 4 5 6 7

11. I feel tense and nervous

Strongly Disagree

Strongly Agree

1 2 3 4 5 6 7

12. I cannot feel my heart beating

Strongly Disagree

Strongly Agree

1 2 3 4 5 6 7

13. I can feel my body trembling

Strongly Disagree

Strongly Agree

1 2 3 4 5 6 7

Please describe the sensations you experience and why you think this is, and its effect on you.....

.....

.....

.....

.....

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.....

.....

Thankyou very much for completeing this questionnaire your help has been invaluable for this research



M E M O R A N D U M

Auckland University of Technology Ethics Committee (AUTEC)

To: Colin Gibbs
 From: **Madeline Banda** Executive Secretary, AUTEC
 Date: 18 September 2007
 Subject: Ethics Application Number 07/163 **The effect of attributional re-training on somatic, physiological, cortical arousal, self-efficacy and learning in beginner white water kayakers.**

Dear Colin

I am pleased to advise that the Auckland University of Technology Ethics Committee (AUTEC) approved your ethics application at their meeting on 10 September 2007, subject to the following conditions:

1. Provision of Consent Forms;
2. Clarification of the role that the researcher has in the assessment of the participants' work as there is not a consistent treatment of this in the documentation provided;
3. Provision of an independent third party to collect the data given the conflicts of interest involved;
4. Provision of a revised response to section D.1.3 of the application, including the need for a medical clearance and including this information in the Information Sheet and the Consent Form;
5. Amendment of the Information Sheet as follows:
 - a. Inclusion in the section titled 'How was I chosen...' of the exclusion criteria given in the revised response to section D.1.3 of the application;
 - b. Revision of the section titled 'What will happen...' to better clarify the various aspects of the research, perhaps as a series of bullet points, and to a less threatening term than 'measured' in the first sentence;
 - c. Alteration of the section titled 'How will my privacy...' by changing the clause 'You will remain anonymous' to 'Your identity will remain confidential' and including information advising participants that the researcher will not know their identities until after the course's completion;
 - d. Inclusion in the section titled 'How do I agree...' of information about how participants who choose to withdraw will have their privacy protected;
6. Amendment of the questionnaire as follows:
 - a. Inclusion of the AUT logo at the beginning;
 - b. Insertion of the word 'cortical' between 'my' and 'arousal' in questions 1a to 1c and between 'level of' and 'arousal' in questions 2a to 2c.

AUTEC recommends that the title would be better understood if it was rewritten in non-technical language.

I request that you provide the Ethics Coordinator with written evidence that you have satisfied the points raised in these conditions within six months. Once this evidence has been received and confirmed as satisfying the Committee's points, you will be notified of the full approval of your ethics application. If these conditions have not been satisfactorily met within six months, your application will be closed and you will need to submit a new application should you wish to continue with the research.

You may not of course commence research until full approval has been confirmed. You need to be aware that when approval has been given subject to conditions, full approval is not effective until *all* the concerns expressed in the conditions have been met to the satisfaction of the Committee.

To enable us to provide you with efficient service, we ask that you use the application number and study title in all written and verbal correspondence with us. Should you have any further enquiries regarding this matter, you are welcome to contact Charles Grinter, Ethics Coordinator, by email at charles.grinter@aut.ac.nz or by telephone on 921 9999 at extension 8860.

Yours sincerely



Madeline Banda
Executive Secretary



M E M O R A N D U M

Auckland University of Technology Ethics Committee (AUTEC)

To: Colin Gibbs
 From: **Madeline Banda** Executive Secretary, AUTEC
 Date: 2 October 2007
 Subject: Ethics Application Number 07/163 **The effect of attributional re-training on somatic, physiological, cortical arousal, self-efficacy and learning in beginner white water kayakers.**

Dear Colin

Thank you for providing written evidence as requested. I am pleased to advise that it satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC) at their meeting on 10 September 2007 and that as the Executive Secretary of AUTEC I have approved your ethics application. This delegated approval is made in accordance with section 5.3.2.3 of AUTEC's *Applying for Ethics Approval: Guidelines and Procedures* and is subject to endorsement at AUTEC's meeting on 12 November 2007.

Your ethics application is approved for a period of three years until 2 October 2010.

I advise that as part of the ethics approval process, you are required to submit to AUTEC the following:

- A brief annual progress report indicating compliance with the ethical approval given using form EA2, which is available online through <http://www.aut.ac.nz/about/ethics>, including when necessary a request for extension of the approval one month prior to its expiry on 2 October 2010;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/about/ethics>. This report is to be submitted either when the approval expires on 2 October 2010 or on completion of the project, whichever comes sooner;

It is also a condition of approval that AUTEC is notified of any adverse events or if the research does not commence and that AUTEC approval is sought for any alteration to the research, including any alteration of or addition to the participant documents involved. You are reminded that, as applicant, you are responsible for ensuring that any research undertaken under this approval is carried out within the parameters approved for your application. Any change to the research outside the parameters of this approval must be submitted to AUTEC for approval before that change is implemented.

Please note that AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to make the arrangements necessary to obtain this.

To enable us to provide you with efficient service, we ask that you use the application number and study title in all written and verbal correspondence with us. Should you have any further enquiries regarding this matter, you are welcome to contact Charles Grinter, Ethics Coordinator, by email at charles.grinter@aut.ac.nz or by telephone on 921 9999 at extension 8860.

On behalf of the Committee and myself, I wish you success with your research and look forward to reading about it in your reports.

Yours sincerely



Madeline Banda

Executive Secretary

Auckland University of Technology Ethics Committee

Cc: Matt Barker matt.barker@aut.ac.nz, Simeon Cairns