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Stress – the physiology and psychology of a training situation

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by

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in collaboration with

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I hereby declare that this work has been completed by myself; it has not been accepted for any previous application for a degree; the work of which it is a record has been performed by myself, except where stated otherwise; and that all verbatim extracts have been distinguished by quotation marks and sources of information have been specifically acknowledged.

Abstract

This thesis describes a study that aimed to assess the psychophysiological effects of offshore survival training, and to investigate whether responses of trainees differed according to age. A group of 99 subjects, randomly selected from across a wide age range, volunteered and subsequently were monitored during the training. The sample population were split into 2 groups according to the training course attended, refresher or combined survival and fire fighting course. Physiological and psychological measurements, chosen as indicators of stress, were performed on these subjects. Attention was centred on 4 particular events: helicopter underwater escape training (HUET); simulated platform abandonment using totally enclosed motor propelled survival craft; simulated platform abandonment into liferafts; and self rescue from a smoke filled room.

State anxiety and urinary free cortisol were assessed early on each morning. Anxiety was also measured before the 4 chosen events. Early morning anxiety and urinary free cortisol were observed to peak on the first day of training, then each showed a very similar pattern of a decline to a plateau. On assessing all combined subjects' anxiety scores in sequence, values were found to be relatively lower towards the end of the course. These results suggested that subjects suffered from pre-course apprehensions that may have caused elevations in anxiety scores during the course. It was also found that subjects with high urinary free cortisol values on day 1, had relatively higher heart rates later in the course.

Despite variation between the training courses, very similar mean heart rates were recorded in combined and refresher subjects. Relatively elevated heart rates were detected during the HUET brief. This was proposed to be the result of psychological activation, probably anxiety.

Indicators of links among physiological and psychological measures were thus detected. Stronger and more consistent relationships may have been observed had more extensive data been available. Age effects were also detected, older refreshers had lower levels of anxiety, but found the course relatively more demanding. The lower anxiety levels were proposed to result from older refreshers having more training experience.

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Glossary of Terms and Abbreviations

ACTH	Adrenocorticotrophic hormone
Analysis of variance (ANOVA)	A way of investigating differences between the means of a specific factor measured from different subject groups. This statistical procedure assesses whether the variation seen among groups is significantly greater than the variation that would be expected, given the amount of variation within the groups.
ANS	Autonomic nervous system
BA	Breathing apparatus
BDI	Beck Depression Inventory
BS	Boredom Susceptibility
CBG	Corticosteroid binding globulin
CHD	Coronary heart disease
Cluster Analysis	This is a "generic name for a variety of mathematical methods...that can be used to find out which objects in a set are similar" (Romesburg, 1984). The similar objects, or in this study subjects, are grouped into clusters. Differences among the clusters can then be investigated. Cluster Analysis can thus be useful for detecting relationships that may not initially be obvious, especially when large datasets are being investigated.
CRF-41	Corticotrophin releasing factor 41
CRH	Corticotrophin releasing hormone
Cronbach's alpha	This coefficient is an estimate of the correlation between two random samples of items from all the items in a test. It is comparable to the mean of the coefficients of equivalence between the two halves, a and b, from one application of the test, and any other two halves, c and d, from another application of the test (Cronbach, 1951).

DMT	Defense Mechanism Test
Dis	Disinhibition
ECG	Electrocardiogram
Effect value	These are mean values, produced by GLM analysis, that include a correction factor for missing valuesand covariates. GLM is useful as it can be conducted on datasets that have missing values, however, when calculating means, GLM includes a correction for these missing values. If there were no missing values in the dataset, the effect values calculated by GLM should be the same as the arithmetic mean.
EMAS	Endler Multidimensional Anxiety Scales
ES	Experience Seeking
General linear model (GLM)	GLM is an approach to ANOVA that requires neither complete data sets, nor a balanced design.
GR	Glucocorticoid receptor
HPA	Hypothalamic-pituitary-adrenal axis
HR	Heart rate
HRV	Heart rate variability
HUET	Helicopter underwater escape training
LHRH	Luteinising hormone releasing hormone
LOC	Locus of control (Rotter's)
LSI	Life Style Index
METS	Modular egress training simulator
Multivariate ANOVA (MANOVA)	This is an extension of ANOVA in that the means of several different factors may be assessed.
OPITO	Offshore Petroleum Industry Training Organisation
Principal components analysis (PCA)	A form of Factor Analysis used to produce a "general variable" from two or more variables, when these variables are simply different ways of measuring this other general variable (Hedderson, 1991)

PSE	Perceived self-efficacy
p-values	Probability values are calculated during statistical tests, and indicate the probability of an event having occurred by chance. These therefore give an indication of the significance of an event, for example, if p=0.04, the event would be said to be significant at the 5% level, because the p-value was less than 0.05.
PVN	Paraventricular nucleus
Repeated measures	This is simply MANOVA conducted on a particular factor that has been measured more than once, e.g. anxiety scores taken on days one to five.
RNA	Ribonucleic acid
SACL	Stress Adjective Check List
SC	Salivary free cortisol
Significance level	This gives an indication of the reliability of the inference made from the statistical test. For example, if a significance level of 5% was chosen, an inference made following the test would have a probability of 5%, or 1 in 20, of being incorrect.
SON	Supra optic nuclei
SSS	Sensation Seeking Scale (Zuckerman's)
STAI	State Trait Anxiety Inventory
(Student's) t-test	A statistical test used to compare sample means. In this study, predominantly two sample paired t-tests were conducted. Paired tests were used on two samples that were not independent, for example, before and after recordings from one subject. As it was the difference between each paired recording that was assessed, the subject variability was removed.
TAS	Thrill and Adventure Seeking
TEMPSC	Totally enclosed motor propelled survival craft
TSST	Trier Social Stress Test

Tukey's (WSD) test	The Tukey's Wholly or Honestly Significant Difference test is a multiple comparison test, which is "recommended for between-subject designs for which all pairwise comparisons are of interest" (Zolman, 1993).
Type I error	To reject the null hypothesis when it is true
Type II error	To accept the null hypothesis when it is false
UFC	Urinary free cortisol (taken as a ratio against creatinine)
UKOOA	United Kingdom Offshore Operators Association
VO_2	Oxygen consumption

1 Introduction

In order to work offshore, individuals are generally required to have offshore survival certificates. These are obtained by undergoing training at establishments, such as RGIT Limited, that provide OPITO (Offshore Petroleum Industry Training Organisation) registered courses. There are, however, arguments that the demands of training are too high, especially for the ageing offshore population. Yet, although the effects of the demands of living and working offshore have been investigated (Sutherland & Cooper; 1986, Hellesøy, 1985) as have the effects of related training situations (Krahenbuhl *et al,* 1981; Hytten *et al,* 1990) only one study has addressed responses to offshore survivai training (Hytten *et al,* 1989). The latter study, at a Norwegian training establishment, only assessed responses to helicopter underwater escape training. The present study therefore represents the first comprehensive quantification of the physiological and psychological responses to the complete offshore survival training course. The four main components of survival training are shown in plates 1 to 4. An outline of the complete contents of the training is contained in Appendix A.

When survival training has been applied in an actual emergency situation it has been quoted as being of "decisive moment in the escape and survival" of helicopter crash victims (Hytten, 1989). The advantages of training in case of helicopter ditching and capsize have been further demonstrated in a study of the effects of training on naive subjects (Bohemier *et al,* 1990). For naive subjects the rate of successfully egressing from the inverted METS (Modular Egress Training Simulator) increased at least three fold, following seven repeated capsize trials. Evidence of real life benefits of training were also illustrated in a study by the Naval Safety Center of helicopter crashes between 1969 and 1975 (Ryack *et al,* 1986). Of the 400 or more people involved, fewer than 8% of those who had received training in underwater escape died in crashes, compared to a mortality rate of more than 20% in individuals who had not received such training.

The standards outlining what training should provide are set out by OPITO and are based on training guidelines that are published by the United Kingdom Offshore Operators Association (UKOOA) (Batchelor, 1993). Up to April 1995 the criteria used for setting the training level included consideration of trainees' previous experience and capabilities. Refresher training was provided for individuals with experience of survival training within the previous 4 years.

This thesis will discuss an investigation that examined how trainees reacted both physiologically and psychologically to training. The aims of the study were:

1. To quantify the degree of psychological and physiological stress experienced by trainees, during survival training.

   It was deemed probable that survival training would be considered as a stressor by most individuals. This seemed likely as components of survival training appeared to meet three of Mason's (1968) four criteria for situations that could elicit stress responses. The three criteria were events that included: novelty, uncertainty, or unpredictability; anticipation of a previously unpleasant event; and, finally, situations that required effort to master "a difficult task in order to forestall aversive stimuli".

   In relation to the training, it was realised that certain levels of stress might be necessary to induce beneficial changes, and conversely that too much stress might result in the individual's competence being reduced. This contrast has been summarised by Welford (1973) who stated that "performance is less than maximal not only if the demand...is too high, but also if it is too low." The study therefore aimed to explore the levels of stress that trainees actually experienced.

2. To assess the impact of training on an ageing population.

   The offshore industry is moving towards maturity, and is therefore accompanied by an ageing workforce. The necessity for investigating the impact of age can thus be seen. Indeed, a recent study that assessed the effects of shift work on sleep patterns specifically noted this requirement (Parkes, 1994). In the present study, subjects across the age range 20 - 59 years were observed to enable comparisons to be made among the different age groups, and to detect any trends that might occur with increasing age.

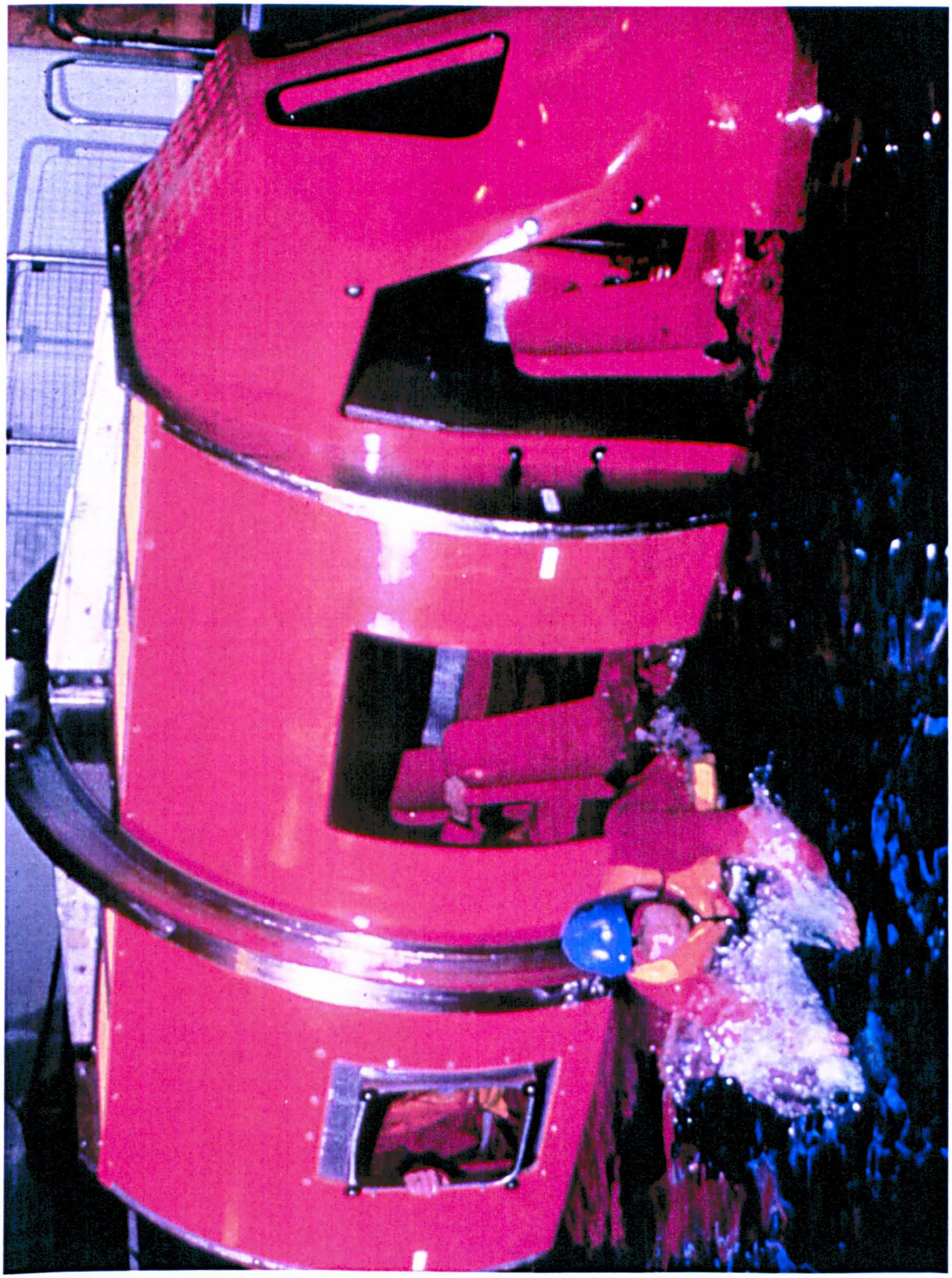


Plate 1 - Simulation of a helicopter ditching on water with a trainee exiting from the helicopter underwater escape trainer (HUET), wearing immersion suit and lifejacket.

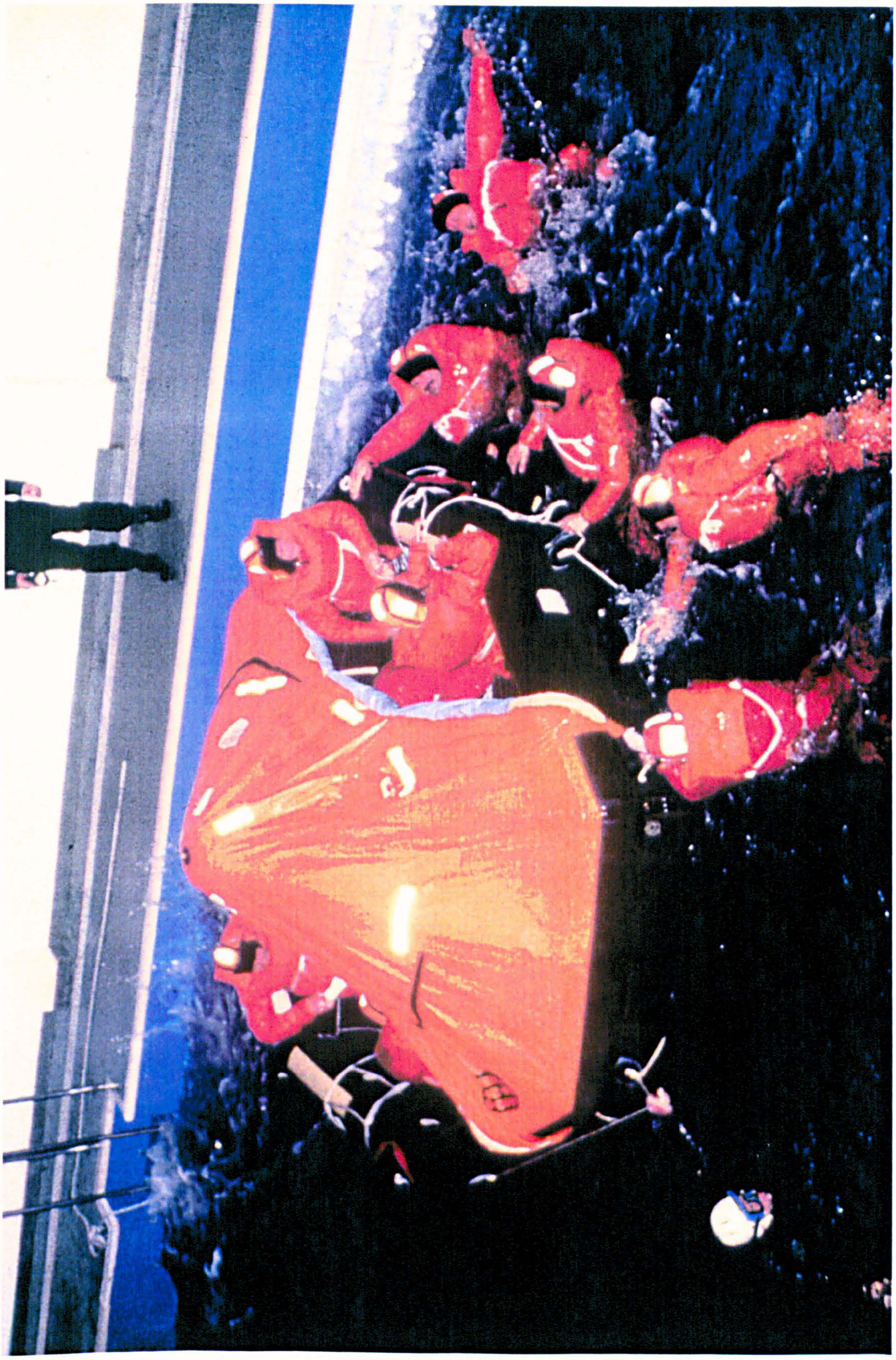


Plate 2 - Simulation of a platform abandonment with trainees swimming through wind and waves to board a liferaft, wearing immersion suits and lifejackets.

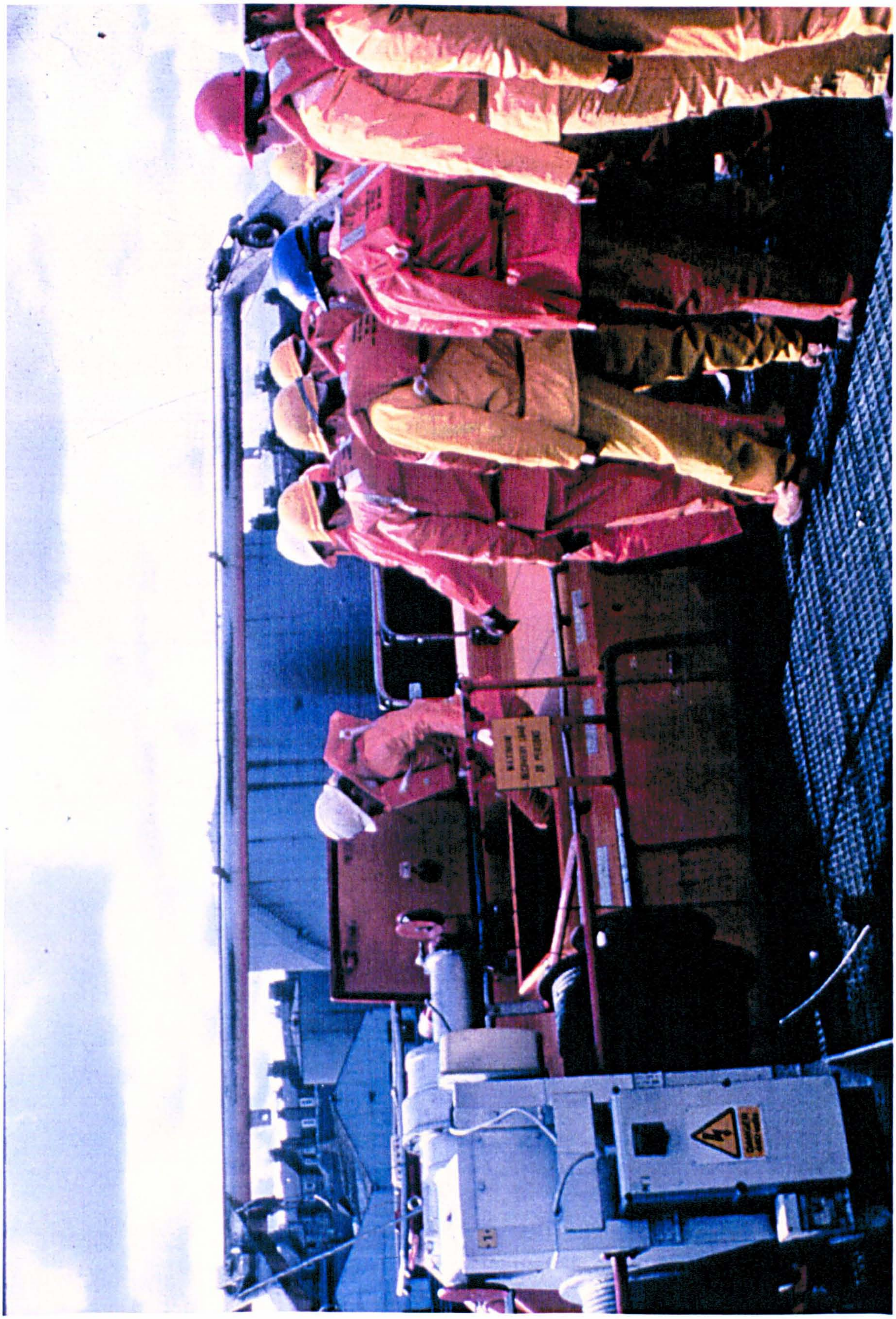


Plate 3 - Simulation of a platform abandonment via a totally enclosed motor propelled survival craft (TEMPSC) with trainees wearing wet weather gear and lifejackets.

Plate 4 - Simulation of an escape from a smoke filled room with a trainee wearing protective clothing and breathing appparatus.

2 Literature Review

2.1 Stress

The use and meaning of the term stress this century, outside the field of engineering, has revolved around two intermingling aspects. These will be outlined in the following two sections, and referred to later in relation to particular aspects.

2.1.1 Stress and Homeostasis

Stress has frequently been referred to in relation to homeostasis. Homeostatic balance is the maintenance of the body at pre-set levels in terms of physiological and psychological functioning. Psychological homeostasis, though perhaps less often referred to, could be described as the "maintenance of the normal mood state of an individual at rest" (Burchfield, 1979). Physiological homeostasis involves the organism's *milieu interieur*, as first referred to by Claude Bernard, that is the fluid matrix in which an animal's "organs and tissues are set" (Cannon, 1935).

Cannon, writing on the "Stresses and Strains of Homeostasis" in 1935, proposed that *critical stress levels* resulted from disruptions to the normal homeostatic mechanisms. These disruptions could take the form of physical or emotional stimuli. This theme of the symptoms of stress being the result of stimuli affecting the body's natural balance is still referred to in the stress literature (Chrousos & Gold, 1992). Some authors have contested the concept of homeostasis, stating that a steady state does not exist as the body's systems oscillate around an optimum level (Weiner, 1991). The suggested rigidity of homeostasis at absolute levels was, however, probably neither what Cannon envisaged, nor what is accepted today.

2.1.2 Defining Stress

There has been some deliberation over the definition of stress. Previously, stress has been referred to as the stimulus that results in a response, as the response to a stimulus, or as an interaction of these two.

The limitations of purely stimulus or response based definitions for stress arise because one is generally referred to in relation to the other, for example, a stimulus is considered as stressful if a stress response results (Lazarus & Folkman, 1984). In reality, it is therefore necessary to consider both. A discussion on stress would not be complete without reference to the extensive work of Hans Selye, and his varying use of the term stress perhaps serves to demonstrate the fluctuating way it has been used. On observing that "diverse nocuous agents" resulted in similar responses in rats, Selye (1936) designated these "unified responses" to be part of the "General Adaptation Syndrome" or GAS. The GAS was described as consisting of three phases. The first phase was termed the "General Alarm Reaction" and occurred immediately after a response provoking stimulus. If the organism was then subjected to continued smaller insults, there followed a stage of resistance or habituation. With constant high level insults, however, resistance failed and exhaustion ensued. Thus, in 1936 Selye viewed stress as responses to stimuli. By 1946, however, he referred to stress as anything that led to alterations in homeostatic processes, in other words, a stimulus definition. Selye then went on to look at stress in terms of the interaction between stimulus and response. From 1956 onwards, however, he forwarded definitions that were clearly in terms of response. In 1980, he defined stress as "the non-specific (that is, common) result of any demand upon the body, be the effect mental or somatic".

Given the present liberal use of the word stress, the definition that is perhaps the most realistic was made by Lazarus in 1966:

> *"Stress is not...stimulus, response, or intervening variable, but rather a collective term for an area of study".*

This definition shall be accepted here, though by no means would it satisfy all or even most of the researchers working in this field. Perhaps, however, this is appropriate given the range of the stress field. Yet, by designating 'stress' as the field of study, essentially removes it for use in the terminology. This necessitates the creation of definitions for the component parts of the field that had previously been referred to as 'stress'. The definitions that will now be described are scattered throughout the literature, but were drawn together by Paterson and Neufeld in 1989.

The stimuli that initiate the process were referred to as *stressors*. The effects of these stimuli being the *stress response*. In this study, the stressors were the pre-conceptions about, and demands of offshore survival training. Paterson and Neufeld considered the interaction between an individual and the stressor(s) to involve three stages. These can be summarised as:

- Before the event occurred, when the stressor may have been perceived as a *threat*, a stress response could only have been initiated at this time;
- during, or if *impact* occurred;
- after, or the *post-impact period*, post-traumatic stress could possibly have occurred after a severe psychological stressor.

2.1.3 Appraisal and Perception of Stressors

Initially, the first stage above was not realised as it was generally thought that a stimulus directly resulted in a response. In 1966, however, the stimulus-appraisal response model was proposed (Lazarus, 1966). A two stage appraisal process was suggested. The initial or "primary" appraisal was an assessment of the stimulus or situation. Four possible outcomes of this situational appraisal were determined:

- neutral outcome, whereby there was no impact, nor would be, therefore no response would result;
- the presence of a threat was revealed that was capable of inducing a response;
- impact had already occurred;
- there existed within the situation the potential for harm or mastery.

The latter situation could arise unavoidably or, unlike the others, be sought out. The situation under investigation in this study was a requirement for employment, therefore somewhat inevitable for the subjects involved. This did not, however, mean that the course would be perceived as a potential stressor by all those who undertook it. A few individuals have 'sought out' this stimulus, i.e. they have enrolled on the course even though not requiring the training for their employment.

If, following primary appraisal, the situation was perceived as a threat, the second stage of appraisal would be entered. This secondary appraisal would involve a self-assessment of the individual's own resources, and possibly a search for other coping options to deal with the stressor. Secondary appraisal would thus be "concerned with consequences of any coping action".

Cox (1985) also forwarded the view that a stimulus would only be stressful if the individual perceived it as such. He contended that a state of stress would exist only if the individual believed that there was a significant discrepancy between the demand upon him/her, and his/her ability to cope. This discrepancy may be positive or negative, in other words, over or under loads of demand. Possible factors that may affect an individual's ability to cope include the demands, personal resources, constraints that the individual is under, and the extent of support from others. Perception of control has also been considered to be important by other authors, in the role of a potential "moderator of stress" (Cooper & Sutherland, 1987). The requirement for prior psychological assessment thus, according to psychologists, seems to be mandatory for a stress response to occur. Physiologists have also referred to the concept of appraisal, but in more of a biological context, for example the "neuroendocrine cascade...begins with a perception of a stressor by the brain" (Sapolsky *et al*, 1986). Yet, Paterson and Neufeld (1989) appeared to support three possible routes for reaching a stress response. Firstly, a stress response may be induced without going through the appraisal stage, for example direct physical injury. Indeed, work has been conducted using subliminal stimuli, which therefore presumably cannot be appraised, and yet have resulted in anxiety (Tyrer *et al*, 1978). Anxiety is a possible component of a stress response. This suggested that appraisal may not be essential in all circumstances. Although Paterson and Neufeld compromised this possibility by stating that the "individual will usually engage in some interpretative activity to assign psychological meaning to the injury". This represented the second route, in that both psychological and physiological mechanisms were involved. Finally, they referred to the "narrowed field...of psychological stress". This latter route would consist of some psychological stimulus being cognitively assessed, and resulting in a stress response.

2.1.4 Stressors

Without considering whether or not appraisal is required, the question arises, 'what initiates a stress response?' In other words, what events can be termed as stressors. The answers to these questions should perhaps be preceded with a consideration of why any stress response occurs. It has been proposed that each individual has an "internal ideal" (Fisher, 1986). Stressors are those that create an imbalance between this ideal and the external environment, and therefore "represent targets for coping behaviour". Selye (1982) also considered that drive resulted from deviations from expectations. Levine and Ursin (1991) preferred to use the term "activation" rather than stress response, but even so felt that activation occurred when the individual perceived the lack or future disappearance of something relevant to that individual. Activation has been regarded "not only as an alarm system, but also as the driving force that makes an animal or human act to reduce needs" (Ursin & Olff, 1993). Stressors have also been placed within the process of natural selection or evolution, as viewed by Darwin (Weiner, 1991). In this case the stressors are "selective pressures that derive from the physical and social environment". Overall, it is suggested that such stress responses, or activation, actually create an impetus to enable the organism to adapt to its environment (Ursin, 1988). It thus appears that stress may be beneficial or even necessary. This agrees with the results of various studies that have found social isolation, therefore reduced stimulation, in young animals to result in behavioural disturbances later in life (Gray, 1987). Equally, however, levels of stress in excess of the individual's optimum can be harmful. Pathological effects will be discussed in more detail later.

Acute stimuli that have been regarded as stressors by previous investigators include parachute training (Ursin *et al*, 1978); flight training (Krahenbuhl *et al*, 1981); abseiling (Brooke & Long, 1987); heat (Taggart *et al*, 1972); mental arithmetic (Williams *et al*, 1982); threat of shock (Hodges & Spielberger, 1966); and the cold pressor test (Obrist *et al*, 1978). These stimuli can be grouped, fairly obviously, into three types - physical, emotional and cognitive. But whether or not an event can be termed a stressor will depend not only on the event itself, but also on the individual faced with the event. This returns to the definition of stress as involving the relationship between the stimulus and the individual's response and thus ultimately the individual's characteristics.

Alternative approaches to defining stressors have also been adopted. For example, rather than considering surrounding psychological influences, e.g. social support, perceptions or expectancies, as being part of the stressor, Overmier (1988) referred to psychological factors as moderators of whether, and to what extent "stressors stress". Furthermore, he proposed that to be able to identify which psychological factors moderate stress a "periodic table of stress" should be constructed. To complete this table the potential of events as stressors would be determined by observing whether "event-induced shifts" in physiology occurred comparative to the organism's basal state following exposure to the event. Ultimately, however, whether factors are part of the stressor or simply moderators of the resultant response, the physiological and psychological implications of the event, as well as the state of the individual presented with it, should be investigated.

2.2 Cortisol and the Stress Response

Just as the range of stimuli that have been investigated is large, so are the available methods for measuring the response. Measurements have been performed that assess the organisms physiological and/or psychological responses. Within the physiological measurements the reactions of the hypothalamic-pituitary-adrenal (HPA) axis have received a considerable amount of attention, especially with respect to production of the steroid hormone cortisol. This was partially due to the influence of Selye's work (e.g. Selye, 1946), which concentrated almost exclusively on this axis.

2.2.1 Physiology of Cortisol Production

Cortisol secretion is initiated by the release of corticotrophic hormone (CRH), previously referred to as corticotrophin releasing factor 41 (CRF-41) (Vale *et al*, 1981), from the medial basal hypothalamus. The hypothalamus is connected to the pituitary, or *hypophysis*, *via* hypothalamic neurones, which run from the paraventricular nucleus (PVN) and supra optic nuclei (SON) of the medial basal hypothalamus to the posterior pituitary, or *neurohypophysis*. Additional connections between the hypothalamus and the anterior pituitary, or *adenohypophysis*, are *via* the long and short portal vessels. The long portal vessels are derived from the superior hypophysial arteries that branch to supply the top of the pituitary stalk and the median eminence, part of the hypothalamus. Neurochemical transmitters, including CRH, can therefore cross from the hypothalamic neurones to the portal vessels *via* capillary plexuses, which act as exchange sites for neurotransmitters, and so on to the anterior pituitary gland. Inferior arteries also supply the anterior pituitary gland, *via* the short portal vessels, but to a lesser extent. CRH thus passes to the anterior pituitary gland where it stimulates the synthesis and release of adrenocorticotrophic hormone (ACTH) from corticotrophic cells. The significance of the hypothalamic-pituitary portal link was demonstrated by the work of Green and Harris (1947) and Harris and Johnson (1950).

Blood from the *hypophysis* drains *via* the cavernous sinuses into the jugular vein. ACTH circulated within the blood then has significant effects on the adrenal glands, which are situated, one superior to each kidney. The adrenal glands consist of an outer *cortex* and inner *medulla*, which are relatively independent in function. The adrenal *cortex* will be discussed fully as it is involved in production of glucocorticoids, important mediators of stress responses. The adrenals receive an extensive blood supply from the inferior phrenic artery, aorta, renal arteries and other small arteries. Blood passes through the *cortex* within arterial branches, then drains *via* medullary venules into central adrenal veins. Blood from the right adrenal then empties into the inferior *vena cava* while that from the left empties into the left renal vein.

There are three zones of cells within the *cortex*, namely the *zona glomerulosa*, *fasciculata*, and *reticularis*, situated in order from beneath the capsule of the adrenal gland to the inner layer of the *cortex*. The latter two mainly produce glucocorticoids and androgens. In humans, the predominant glucocorticoid is cortisol, which is produced from cholesterol. There are many sources of cholesterol, including that present as low density lipoproteins in the circulation, and cholesterol esters in lipid droplets contained within the cells of the adrenal *cortex*. The *cortex* can also synthesise cholesterol from acetyl coenzyme-A. ACTH results in the conversion of cholesterol to pregnenolone, which is the rate limiting step in the formation of adrenocorticoids. ACTH is believed to act by binding to specific cell receptors, which increases the permeability of the cell's membrane to glucose and certain ions and activates adenyl cyclase. This leads to activation of cAMP dependent protein kinase and protein phosphorylation activities. (Nelson, 1980; Keele *et al*, 1986; Orth *et al*, 1992)

Within the HPA axis, negative feedback control loops exist. These include the inhibitory effects of elevated glucocorticoid levels on the hypothalamus and the anterior pituitary. In the short term, within minutes, negative feedback results in reduced secretion of CRH and ACTH. Delayed feedback, however, which occurs over hours or days, leads to decreased synthesis. A "short" negative feedback loop has also been proposed with ACTH acting to inhibit CRH production from the hypothalamus.

In the circulation, more than three quarters of cortisol is bound to corticosteroid binding globulin (CBG) or transcortin. The remainder is loosely bound to albumin and approximately 5-10% remains free or unconjugated (Kirschbaum & Hellhammer, 1989). It is the free portion that is believed to be biologically active.

Free cortisol diffuses through cell membranes, where it binds to cytosolic receptors and thus passes through to the nucleus to bind with nuclear chromatin and stimulate the production of messenger RNA (mRNA). The mRNA leaves the nucleus and binds to ribosomes, so triggering production of specific proteins and enzymes (Nelson, 1980). (See Section 2.2.3 for an outline of some of the actions of cortisol within the body.) It has also been suggested that cortisol passes directly into the nucleus, and initiates enzyme synthesis without binding to cytosolic receptors. In the latter case, cortisol may undergo a conformational change within the nucleus prior to binding with nuclear chromatin (Evans, 1994).

Cortisol was believed to follow a smooth circadian pattern of production with a peak in the early morning, followed by a gradual drop in concentration during the day. A relatively intensive study that measured plasma cortisol in blood samples taken from 6 subjects every 20 minutes (Weitzman *et al*, 1971) suggested, however, that the concentration of cortisol over the course of the day did not follow a smooth pattern. In the above study, subjects resided in a sleep-research unit for 10 to 12 days. The first 3 to 5 days were treated as the acclimatisation period, and measures designed to assess the 24 hour pattern of cortisol were performed over the last 7 days. Four phases of pulsatile cortisol production were found: the "minimal secretory activity" phase occurred before and after lights out; the "preliminary nocturnal secretory episode" was during the mid hours of sleep; the "main secretory phase" was the last 2 hours of sleep and the first hour after waking; and the "intermittent waking secretory episode" occurred during the remaining daytime . Although there was a trend of decreasing cortisol during this last phase, some subjects showed cortisol peaks later in the day that were equivalent to those found immediately after waking, i.e. the "main secretory phase". This was found even though subjects remained within the laboratory where their only activities were "reading, watching television, and engaging in conversation".

2.2.2 The Measurement of Cortisol in Psychophysiological Studies

To a certain extent, the assessment of cortisol in response to stress is an extension of the previous interest shown in the reactions of the hypothalamic-pituitary-adrenocortical (HPA) axis. It was Selye who especially advocated the importance of considering this axis when investigating stress. Many studies have subsequently verified this interest by demonstrating that cortisol levels do increase in response to: mental tasks, (Bohnen *et al*, 1991), unpleasant films (Hubert & de Jong-Meyer, 1992), public performance "stage fright" (Fredrikson & Gunnarsson, 1992), public speaking (Bassett *et al*, 1987), radial acceleration, Gz (Mills, 1985), running on a treadmill (Few, 1974), and a simulated car driving challenge (Seeman *et al*, in press).

One of the main reasons for measuring cortisol is therefore to assess adrenal cortical activity. In other words, the level of activation of the HPA axis. Due to the difficulties of analysing cortisol, however, few early researchers in the field assessed cortisol levels directly, and instead employed indirect methods of estimating adrenocortical activity. These included evaluating the loss of circulating eosinophil or lymphocyte levels, or the concentration of electrolytes, uric acid, or phosphates in urine (Mason, 1968). One of the most widely quoted series of studies using the first method was conducted on the oarsmen, coxswain and coach of a Harvard rowing team (Renold *et al*, 1951). Significant changes in eosinophil levels were found in the cox and coach as well as the oarsmen. This implicated psychological factors as important stimuli acting on the adrenal *cortex*. With the advent of chromatographic techniques (Few, 1974) and more recently radioimmunoassay (RIA), however, the measurement of cortisol in plasma, urine (Ruder *et al*, 1972) and saliva (Kirschbaum *et al*, 1989) has been used as a direct means of assessing adrenal status. Interest in the HPA axis stems from its importance as part of the stress response, indeed it has been said that the "adrenocortical axis, is the endocrine axis which is among the most central to the stress response" (Sapolsky *et al*, 1986). But why should this be the case?

2.2.3 The Significance of Cortisol Within the Stress Response

The actual significance of cortisol within the body's physiological reaction to stress seems to have initially been an enigma. Demands on organisms that threatened homeostasis were seen in the first half of the twentieth century to result in increased secretion of glucocorticoids (Selye, 1936; Munck *et al*, 1984). This was believed to be part of the "flight or fight" response, in that cortisol promoted gluconeogenesis, thereby preparing the organism for action. Selye extended this hypothesis and suggested that excessive levels of glucocorticoids resulting from abnormal reactions to stress were the cause of, among others, allergic and rheumatic diseases (Selye, 1946). These he termed "diseases of adaptation". It was, however, subsequently found that administration of cortisone or ACTH, resulting in excessive levels of glucocorticoids, relieved symptoms of rheumatoid arthritis (Hench *et al*, 1954), a confusing observation. Cortisol appeared to enhance or prime the body's response to stress at lower concentrations, but conversely inhibit it at higher concentrations. Many researchers simply termed these high concentration effects as "pharmacological", i.e. the concentrations of hormone were well in excess of the normal physiological range and therefore did not have a physiological basis. Consequently, the physiology of cortisol effects were not fully explained or understood.

An alternative theory that was published in 1954 seemed to accommodate both extremes of cortisol production. It suggested that glucocorticoids had both "permissive" and "suppressive" roles (Ingle, 1954). A hormone was deemed to exhibit permissive effects if the following conditions were met: a particular "metabolic response to a stimulus" was found when the endocrine organ was present; the response was not found when the organ had been removed; and the response to the stimulus returned when a steady state (basal) supply of the hormone was "substituted for an endocrine organ". Ingle demonstrated that adrenal cortical hormones met these requirements in several series of experiments, including one in which the experimental animals' hind limbs were fractured and non-protein nitrogen levels in the urine were measured. At the other extreme, rather than being "pharmacological", it was later suggested that the physiological role of the suppressive effects of cortisol at higher concentrations was to dampen the body's reactions to stimuli, and so prevent damage from these same reactions (Munck *et al*, 1984). Yet the physiological basis for how these apparently contradictory effects could coexist was still not explained.

Glucocorticoid physiology has recently been "revisited", and a model described by which cortisol could exert "permissive" effects at lower concentrations and "suppressive" effects at higher concentrations (Munck & Náray-Fejes-Tóth, 1992). Additionally, the model seems to explain why glucocorticoids reduce production of intercellular mediators yet also increase the number of relevant available receptors. Mediators include lymphokines, hormones, neuropeptides and other substances that glucocorticoids influence as part of the stress response. The model suggests that two dose response curves for mediator and receptor concentrations, against the concentration of glucocorticoids, exist. These two curves have similar patterns but are opposites, i.e. at low cortisol concentration, mediator concentration will be high while receptor concentration will be low. The inverse then applies at high cortisol concentration. The working physiological model involves the combination of the two curves, resulting in a single bell-shaped curve with cortisol concentration along a logarithmic x-axis and mediator-receptor complex concentration, i.e. mediator activity, along the y-axis. The hypothetical curve therefore reaches peak activity at 100nM cortisol, representing permissive effects, but drops in activity at 1000nM cortisol, representing suppressive effects. It should be noted that not all glucocorticoid effects demonstrate dual control.

Thus, cortisol does indeed appear to have a significant and predominantly dual physiological role within the stress response. Furthermore, it is produced in response to both psychological and physiological stressors (Mason, 1968). Consideration of the cortisol response is therefore important, even more so given the numerous effects that glucocorticoids have within the body. Glucocorticoids have been found to promote hepatic gluconeogenesis, inhibit glucose uptake by tissues, stimulate protein catabolism, and promote sodium ion retention and potassium ion excretion, like aldosterone, but with substantially less potency, the changes in ion balance therefore enhancing the excretion of a water load. Furthermore, glucocorticoids suppress various immune functions, and are used to treat the abnormal levels of inflammation found in rheumatoid arthritis. In addition, they affect the electrical discharge threshold in the brain, bone metabolism and inhibit several hormones and neuropeptides (Keele *et al*, 1983). Indeed, it seems that glucocorticoid effects are so extensive, that the only common link among them is that the effects are mediated by glucocorticoid receptors (GR). As GR are present "in virtually every nucleated cell type in the body" their effects would thus be extremely wide ranging (Munck *et al*, 1984).

2.2.4 Cortisol Reactivity and Pathology

Cortisol had been measured previously to test the hypotheses that the level of HPA reactivity could reflect susceptibility to disease (Chrousos & Gold, 1992) and also that chronic exposure to stressors, and therefore glucocorticoids, would have pathological effects (Troxler *et al*, 1977). Listed pathological effects of long term exposure to glucocorticoids include myopathy, secondary steroid diabetes, hypertension, immunosuppression, infertility, inhibition of growth, and, in humans, depression (Sapolsky *et al*, 1986). With reference to the latter, administration of glucocorticoids, as well as the excessive levels found in Cushing's disease are linked to increased symptoms of depression. Furthermore, individuals with clinical depression have been found to have "24-h mean cortisol levels above the normal range" (Linkowski *et al*, 1985). As the present study was conducted over, at most, 5 days it was not considered feasible or worthwhile to investigate pathological changes.

2.2.5 Psychological Effects on Cortisol Response

The wide range of inter-individual responses to any given situation would suggest that some enduring individual trait(s) such as personality, level of trait anxiety, or method of coping affect(s) the cortisol response. Additionally, short term or state factors such as state anxiety or individual perception of the situation could be significant sources of variation. The possibility that psychological factors significantly influence cortisol response will now be considered.

A definite psychological related effect on cortisol response appears to exist, after all "psychological influences are among the most potent natural stimuli known to affect pituitary-adrenal activity" (Mason, 1968). Yet, whether or not cortisol levels themselves can be used as indicators of psychological change, or whether cortisol correlates significantly with psychological measures, is still disputed. Studies have been conducted in various situations using various psychological measures to investigate possible correlations. Cortisol was analysed in blood sampled, *via* venepuncture, from medical students following an important oral examination (Bloch & Brackenridge, 1972). This study could be criticised for taking a single sample when the most common approach has involved at least two measures of cortisol, so enabling change in cortisol to be assessed. It might also be expected that the act of venepuncture itself may have resulted in elevation of cortisol. Significant correlations were, however, found following the examination between cortisol and self-ratings on visual analogue scales of "emotionality", but not with "worry" nor "emotional interference". Although the results indicate a link between adrenocortical response and psychological variables, the use of what appear to be somewhat vaguely defined scales casts doubt on the outcome. An important point that was emphasised, was the necessity of selecting psychological measures, in this case measures of anxiety, that are suitable for the situation under study.

In another study, responses to an entrance test consisting of jumping from 5 feet into a deep swimming pool were measured in a group of navy volunteers (Vaernes *et al*, 1982). As the subjects for the study were non-swimmers, it would be expected that the subjects would perceive the test as an intimidating stressor. Added to this was the background stress of being within a military environment for the first time, and living in barracks with unknown individuals. In some ways this parallels the study of offshore survival course trainees, in that trainees undertook various tasks considered to be demanding, while on a course of up to one week away from familiar surroundings. Samples of urine and blood were collected before and after the entrance test. The samples were assessed for a variety of hormones. Principal components analysis (PCA) was then applied and three "factors" were distinguished. One of these was a cortisol factor, and this was found to be significantly correlated to two aspects of the Kragh's Defense Mechanism Test (DMT) score. Correlations were with the reaction formation score and the overall defence mechanism constructed score. The latter is based on the number of repressions, reaction formations, and incidences of isolation occurring during the test. Vaernes *et al* proposed that "endocrine response systems are related to different structures and different functions within the central nervous system". The cortisol system was considered to be connected to defence reactions. The results pointed in that direction, but did not provide very strong support for the latter conclusion. For example, out of four subscales measuring defence within the DMT, the cortisol factor only correlated with one.

Baade *et al* (1978) also used factor analysis on measures that had been made on Norwegian Army parachutist trainees. Cortisol factors were detected in basal and post jump parameters. One factor indicated that basal cortisol correlated with defence according to the DMT. Another consistent factor linked increased cortisol with poorer performance during parachute jumps. Similarly, Hytten *et al* (1989) demonstrated a link between cortisol and defence. Subjects with high defence scores on the Life Style Index (LSI) demonstrated a significant correlation between LSI and cortisol response before conducting HUET ditches. No reference was made, however, to correlations with cortisol following the ditches, nor to those subjects who did not have high defence scores.

These three studies all suggest a positive relationship between cortisol and defence. This is particularly interesting as defence may overlap with coping, and coping has been linked to the level of cortisol activation (Pearlin & Schooler, 1978; Ursin, 1980). It is, however, curious that the factor analysis approach has not been adopted and verified by other research groups (Vaernes and/or Ursin were involved in all of the above studies).

Neither the Freiburg Personality Inventory nor the German form of Spielberger's trait anxiety inventory were found to correlate with plasma cortisol levels following a stressor composed of venepuncture and a LHRH test (Hubert *et al*, 1989). Correlations were, however, found with 5-point rating scales of anxiety and tension.

From the results of the above and other studies it would appear that specific questionnaires, validated for use as indicators of psychological parameters and change, do not consistently predict the extent of response of the HPA. General psychological measures in the form of self-rating scales have, however, provided significant correlates with HPA responses. The possibility of significant relationships between psychological and cortisol measures does therefore seem to exist. One possibility is that new personality questionnaires "based on biochemical, endocrinological or immunological facts besides psychological theory" are required before the extent or lack of personality effects on the HPA axis can be fully determined (Kirschbaum *et al*, 1992a).

Social factors have also been proposed as affecting cortisol response. Kirschbaum *et al* (in press) observed that levels of social support during an acute challenge affected the cortisol response, with additional variations according to gender. Females demonstrated greater cortisol responses following support provided by a partner as opposed to when no support was provided, although the females reported greater benefits from partner support than male counterparts. A study involving 767 adults, who provided several saliva samples over the course of one day, found socio-economic status to be positively correlated with cortisol levels, especially in females (Brandtstädter *et al*, 1991); while "indicators of successful development and personal well-being" resulted in positive correlations, particularly in males. Loneliness has also been found to be related to circulating cortisol levels. Psychiatric inpatients were divided into high and low loneliness groups according to their scores on the UCLA Loneliness Scale (Kiecolt-Glaser *et al*, 1984). The high loneliness group had significantly higher single sample urinary cortisol levels than the lower scoring group. The measures were, however, made on inpatients, and comparisons with reference population values for the Loneliness Scale were not made. Further studies are therefore required to determine whether loneliness affects cortisol levels in other populations.

The affinity between psychology and adrenocorticoids has thus been demonstrated in various situations, but more work is required into the extent and intricacies of relationships between the two. It is also feasible that other factors, not related to psychology, affect the adrenocortical response. These could include age, gender, physical fitness or body build.

2.2.6 The Measurement of Cortisol in Saliva

Cortisol is present in blood, urine and saliva. Within the blood, the majority of cortisol, 70-85%, is bound to corticosteroid binding globulin (CBG), a smaller proportion is bound to albumin, 10-15%. It has also been suggested that cortisol binds to erythrocytes. This leaves approximately 5-10% of cortisol unbound or 'free' (Kirschbaum & Hellhammer, 1989) and it is this free fraction that is believed to be biologically active. (The precise model for transfer of free hormone from blood to the tissues is debated. This has been extensively reviewed by Ekins (1990) along with discussions of the implications for measurements of free hormone in blood.) It would therefore seem pertinent to measure the free fraction, especially as the bound fraction is known to increase substantially in response to factors such as pregnancy, and the use of contraceptive preparations, without any apparent detrimental effects. Simple techniques for separating free from total cortisol in plasma and then determining the level of free hormone were not available in the early 1980's (Riad-Fahmy *et al*, 1982), hence assessment of free cortisol in saliva was suggested as a viable alternative. This was possible because cortisol has a low molecular weight, 362, and is lipophilic. The unconjugated steroid can therefore pass through cell membranes by intracellular diffusion (Vining *et al*, 1983). These properties also mean that changes in plasma concentrations of cortisol are rapidly reflected in saliva and that the concentrations of cortisol in saliva highly correlate with those present in plasma. The delay between cortisol changes in plasma occurring in saliva has been estimated at less than one minute (Walker *et al*, 1984). Correlations of saliva and plasma free cortisol are generally high, $r=0.97$ (Walker *et al*, 1984), $r=0.89$ (Umeda *et al*, 1981). Although the numbers of subjects used in some studies has not been high, the continuity of the findings, supported by the fact that transfer from plasma is passive, indicates that saliva free cortisol parallels that in plasma. Concentrations of free cortisol in saliva have, however, been shown to be up to 50% lower than in plasma (Meulenberg *et al*, 1987; Vining *et al*, 1983; Walker *et al*, 1984). The main reason for differences in concentration is the presence of high 11β-hydroxysteroid dehydrogenase activities in saliva. This enzyme converts cortisol to cortisone.

That free cortisol diffuses passively from plasma, through the acinar cells of salivary glands, to saliva explains why cortisol concentration in saliva is independent of salivary flow rate. This independence has been demonstrated during maximal salivary flow, by swabbing the sides of the tongue with 2% citric acid and in conjunction with anticholinergic drugs, which 'dry' the mouth (Ben-Aryeh *et al*, 1985; Guechot *et al*, 1982).

These and other studies have verified the practice of measuring cortisol in saliva. Furthermore, for this study, it would not have been possible to collect blood samples on the grounds of ethical justification, and because subjects were customers of RGIT Limited who had generously agreed to take part, but not to invasive, painful and therefore 'stressful' sample collection. Saliva also presented advantages in terms of cost, as payment for the continuous presence of medical personnel, which would generally have been required for blood sampling, was not necessary.

Specific devices for collection of saliva include the 'Curby cup'. This can be fitted over the parotid gland and therefore used to collect purely parotid fluid (Walker *et al*, 1984). The 'Salivette' consists of a cotton roll that the subject chews on for approximately 30 seconds, hence stimulating flow. The cotton roll is stored in a plastic vial until required for analysis, when it is centrifuged to enable extraction of the salivary fluid (Kirschbaum & Hellhammer, 1989; Bohnen *et al*, 1990). Other means of stimulating flow have included subjects chewing unflavoured gum, sucking solid objects (Vining *et al*, 1983), and as already mentioned swabbing the tongue with citric acid. It has been pointed out, however, that some steroid hormones may adhere to the cotton fibres of the 'Salivette', thereby leading to erroneous results (Vining & McGinley, 1986), and also that citric acid may interfere with biochemical analysis unless care is taken to collect uncontaminated saliva. Alternatively, as was done in this study and others, subjects can expectorate directly into disposable tubes (Ben-Aryeh *et al*, 1985; Riad-Fahmy *et al*, 1982).

Finally, cortisol was assessed in saliva because such samples represent acute measures of adrenocortical activity, and the ease of sampling facilitates multiple sampling. That salivary cortisol is an acute measure is a result of cortisol's short half-life, approximately 60 to 90 minutes (Weitzman *et al*, 1971). This has been found to be shorter, approximately 30 minutes, following exercise at high work loads (Few, 1974). Additionally, the transfer of cortisol from plasma to saliva is rapid, and the time to peak level in saliva is relatively fast at approximately 10 minutes after the onset of the stressor (Ursin & Olff, 1993). Variations have also been found in the latter measure. For example, studies by Kirschbaum *et al* (1993) of a stressor consisting of a 10 minute anticipation period and 10 minutes of public speaking and mental arithmetic tasks, found that salivary cortisol peaked 10 minutes after cessation of the stressor.

2.2.7 The Measurement of Cortisol in Urine

Unlike salivary cortisol, assessment of cortisol in urine provides a long term indicator of HPA axis activity. This is due to the extra time that is required for free cortisol in the blood to be excreted in urine (Fillenz, 1993). In the present study, samples were collected early in the morning, therefore providing a mean concentration for the overnight period. Only unconjugated or "free" cortisol is filtered through the glomerular capsules of the kidney. Most is then reabsorbed by the renal tubules. Thus only 1% of the "daily adrenal secretion" of cortisol is excreted in the urine (Beisel *et al*, 1964). Direct assessments of the correlation between the free cortisol in plasma and urine, and as already mentioned between that in plasma and saliva, have indicated significant relationships. Few studies have yet correlated salivary and urinary cortisol.

The majority of studies investigating urinary cortisol have involved 24 hour collections of urine. Twenty four hour collections are often split into two or four hour samples to enable investigation of circadian rhythm (Touitou *et al*, 1983). Any timed urine collection is, however, associated with the problem of ensuring that a complete collection has been made. Creatinine was proposed to be excreted at a relatively constant rate. It was therefore measured in 24 hour urinary studies to determine whether the sample of urine was complete. Edwards *et al* (1969) and Curtis & Fogel (1970) have, however, disputed the validity of using creatinine to check that collections are complete, since they found significant interindividual variability in creatinine excretion rates.

An alternative approach is to assess cortisol in spot or single urine samples. Single samples still require correction for variations in urine flow. Urinary cortisol has therefore been expressed as a ratio against creatinine concentration. This has been used elsewhere and referred to as "normalizing" (Kiecolt-Glaser *et al*, 1984; Harte & Eifert, 1995). While there are still reservations about the consistency of creatinine excretion rates, this procedure is currently the most appropriate and consistent method for standardising cortisol excretion in single samples. Furthermore, single sampling avoids the problems of incomplete collections. For the current study, due to the practicalities of the situation, this was the only viable option.

Measurement of cortisol in single urine samples also has some of the benefits associated with assessment in saliva. These include the fact that sample collection is non-invasive and therefore relatively stress free. It can be conducted without the requirement of medical supervision or investigator supervision. Collections can therefore be made by subjects at times when investigators cannot be present.

It should be remembered, however, that the reactions of the adrenocortical axis are not the only ones to be considered as part of the stress response. As early as 1949 Moruzzi and Magoun proposed that the general alarm response "seemed to affect all somatic processes". The responses of the cardiovascular system when organisms are subjected to various stressors have also been investigated.

2.3 Heart Rate Measurement in Psychophysiological Studies

As previously stated, stress is believed to affect all somatic processes. The assessment of heart rate (HR) in this study therefore provides an indicator of physiological activity from a system other than the HPA axis. As HR is under sympathetic and parasympathetic control, it could be considered that this indicator represents the other section of the physiological stress response, the autonomic nervous system (ANS). The sympathetic and parasympathetic divisions of the ANS have opposite effects on HR, the latter *via* the *vagus* nerve. These have been demonstrated using pharmacological blocking agents. Stimulation of sympathetic fibres act to increase HR, whereas stimulation of the *vagus* decreases HR (Katona *et al*, 1982). When both divisions are blocked the resulting HR, or intrinsic heart rate, is approximately 100 beats per minute (bpm), while normal resting HR is approximately 70 bpm.

HR response has been investigated in various situations. For example, when cycling under conditions of heat stress, HR was found to increase more during exercise, and recover less rapidly following completion, than under control conditions (Kilgour *et al*, 1993). When faced with the threat of receiving electric shocks, subjects who were led to believe that they could control the shocks showed higher HRs than subjects for whom control was minimal or unobtainable (Obrist *et al*, 1978). Mental arithmetic was found to lead to increases in HR above what was predicted from oxygen consumption levels (Carroll *et al*, 1987). With the stressor of receiving a painful noise, it was found that a personality variable interacted with the probability or uncertainty of receipt to determine HR changes (Gaines *et al*, 1977). As a final example, the relationships between HR and oxygen consumption have also been assessed during simulated fire suppression (Sothmann *et al*, 1991). The significance of HR change will now be considered.

2.3.1 The Significance of HR Change

Early hypotheses on the reasons for change in cardiac activity focused around the "concept of energy mobilisation" (Duffy, 1951). Activation or arousal was seen to be partially dependent upon the level of energy, with the existence of a continuum from the low of sleep to the high of extreme animation. Physiological systems involved in energy mobilisation provided an indicator of energy requirements and therefore also of arousal. As HR was seen to be involved in the regulation of metabolic requirements, HR itself was justified as an index of arousal. Consequent work, however, demonstrated that cardiac responses appeared to contradict the idea that energy mobilisation occurred in a continuum; HR changes were detected that were bidirectional, depending on the stimulus (Lacey & Lacey, 1970). Tasks or stimuli that required "internal cognitive elaboration", e.g. mental arithmetic, were associated with increases in HR. Alternately, HR was found to decrease during tasks that involved "simple environmental reception", such as attending to white noise or photic flashes.

It was thus argued that cardiac changes depended at least partially on the stimulus, and whether the subject's assessment of a situation determined that environmental rejection or intake was required (Lacey, 1967). Lacey & Lacey's hypothesis contained further importance as it suggested that cardiac activity could affect cortical processing through a "negative feedback path from the heart to the brain". This was proposed to act as a gating mechanism for environmental input to the central nervous system (CNS). During internal cognition, HR would increase, resulting in an elevation of threshold and therefore exclusion of external stimuli. During "environmental reception", HR would decrease leading to the threshold being lowered, and external stimuli being perceived.

Contrary to the above, where the type of stimulus was proposed to affect HR, the Cardiac-Somatic Hypothesis stated that HR mirrored somatic activity when sympathetic influences on the heart were minimal (Obrist *et al*, 1974). It was suggested that such situations, where the heart was primarily under vagal control, typified psychophysiological studies. Indeed, Obrist's work on passive coping arising from classical aversive conditioning was one example (Obrist, 1976). According to Obrist, unless sufficient sympathetic activity to overcome vagal influences could be invoked, such as during active coping, changes in HR would be a reflection of muscular activity. These parallels between HR and muscular activity were proposed to result from the "integration of cardiac and somatomotor events...within the central nervous system" (Obrist, 1981). Two possible mechanisms by which changes in somatomotor events would automatically result in changes in cardiac activity were forwarded. These were cortical irradiation and somatomotor feedback. Cortical irradiation would involve the CNS co-ordinating striate muscular activity, and simultaneously affecting the centres controlling cardiovascular activity. Somatomotor feedback shared at least some similarity with the Laceys' suggestion of visceral afferent feedback (Lacey & Lacey, 1970).

Sympathetic and parasympathetic influences on the heart have since been investigated by measuring pre-ejection period and respiratory sinus arrhythmia, respectively. These are "among the more frequently employed noninvasive indices of autonomic control of the heart" (Berntson *et al*, 1994). Berntson *et al* found that the pattern of autonomic response varied with different stressors and individuals. These findings demonstrate that, contrary to Obrist *et al's* (1974) suggestion, psychophysiological studies include assessments of situations where sympathetic influences on the heart predominate as well as those where the vagus is dominant. Obrist *et al* (1978) did, however, establish that the individual's perception of control over a stressor was reflected in the extent of β-adrenergic, or sympathetic, influence on the heart. HR remained more elevated in situations where control over a stressor was difficult, but potentially achievable, compared to when it was very easy or impossible to control stressors. Thus again the stimulus, or at least the perception of control over the stimulus, was reflected in the HR response.

Contemporary authors have stated that "metabolic requirements are the principal determinants of cardiac activity" (Anastasiades & Johnston, 1990). The following section will, however, outline some of the evidence that purely psychological factors can influence cardiac activity.

2.3.2 The Case for Psychological Factors Influencing Cardiac Activity

The sympathetic and vagal influences on HR have also been referred to as the "integrative neural cardiovascular control system" (Korner, 1971). External and internal factors have been raised as two somewhat overlapping categories that affect integrative neural cardiovascular control (Rompelman *et al*, 1980). External factors include physical influences such as exercise, posture, or climate. An example of an internal factor would be respiratory arrhythmia, where HR oscillates in line with respiration. Internal effects on HR thus "stem from autonomous physiological activity". Yet, although these two categories of effects on HR have been defined, wide inter- and intra-individual variabilities in response to stimuli are still observed. It has been suggested that such variabilities are the result of psychological inputs (Rompelman *et al*, 1980).

Suggested psychological influences on HR have included individual's level of trait and state anxiety (see Section 2.4). Forty-five female students were split according to trait anxiety and coping style (Fuller, 1992). State anxiety, measured on the X-form of Spielberger's State Trait Anxiety Inventory (STAI), and resting HR were assessed before and after the student's oral comprehensive examinations. It was found that HR was faster, and state anxiety was higher, the day before than 2 weeks before or 1 week after the examination. Furthermore, HR was faster in high trait anxiety and repressor subjects than in "truly low anxious" subjects. This study provided evidence of links between HR and both state and trait anxiety. In contrast, an earlier study that investigated responses to threat of shock observed no difference in HR responses between high and low trait anxiety subjects (Hodges & Spielberger, 1966). Subjects "who reported moderate to extreme fear of shock two months prior to the experiment" did, however, demonstrate larger responses than subjects who reported little fear. Higher levels of subjective anxiety on the day of the experiment were also associated with greater HR increases. Results were therefore not totally at odds, though as pointed out by Fuller (1992) and by Johnston *et al* (1990) comparison of laboratory and real-life stressors frequently yields contrasting results.

In 1976 Obrist referred to the measurement of oxygen consumption (VO_2) as a possible means of determining the extent of somatic effects on HR. Previously somatic activity had been assessed using such measures as electromyograms of the chin muscles, respiratory frequency, eye movement and eye blinks. VO_2 has since been used in psychophysiological experiments to determine whether levels of HR response to stressors can be entirely accounted for by the metabolic requirements of the subject. On the basis of the proposal that VO_2 and HR are linearly related under steady state aerobic conditions (Åstrand, 1960), regression lines of VO_2 and HR were calculated during aerobic exercise. VO_2 and HR were then measured during the given stressor, and any bpm above that predicted from actual VO_2 was termed "additional heart rate". It was proposed that the additional heart rate was the result of psychological activation (Strømme *et al*, 1978).

Perhaps the most widely quoted study of additional heart rate is that of Strømme *et al* (1978). This was part of an extensive investigation of military parachute trainees (Ursin *et al*, 1978). As well as HR, hormones were measured over four jump days. Plasma cortisol increases were observed on each day, but the extent of the increases were reduced after Jump Day 1. This was not the case with cardiac responses, however, with a significant additional heart rate being observed immediately before the jump, as well as after it, 40 and 60 bpm, respectively, on all test days. This suggests that the psychophysiological mechanisms involved in this cardiac response may differ from those that regulate hormones. Almost no additional HR was detected until as late as 280 seconds before the jump, not even on the first day. Additional HR may thus have uses over and above those of endocrine measurements, for example, as a valid indicator of even very transient physiological activation.

Whether the phenomenon of additional HR was due to HR and VO_2 having been correlated during dynamic rather than static exercise has been investigated (Carroll *et al*, 1987). The HR/VO_2 relationships are different for static and dynamic exercise. This could therefore have been an important factor as additional HR has often been assessed during mental tasks, where subjects were requested to remain still. Carroll *et al* (1987) conducted measures of HR and VO_2 during static leg lifting exercise, and used the results to generate expected HR/VO_2 regression equations. Despite adopting this alternative approach, predicted HR values were still "significantly less than the values actually recorded during the psychological tasks", mental arithmetic and playing video games. Thus the phenomenon of additional heart rate was still present, and was not an artefact of the type of exercise that regression lines were based on. This supports the hypothesis that additional HR results from psychological activation.

2.3.2.1 Psychological influences on heart rate variability and reactivity

Rather than studying mean heart rate, some researchers have tended to focus on heart rate variability (HRV). HRV has been described as the fluctuations in HR interval or R-R interval (Kitney & Rompelman, 1980). This has generated interest because implications about autonomic physiological activity can be obtained from HRV data. Using HRV power spectra, for example, indicators of the extent of influence of respiratory fluctuations on HR can be extracted. Possible psychological influences on HRV have also been investigated.

Rompelman *et al* (1980) found strong indications of differences in the neural cardiovascular control of HRV among subjects of different psychic state. Specifically, the effects of respiratory arrhythmia and blood pressure fluctuations on HRV power spectra were investigated in psychiatric patients and normal subjects. The effects of blood pressure fluctuations in particular were clearly lower in one group of psychiatric patients compared to normal subjects. The normal subject population was, however, quite small. This evidence supported the hypothesis that inter-individual variation in HRV is at least partially due to psychological factors. Specific factors that were measured and found to have significant effects were the level of extraversion, anxiety, and capacity in a binary choice task, as well as age.

HRV has also been shown to decrease with increasing mental load (Hitchen *et al*, 1980). This may have relevance for the pathophysiology of disease, as reduced levels of HRV have been associated with increased susceptibility to heart disease (Morse *et al*, 1992).

The possibility that the psychological influence of social support may act as a "stress buffer" on cardiac activity has also been investigated (Uchino *et al*, 1992). Individuals receiving high levels of social support, while under the chronic stressor of caring for a family member suffering from Alzheimer's disease, were associated with normal age-related decreases in HR reactivity in response to mental arithmetic stressors. Low levels of social support, however, were associated with age-related increases in HR reactivity, suggesting "greater age-related increases in cardiovascular sympathetic control". Plentiful social support may thus reduce the negative cardiovascular consequences of chronic stress.

Other researchers have pursued the hypothesis that heightened cardiovascular responsivity to psychological stressors contributes to the development of coronary heart disease and essential hypertension. However, a recent prospective study of the association of blood pressure reactivity, and the development of essential hypertension found "little support for the reactivity hypothesis" (Sheffield *et al*, 1994). A more detailed account of this study has since been published, and it was suggested that the predictive power of stress reactivity measures may only be detected in studies of over 20 years duration (Carroll *et al*, 1995). Further work is required to determine the utility of reactivity to psychological stressors as an indicator of cardiovascular problems.

The apparent contradictions among the results of some of these studies almost certainly arises from the varying approaches to determining HRV and HR reactivity. This can be seen in a paper by Morse *et al* (1992) in which four possible definitions of HRV were outlined, for example, the maximum minus the minimum bpm, and the standard deviation of R-R intervals over a 24 hour recording period. Authors such as Rompelman, Kitney and Luczak have adopted a more detailed method for analysing the effects of internal factors on HR using power spectra. Overall, it seems that low HR variability, i.e. constant HR rather than fluctuations, represents an unhealthy response, and has been linked with increased risk of heart diseases. Alternatively, in response to stressors high HR reactivity, i.e. significant changes from resting HR in response to stressors, may be indicative of later cardiovascular related problems.

2.3.3 Measuring Heart Rate

Measurement of HR, unlike some cardiovascular indices, such as HRV, does not require complex analytical techniques. Further, in the current study, the influence of physical activity in most of the training exercises would have restricted the value of assessing HRV (Luczak *et al*, 1980). Nonetheless HR measurement can still be conducted accurately as well as remotely with the use of telemetric devices (Seaward *et al*, 1990), though manual assessment is still occasionally resorted to (Bassett *et al*, 1987). Telemetric devices also enable ambulatory recordings of HR. Subjects' HR responses can therefore be monitored across a range of activities, for example, in the current study HRs were recorded during dry and in-water training exercises.

2.4 Anxiety

Somewhat like the term stress, anxiety has been, and is used in many contexts (Morelli, 1985). In this study, however, anxiety shall be viewed in two ways. First as state anxiety, which is associated with the temporary and variable condition of feeling concerned, nervous and/or tense. Secondly, in terms of trait anxiety, which is whether an individual is intrinsically anxious, in other words as a personality characteristic. Trait anxiety is thus more stable and to a certain extent determines the level of state anxiety experienced in response to stressors. Whether viewed in the short or long term, however, anxiety is invariably a negative experience. Indeed, Paterson and Neufeld (1989) define anxiety as the "subjective experience of physiological arousal combined with a negative tone".

2.4.1 Anxiety and its Association with Stress

With regard to stress, anxiety fits in with the model of stress adapted from Hooke's law of elasticity. Despite debate over the definition of the term stress, investigators in the field are relatively united in referring to this model. Hooke's Law states that:

$$Stress = \kappa * Strain,$$

where κ is Young's modulus of elasticity.

In the stress field this model can be rewritten as:

$$Stressor = \kappa * Stress\ response,$$

where κ is an index of emotionality or trait anxiety.

This model demonstrates the importance of trait anxiety within the stress process. According to the model, to result in the same extent of stress response, individuals with low κ values require greater stressors than individuals with high κ values (Eysenck, 1986).

Anxiety has been measured in the present study to provide an indicator of subjectively experienced stress. Although stress and anxiety tend to be interchanged in the literature, they should not be considered to be the same. Anxiety can be viewed as one possible aspect of a stress response. Some authors have taken this argument further stating that anxiety is that which is present before the stress response occurs. Anxiety would thus be a factor that affects the individual's response rather than a component of the response (Hinton *et al*, 1991a & 1991b). This attitude was reflected by Eysenck (1989) who stated that "any attempt to relate individual differences in susceptibility to stress to personality should be based on the 'big two' personality dimensions of extraversion and neuroticism or anxiety". To the present author both of these views appear to be reiterating the relationship between trait anxiety and stress described earlier. The possibility of a state anxiety component of a stress response is therefore not excluded.

Even if it were proven that anxiety does not form part of the stress response, it would still play an important role in the overall process. Hinton *et al* (1991a), for example, define anxiety as "anticipatory fear", and go on to state that a possible component of a stress response is fear itself. The use of anxiety in the present study as a subjective indicator of stress is therefore still appropriate.

2.4.2 Other 'Emotions' Associated with Anxiety

Important distinctions have been made between anxiety and depression. Tellegen (1985) proposed that anxious mood primarily involves very high negative affect, or dissatisfaction, whereas depressed mood is related to very low positive affect, or satisfaction. This theory has also been linked into different personality types. Extraversion was suggested to be associated with positive affect, extraverts encountering more positive affect than introverts (Costa & McCrae, 1980). Additionally, highly neurotic or anxious individuals would be more susceptible to negative affect than those who rate low in neuroticism. As positive and negative affect were defined as two separate characteristics, rather than extremes of a single scale, whether an individual is extraverted or introverted would not necessarily influence their susceptibility to anxiety, and *vice versa.*

Gray (1986) proposed an alternative model of personality consisting of two orthogonal dimensions, "trait anxiety" and "impulsivity". These dimensions were described with reference to individuals' "sensitivity to reinforcing events". The scales of stable to neurotic, and introvert to extravert, as forwarded by Eysenck (1967), were also considered and overlaid on Gray's dimensions. Increasing neuroticism would be associated with general increases in sensitivity to reinforcement. When combined with increases towards introversion or to extraversion, the sensitivity would be specific to punishing or rewarding events, respectively. The trait anxiety dimension therefore ranged from stable extraverts to neurotic introverts, the latter being the most susceptible to "fear, anticipatory frustration, and anxiety". Thus unlike the model discussed above, the introversion/extraversion scale was found to be related to trait anxiety.

Despite these differences, the link between neuroticism and negative affect in the former model, and Gray's (1986) dimension of "trait anxiety" both correspond with Spielberger *et al*'s (1983) proposal that trait anxiety determines the extent of state anxiety experienced in response to stressors. Using the State Trait Anxiety Inventories, this relationship only seems to exist in situations "of an ego-threatening nature", for example, those involving loss of self-esteem (Kendall *et al*, 1976). It has also been proposed that previous experiences of state anxiety are reflected in the level of trait anxiety (Spielberger *et al*, 1983). Indirect evidence has, however, been found that over the course of 10 years neuroticism was relatively constant (Costa & McCrae, 1980). Further investigations are clearly required into whether trait anxiety changes over time, and if so, what the changes are linked to.

Fear is also frequently paired with anxiety. Epstein (1986) stated that fear and anxiety are differentiable, though they often occur together. Fear was perceived as the drive that supports flight, while anxiety could occur under various conditions, including during fear. The reverse relationship did not hold, however, as fear would not always be present when anxiety was experienced. Epstein (1986) went on to list situations that could elicit anxiety, including threats of physical harm, threats to self-esteem, strong stimulation, helplessness, and frustration.

2.4.3 The Measurement of Anxiety

One extensively used index of anxiety is Spielberger *et al*'s State Trait Anxiety Inventory (1983). Assessments of consistency have been performed on both the state and trait forms of this inventory. Test-retest correlations were found to be fairly high for the trait anxiety inventory (Spielberger *et al*, 1983). As the state anxiety inventory was designed to assess the fluctuating levels of anxiety found in different situations, high test-retest reliability was not expected. Indeed, measures of state anxiety did not correlate well when recorded up to 104 days apart in one study and 10 months apart in another (Spielberger *et al*, 1983, Newmark, 1972). The internal consistency of trait and state scales was also assessed in both studies using Cronbach's alpha. The resulting alpha coefficients were high, and according to Spielberger *et al* remained so across an age range of 19 to 69 years. This indicated that the 20 individual test items within each scale were assessing the same parameter. See the Glossary for a brief explanation of Cronbach's alpha coefficient.

Other studies have investigated the state trait distinction, for example, high school and university students completed the STAI during one non-stress and two stress conditions (Gaudry *et al*, 1975). The STAI test item scores from both groups were factor analysed, and 3 separate state anxiety factors were found for each group, corresponding to the 3 recordings of state anxiety made under different situations. A distinct trait anxiety factor was also detected, supporting the proposal that state and trait anxiety are different, and that state anxiety is labile.

As mentioned previously, Kendall *et al* (1976) found that the STAI trait form only measures one dimension, the "cognitive dimension of ego involvement or fear of failure". A requirement has, however, been identified for scales that assess the trait anxiety associated with other situations. Endler *et al* (1992) claim that the Endler Multidimensional Anxiety Scales (EMAS) fulfil this requirement. The trait EMAS consist of four sections aimed at four constructs: social evaluation, physical danger, ambiguous, and daily routines. The actual items are, however, the same for each scale. This suggests that other trait anxiety measures could also be used to assess these four constructs simply by supplying four slightly different sets of directions.

The STAI has, however, been criticised for its hidden multidimensionality, despite claiming to be a unidimensional scale (Endler *et al*, 1992). When factor analyses were conducted on the individual items of the state and trait scales, rather than on total scale scores, factors linked to the positive and negative wording of items were detected. (There are ten positive and ten negative items in the state anxiety scale, and nine positive and eleven negative items in the trait anxiety scale.) Endler *et al* stated that these factors were evidence of "spurious multidimensionality". Alternatively, Spielberger *et al* (1983) forwarded the view that the anxiety-absent or positive wording items "discriminated better at lower levels of stress", while the anxiety-present or negative wording items were more able to discriminate the intensity of state anxiety change at higher levels of stress. The STAI state form was therefore seen as being able to assess state anxiety across a wide range of situations. Using Principal Components Analyses, Kendall *et al* (1976) also found evidence of the split between negative and positive wording items. They considered that this could have been an artefact of the scoring system. Some debate thus exists as to the appropriateness of using positive and negative wording in the STAI.

The scales used to assess anxiety and depression have also been questioned. Despite the theoretical distinctions between anxiety and depression, it has been suggested that the scales commonly used to assess these dimensions do not distinguish between them sufficiently well to enable isolation of depressed subjects in non- or sub-clinical populations (Tanaka-Matsumi & Kameoka, 1986). Endler *et al* (1992) correlated STAI trait & state and EMAS scores with Beck Depression Inventory (BDI) scores from 605 psychology undergraduates. Criticism was made of the ability of the STAI to isolate anxiety, given the strong correlations that were found among the STAI and BDI scores. However, significant correlations were also found among the EMAS and BDI scores, although following Principal Components Analyses, the four trait EMASs were contained within separate factors from the BDI. Overall, this suggests that new or adjusted scales are needed if absolute distinction between anxiety and depression is required.

Hinton *et al* (1991b) have also queried the distinctions among the shortened versions of the stress adjective check list (SACL) (Mackay *et al*, 1983) and the state anxiety and state anger scales (Spielberger *et al*, 1983). They found strong correlations between the SACL and state anxiety, and suggested that the SACL was in fact measuring anxiety, three quarters of the test items being either identical or at least very similar in the two scales. They concluded that further work is required in developing a "non-specific emotional response to stress scale", i.e. a scale that does not focus on fear but contains items of a more general 'uneasiness' nature.

The most appropriate questionnaire(s) to use when assessing stress is thus currently receiving some attention. Ultimately, however, the STAI was chosen for use in the present study primarily because of its wide recognition within the scientific literature, and also because of its applicability over a wide range of stressors. Other measures of anxiety and stress may well become available and be considered to be more appropriate for future studies.

2.4.4 Anxiety and Health

As with cortisol and cardiovascular measures, the question of whether hyperreactivity is associated with increased risk of disease has been investigated for anxiety. Russek *et al* (1990) found a significant relationship between the emotion 'severe anxiety' and later increased likelihood of coronary heart disease and overall illness.

3 Research Method

Physiological and psychological measurements, chosen as indicators of stress, were made on individuals undergoing offshore survival training. Details of the overall content of the refresher and combined basic courses are contained in Appendix A. Attention was centred on four exercises to represent the four parts of training, namely:

- helicopter underwater escape training (HUET);
- simulated platform abandonment drills by way of totally enclosed motor propelled survival craft (TEMPSC);
- simulated platform abandonment drills into life rafts;
- self rescue from a smoke filled room, using breathing apparatus (BA).

These four exercises were considered to be potentially psychologically and physically demanding.

3.1 Methodology

3.1.1 Course specific questionnaires

All subjects were requested to complete all sections of a series of course specific questionnaires. The questionnaires are contained in Appendix B, and include:

- 'Subject details-1' - this form was included in case subjects had to be contacted outwith the training course. Before the subject completed the form the investigator added the subject's personal code to emphasise that confidentiality would be maintained;
- 'Subject details-2' - this questionnaire was developed to determine the individual's previous experience of survival training and the offshore environment;
- 'Subject details-3PSE' - this examined the subject's impression of the training before they commenced the course, as well as their perceptions of themselves, or their perceived self-efficacy (PSE);
- 'Post activity evaluations' - these were designed to assess the subject's evaluation of each part of the training being investigated, immediately after the event;
- 'Perceived outcome' - this determined the subject's evaluation of the course and themselves on completion of the course.

Completion of these forms therefore provided an indication of the individual's perception of their own ability to cope before, during and after the training. The importance of considering subjects' perceptions of stressors, and themselves has frequently been referred to in other investigations of stress responses (Hodges & Spielberger, 1966; Cox, 1985).

3.1.2 Psychological questionnaires

Psychological stress was assessed using Spielberger's State Trait Anxiety Inventory (STAI). This is a two part questionnaire designed by Spielberger in collaboration with Gorsuch *et al* (1983). Each part has 20 questions with the respondent marking one of four possible standard options to each question - always, sometimes, rarely, never. Scoring was carried out using a standard key, with possible scores ranging between 20 and 80. The state form, Y1, was designed to measure situational anxiety. The directions, therefore, request the respondent to indicate how they feel "*right now*, that is, *at this moment*". The trait form, Y2, measures the individual's inherent anxiety. The directions for this form request the respondent to consider how they "*generally feel*".

The Sensation Seeking Scale or Interest and Preference Test, a questionnaire designed by Zuckerman (1979), was used to assess personality. There are 40 questions, each with two possible responses. Responses were recorded on a separate answer sheet. A template was made to fit over the answer sheet, and this was used to enable easy and accurate scoring. The questions can be split into four different groupings; Experience Seeking (ES), Thrill and Adventure Seeking (TAS), Disinhibition (Dis), and Boredom Susceptibility (BS). Possible scores range from 0 to 40 for total scores, and 0 to 10 for each of the subcategories.

A further appraisal of personality was conducted using the Locus of Control scale, designed by Rotter (1966). An individual's locus of control can range from being external, that is the belief that life is under the command of forces outwith one's control, to internal, in which case the individual believes that he/she has direct control over the outcome of his/her own life. As the measure is a scale, individuals generally fall between the two extremes. The Locus of Control scale consists of 29 questions, each with two possible responses, six of the questions are "fillers". Responses were recorded on a separate answer sheet. A template was used in scoring this questionnaire. The responses to the fillers were not used in the overall score. Total scores thus ranged from 0 to 23. There are no subsections to this questionnaire, the overall score being considered as a point along the scale.

3.1.3 Heart rate measurement

A Polar Sports Tester model PE 4000 was used to monitor and continually record heart rate. This portable microprocessor incorporates a battery powered electrocardiogram (ECG) sensor and transmitter. The processor connects to a chest strap that includes two contact electrodes. The chest strap was worn directly in contact with the subject's skin, the sensor being positioned approximately over the sternum. A small amount of moisture applied to the contact electrodes facilitated the initial detection of the heart beat. Signals from the transmitter are then picked up by a receiver, which takes the form of a watch worn on the subject's wrist. Heart rates are stored within the microprocessor in the watch. Three storage options are available 5, 15, or 60 second time periods, with a total storage time of 2 hours and 40 minutes, 8 hours, and 33 hours, respectively. The data can then be recalled manually using the function buttons on the watch, or be downloaded for storage on disk, using an interface and Polar software. The software also enables averages to be determined later over any specified periods. Heart rate traces stored on disk were labelled using a coding system similar to that used for the salivary and urinary cortisol samples.

The Sports Tester has recently been compared with direct ECG measurement, and found to be both accurate and reliable (Seaward *et al*, 1990). Little information, however, is supplied with the Sports Tester on how the heart rate values are derived, but Seaward *et al* state that "momentary heart rate is calculated for each time interval between successive signals". Average heart rate is then calculated by the microprocessor and displayed on the watch face.

3.1.4 Exercise test

An incremental exercise ergometer test, which would elicit heart rates of no more than 75% of an estimated maximum, was developed for the study (see Appendix C). Work loads used ranged from 50 watts to a maximum of 150 watts, over increments of 25 watts. The test, which incorporated allowances for age and fitness, was applied, and found to be effective in eliciting a range of heart rates.

Harpenden callipers were used in the measurement of body fat. Three readings of skinfold thickness were taken at each of the following sites: biceps, triceps, subscapular, and suprailliac. An average for each site was calculated, the four resulting averages were summed. Then, using Durnin and Womersley's tables (1973) this final figure was used to determine total percentage body fat. Height and weight were measured, with individuals in normal clothing but not wearing shoes.

3.1.5 Collection of samples for cortisol analysis

Measurement of cortisol concentration was included as it is generally accepted as a valid indicator of "altered physiological states in response to stressful stimulation" and "of psychologically-induced stress" (Kirschbaum & Hellhammer, 1989; Ben-Aryeh *et al*, 1985). Cortisol in saliva is an acute measure, reflecting the activation of the hypothalamic-pituitary-adrenal axis (HPA) over the 20 to 90 minutes prior to collection. In the current study, salivary cortisol was therefore used as a short term indicator of changes in the HPA axis. There is a delay before cortisol enters the urine, and consequently urinary free cortisol represents a chronic measure. In the current study urinary free cortisol was used as an indicator of any long term changes in the activity of the HPA axis.

Saliva and urine samples were collected at various times throughout the course (see Section 3.2.2).

Both urine and saliva samples were analysed for cortisol concentration using "Coat-a-Count", a commercially available radio immunoassay technique, produced by Diagnostic Products Corporation (Los Angeles, CA, USA). Samples that were stained and/or viscous were rejected. Absolute values were used for salivary free cortisol, that is the level of unbound cortisol in saliva, expressed as nanomoles per litre (nmol/L). Urinary free cortisol, however, was measured as a ratio against creatinine, thus controlling for variations in urine flow rate.

Samples were analysed by staff at the Department of Clinical Biochemistry at Aberdeen University Medical School. Analysis was therefore conducted by individuals who did not have access to any of the information about subjects or the sequence of course events. The saliva sample analyses involved defrosting the samples at 5°C overnight, and then spinning them in a Bench centrifuge at 5000 rpm for 5 minutes. Fifty microlitres of the resulting relatively clear supernatant was used in the analysis. This volume, which is double the Coat-a-Count recommendation, was used to improve sensitivity. Checks made in preliminary experiments determined that at this specific volume, the anti-body was still in excess. Recovery rate was also investigated, and found to vary between 78% and 85%, over six concentrations, up to 15 nmol/L. Standard concentrations were measured and the % bound plotted against concentration on a log graph. Concentrations of actual samples were read off the standard line graph, therefore correcting for reduced recovery.

3.1.6 Data handling

Initially the basic format for data entry utilised a Lotus 123 spreadsheet. Whilst the initial data collection was being conducted, however, it was realised that entering the data into a database would be less liable to error, and more flexible for later extraction of sections of data. The data were therefore transferred into DataEase, a relational database produced by Sapphire International plc.

Each dataset (a total of 139 datasets were created) was assigned a relevant code, as well as a number (see Appendix D). The codes were used predominantly for reference in the database, whereas, the numbers corresponded to questions on forms and questionnaires. As each subject's forms accumulated, it was found to be useful to record all of an individual's data on a summary sheet. These summaries could thus be referred to directly, whilst the bulk of the forms were stored separately.

3.2 Protocol

3.2.1 Recruitment

Subjects were selected from classes of trainees at enrolment. Selection was carried out such that the study population was representative of the age range 20 to 60 years old. Initially it was intended that 15 subjects be recruited from four age categories, the twenties, thirties, forties and fifties, for refresher and combined groups. This would give a total of 120 subjects, all of whom would be selected from among trainees who had clear health screening forms. No other selection criteria were used. Individuals were randomly selected, taken aside from the main group, and, to satisfy ethical considerations, given a verbal outline explanation of the study. (This study was cleared by the Joint Ethical Committee of the Grampian Health Board and the University of Aberdeen in August 1991.) Individuals were told that the study was investigating the responses of individuals to survival training, and were requested to consider volunteering to take part. They were then given a volunteer information sheet, which reiterated in writing what they had just been told (Appendix E). Emphasis was placed on the recruitment being voluntary. If the individual agreed to become a subject, they were asked to complete a consent form.

Subjects then completed a series of questionnaires concerning their experience both offshore and regarding survival training. A further questionnaire was administered to assess the subject's own perception of their ability to cope with the survival training.

The last questionnaires completed at enrolment were Spielberger's State and Trait Anxiety Inventories, in that order. An initial explanation was given prior to completion of these forms. Once the state form had been completed, the distinction between the state and trait requirements was emphasised, and the subject then completed the trait form.

Finally volunteers were requested to provide saliva and urine samples. Two 20ml Sterilin containers were supplied to the subject, who was requested to urinate into one and then, soon afterwards, expectorate into the other.

3.2.2 Data collection during the course

Saliva samples were collected before and after the HUET drill, abandonment to life raft and to TEMPSC, self-rescue exercise from a smoke filled room, and exercise test. No pre-abandonment to life raft samples were procured from refresher subjects, as, during the refresher course, the abandonment was carried out immediately after the HUET. A sample taken before the abandonment would therefore reflect the post effects of the HUET, rather than the pre effects of the abandonment. Urine samples were obtained from the subjects early, before 8am, on each morning of the course.

Similarly state anxiety scores were recorded, using Spielberger's inventory, immediately prior to the self-rescue with BA fire training exercise, HUET, abandonment to a life raft, and abandonment using a TEMPSC, and early, before 8 am, on each morning of the course.

Before any of the four selected activities, subjects were fitted with a Polar Sports Tester model PE 4000. The recording intervals were set at 5 seconds for all of the exercises, except for the duration of the trip to sea during the TEMPSC training, and during the refreshers' HUET and abandonment to life raft exercises, which were combined within one pool session. During the trip to sea, the recording time was set for every 60 seconds. No detailed analysis was to be carried out on the sea trip, hence the longer time interval. During the refreshers' HUET and abandonment drills, the time interval was set at 15 seconds. This was necessary as, including briefing time, the consecutive exercises took 3 hours, which is outside the maximum storage time for 5 second recording.

The relevant times were noted from a Sport tester watch worn by the investigator. All Sport tester watches were synchronised weekly.

Following completion of each section of the course, subjects were requested to complete the relevant post-activity evaluation form. At this time they were also supplied with a Sterilin container, for an early morning urine sample, and an anxiety inventory with directions for use early on the following morning.

3.2.3 Exercise test

Prior to starting the exercise test each subject was fitted with a Sports Tester. A 5 minute recording was then made while the subject was seated at rest. Aerobic fitness was assessed using a Monarch ergometer, according to the protocol in Appendix C. Saliva samples were obtained before and after the exercise. Height, weight, and body fat were also measured.

The personality questionnaires described in Section 3.1.2 were completed at this time. Emphasis was placed on explaining these forms.

3.2.4 Completion of course

On completion of the training course, subjects were requested to answer the questions posed in the "perceived outcome" form (Appendix B). Subjects were also given a print-out of their heart rate trace from the exercise test. An indication of their aerobic fitness was included with this, along with their percentage body fat, and normal values of these variables from individuals in their age group.

3.3 Initial Trial

An initial trial was performed on two trainees, to test the proposed methodology, and identify problem areas.

Recruitment had been foreseen as one possible problem area. For example, there was some doubt that subjects would agree voluntarily to take part, with no incentive other than some feedback regarding personal fitness. This trial run showed, however, that generally, individuals were amenable to taking part. Recruitment of subjects at the enrolment stage of the course was confirmed as being the most suitable time. It was established that the time required for each subject to complete the initial forms, and provide urine and saliva samples, was a minimum of 20 minutes. Given that the time available was a maximum of 40 minutes, and ideally four subjects should be recruited per week, additional help was provided for recruitment.

When asked, individuals had not experienced any discomfort whilst wearing the heart rate monitors. Furthermore, the Sports Testers were found to be effective in continually detecting and recording heart rates. Interference in the form of improbable heart rates, e.g. drops to zero, was observed to occur when subjects were close together. Subsequently individuals were allotted to different groups within the class during practical exercises, and otherwise requested to maintain at least a 1 metre distance from other volunteers.

It was confirmed that printed sheets for recording timings during the four selected exercises, HUET, abandonment to TEMPSC and life raft, and fire fighting training, would be necessary. Times were then recorded on individual activity diaries in order to maintain consistency. To ensure that all times noted were accurate, weekly synchronisation of the watches used was commenced. Any difference among the five watches was noted.

Course specific questionnaires did not generate any difficulties during the initial trials. Little problem was found with the timing, nor with the method of collection of saliva and urine samples. Finally, training officers were requested to ensure that study subjects were treated as any other trainee.

3.4 The Pilot Study

As no major problems were encountered, a pilot study was therefore initiated. Data collection proceeded according to the plan of work (see Section 3.2). Two groups of 15 subjects were measured. Individuals were selected from across the originally specified age range. Only 4 individuals, out of the 34 who were approached, declined to take part in the study during this pilot phase.

3.4.1 Summary of findings from the pilot study

The pilot study demonstrated that individuals were willing to volunteer and continue to act as subjects throughout the duration of their training course. Additionally, it was confirmed that it was possible to collect the full complement of originally outlined data. Using the sports testers, heart rates could be measured continually: the most pertinent sections for analysis were also established (see Sections 5.1.2 - 5.1.5). Finally, it was decided that data collection should continue to the original proviso of 120 subjects.

3.5 The Main Research Questions Summarised

The previous section discussed the measurement techniques that were used in this study, and how they were applied. The techniques aimed to address the aims of the study that were outlined in the introduction. The detailed research questions that the study intended to answer were:

- Did specific training events result in exceptional increases in salivary cortisol?
- Was anxiety particularly high at any point in the course?
- Were the heart rate levels reached during the course unacceptably high?
- Was there a background, or basal, elevation of physiological and psychological activity, as assessed using the measures of early morning urinary free cortisol and state anxiety?
- Did coping perceptions change over the course of the training, and were any changes affected by age?
- Were there any links between the physiological and psychological measures conducted during the study?

4 Results and Discussions - Questionnaires

4.1 Data Collected

Ninety-nine subjects were observed while undertaking either the 3 day Offshore Basic Survival and Fire fighting Refresher course, referred to as "refresher", or the 5 day Combined Offshore Survival and Fire fighting Course, referred to as "combined". (Note that not all combined subjects were entirely naive to the training, see Section 4.2.1.) Overall, 52 refreshers and 47 combined subjects were observed, according to Table 1:

Table 1

Subject numbers, by age

	Age ranges (years)				
	20-29	30-39	40-49	50-59	**Totals**
Refresher	15	15	15	7	**52**
Combined	15	15	13	4	**47**
Totals	**30**	**30**	**28**	**11**	**99**

Age groupings were defined, putting individuals in their twenties, thirties, forties, and fifties together, as per Table 1. Five of the defined age groups contained the originally specified number of subjects, while both of the 50's groups and the combined 40's group fell short of the intended quota of 15. Despite the representative nature of the sampling, it was found that there was simply a lower proportion of older individuals taking part in survival training. This impediment to observing 120 subjects, from across a full age range, and the urgent requests for information from the project's main sponsor (RGIT Limited) and the offshore industry, meant that analysis proceeded with slightly less than the originally intended number of subjects. The lower numbers were less satisfactory in some respects, but the study population may thus have been more representative of the true population's age distribution.

4.2 Demographic/Background Data

The total population were split according to whether individuals were observed during a 3 day refresher course, or a 5 day combined course. Further subdivisions were based on age groupings. The average age of all the refresher subjects was 37 $\pm$ 10 years, and 35 $\pm$ 10 years for all combined subjects, with ranges of 21 to 56 years, and 19 to 53 years, respectively.

4.2.1 Offshore & survival training experience

From the refresher group, 92% (n = 48) were in employment, 98% (n = 51) having worked offshore. Within the combineds, 94% (n = 44) were employed, 45% (n = 21) with offshore work experience. The majority of individuals, both refreshers and combined, were completing the training because of job requirements.

Given that all refreshers had previously taken part in survival training, 92% (n = 48) had experience of HUET, 94% (n = 49) of abandonment into a life raft, 96% (n = 50) of fire fighting training, and 98% (n = 51) of abandonment into a life craft or TEMPSC. Of the combined subjects, only 28% (n = 13) had undergone survival training, 17% (n = 8) had experience of HUET, and 23% (n = 11) of abandonment into a life raft, however, 36% (n = 17) had experience of fire fighting training, and 30% (n = 14) of abandonment into a TEMPSC. There appears to have been a discrepancy among combined subjects regarding the extent of offshore experience versus survival training experience. This was probably a result of the former varying requirements by Offshore Oil Operators for survival training prior to working offshore. Subjects were requested to provide details of previous attendance of survival training courses, however, the extent of information provided was variable. Data were therefore not considered to be sufficiently reliable to use in the overall group analyses. Future studies would benefit from pursuing this factor.

4.2.2 Course expectations

Individuals' perceptions of which aspects of the courses they would find most and least able to handle are given in Figures 1a & 1b and 2a & 2b. (Figures not within the main document are contained within Appendix F.)

The TEMPSC training was regarded as being most easily handled (see Figures 1a & 1b in Appendix F). This was reiterated in that life boats were also scored the lowest on the exercise that was expected to be handled least effectively (see Figures 2a & 2b in Appendix F). HUET and fire fighting stood out as the exercises that subjects perceived they would handle least effectively, HUET more obviously in the combined group, fire fighting slightly more in the refresher group. The former distinction may have been a result of the wide spread exaggerations regarding the HUET, with the majority of combined subjects having no previous experience to contradict these tales. Having undergone HUET training the temptation appears to be to describe it in the worst possible light to those who have not completed the training. Similarly, few individuals new to training would have come across the realities of large-scale fires that were contained within a building, and therefore would not have reason to perceive the fire training as especially difficult. The refresher subjects, on the other hand, would have experienced fire fighting, possibly from before the more recent changes in the practical activities. Within the two years before this study, fire training was modified by reducing the heat within the smokehouses, and supplying trainees with more extensive protective clothing. Refresher subjects would thus have been aware of the difficulties that could be incurred, for example, the discomfort of smoke in the nose, eyes and throat, or the extreme heat emitted from large gas flames.

No statistically significant age effect was observed in these perceived self-efficacy questions.

4.2.3 Physical abilities

When asked to rate physical fitness, 67% (n = 35) and 49% (n = 23) perceived themselves as adequately fit, whereas 23% (n = 12) and 34% (n = 16) perceived themselves as quite fit. From those sampled, 6% (n = 3) and 13% (n = 6) rated themselves as non-swimmers. Results are for refreshers and combineds, respectively. (See Table 2 for overall ratings.)

Table 2

Total ratings of physical fitness and swimming ability

Physical fitness rating:	Refresher subjects	Combined subjects
Very fit	1	2
Quite fit	12	16
Adequate	35	23
Unfit	4	6
Totals	**52**	**47**
Swimming ability rating:		
Very good	7	4
Quite good	10	18
Adequate	32	19
Non-swimmer	3	6
Totals	52	47

4.3 Analysis of Course Specific Questionnaires; Correlation with Demographic Data

Analyses on the course evaluation and outcome questionnaires were carried out on the data from the completed groups, initially based around the HUET exercises. Means and standard deviations were calculated, and plotted as histograms. This served to provide a method of detecting any obvious patterns, changes, groupings, etc. Subsequent analysis was expanded to include all four of the selected exercises, these being HUET, abandonment into a life raft and into a TEMPSC, and fire training using BA.

The general linear model (GLM) approach to analysis of variance (ANOVA) was applied to the ranked evaluation questionnaires, to determine if there were any age, fitness rating, swimming ability rating or smoking dependent differences. One-way ANOVA was applied to the responses to the remaining, categorical course evaluation and outcome questionnaires. Tukey's pairwise comparison was consequently applied to the categorical data to distinguish where differences lay. These analyses were conducted using Minitab v8.0 extended. The Tukey's test was always conducted at the 5% significance level.

Comments have been noted for those within question differences that were found to be statistically significant, or when a lack of statistical difference was interesting in itself. The following symbols have been used to represent p-values of less than: 0.10 †, 0.05 *, 0.01 **, or 0.001 ‡. These values are ordered according to increasing levels of significance. Printouts of statistical procedures are detailed in Appendices G1 to G5. Figures not within the main document are contained in Appendix F.

4.3.1 Fire fighting training evaluation

Refreshers found disorientation, as well as smoke, to be the more difficult aspect of the fire training to cope with (see Figure 3a). Smoke was the major source of difficulty for combined subjects (see Figure 3b). This difference between refresher and combined subjects may have been a result of the more complex smokehouse that was used for refresher training.

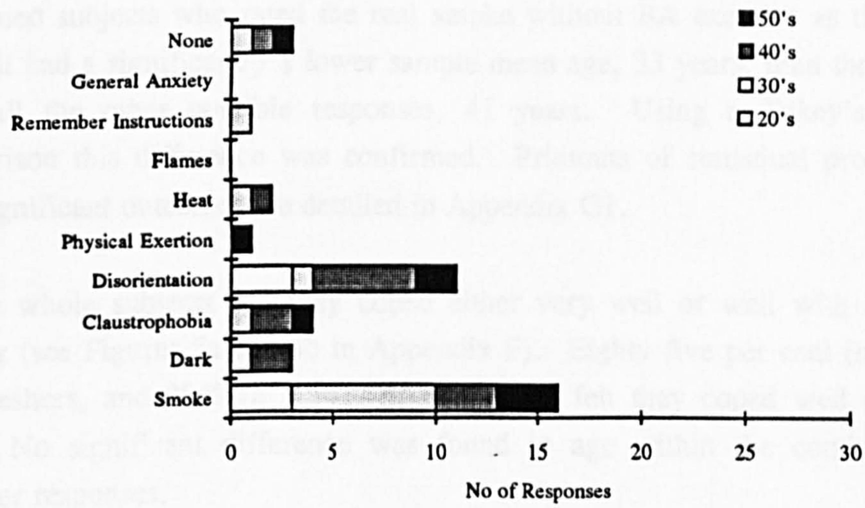


Figure 3a
Aspect of fire training most difficult to cope with - refresher subjects

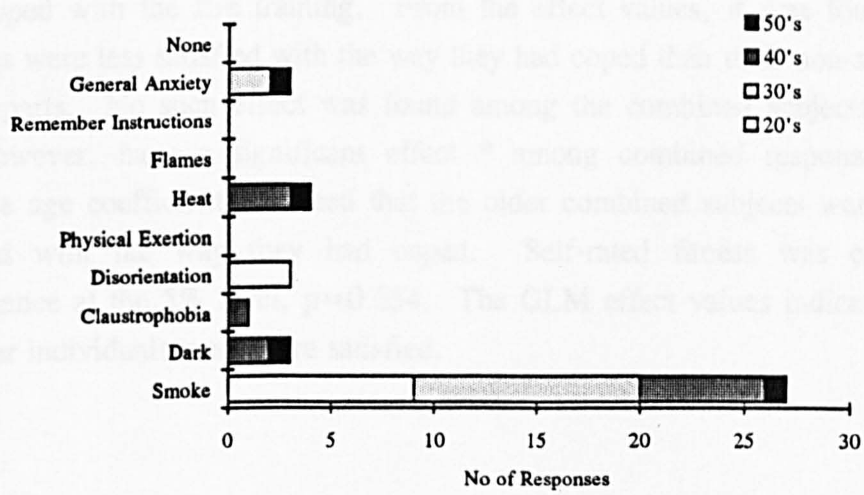


Figure 3b
Aspect of fire training most difficult to cope with - combined subjects

Furthermore, the exercises that involved most 'smoke contact' were given as the most difficult, escape with BA and real smoke without BA, for refresher and combined subjects, respectively (see Figures 4a and 4b in Appendix F). It should be noted that the refresher course did not include the exercises involving real smoke without BA, nor cosmetic smoke with BA. The BA donning and walk about was found to be the most difficult by some refreshers. This was possibly a reflection of the physical nature of this exercise.

Combined subjects who rated the real smoke without BA exercise as the most difficult had a significantly ‡ lower sample mean age, 33 years, than those who rated all the other possible responses, 41 years. Using a Tukey's paired comparison this difference was confirmed. Printouts of statistical procedures with significant outcomes are detailed in Appendix G1.

On the whole subjects felt they coped either very well or well with the fire training (see Figures 5a and 5b in Appendix F). Eighty five per cent (n = 33) of refreshers, and 98% (n = 41) of combineds felt they coped well or very well. No significant difference was found in age within the combined or refresher responses.

GLM demonstrated that only the smoking factor had a significant effect ** among the refresher responses to how satisfied individuals were with the way they coped with the fire training. From the effect values, it was found that smokers were less satisfied with the way they had coped than their non-smoking counterparts. No such effect was found among the combined subjects. Age did, however, have a significant effect * among combined responses. A negative age coefficient indicated that the older combined subjects were more satisfied with the way they had coped. Self-rated fitness was close to significance at the 5% level, p=0.054. The GLM effect values indicated that the fitter individuals were more satisfied.

p-value <0.10 †; <0.05 *: < 0.01 **; <0.001 ‡.

4.3.2 Helicopter Underwater Escape Training (HUET) evaluation

For refresher and combined subjects, disorientation clearly was the most difficult factor of the HUET training (see Figures 6a and 6b). General anxiety also appeared to be prominent, and was rated by the same number of refresher and combined subjects. Remembering instructions was more highly rated by combined subjects, which may have been expected for individuals taking part in a training course for the first time.

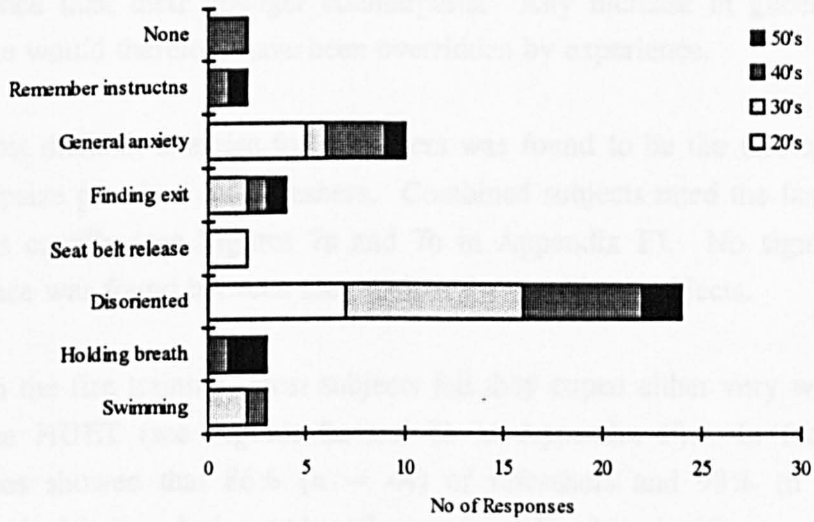


Figure 6a

Aspect of HUET most difficult to cope with - refresher subjects

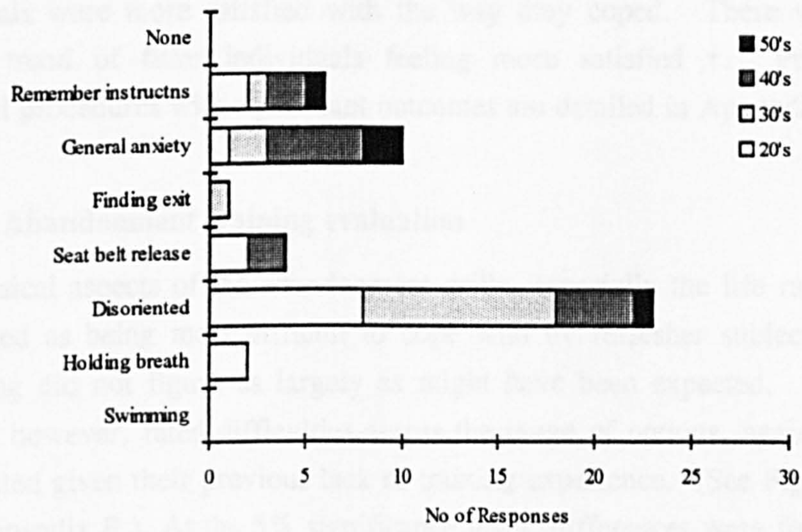


Figure 6b

Aspect of HUET most difficult to cope with - combined subjects

From the question 'Which aspect of the helicopter underwater escape did you find most difficult to cope with?', the mean age of those refreshers rating general anxiety, 34 years, was close, p = 0.062, to being significantly lower than the mean age of those who rated any of the other possible responses, 42 years, except disorientation. According to the Tukey's test, for combined subjects, those rating general anxiety were significantly * older, 41 years, than those who found breath holding, seat belt release, or finding an exit, 29 years, as the most difficult aspect. The refresher and combined results thus oppose each other. This may have been a result of the older refreshers having more experience than their younger counterparts. Any increase in general anxiety with age would therefore have been overridden by experience.

The most difficult exercise for refreshers was found to be the fast capsize, the only capsize practised by refreshers. Combined subjects rated the fast and slow capsizes equally (see Figures 7a and 7b in Appendix F). No significant age difference was found between the capsizes for combined subjects.

As with the fire training, most subjects felt they coped either very well or well with the HUET (see Figures 8a and 8b in Appendix F). In fact, totalled responses showed that 86% (n = 44) of refreshers and 93% (n = 43) of combineds felt they had coped well or very well. No significant age, fitness, swimming, or smoking effects were found, among the possible responses for refresher subjects. Although age was found to be significant at the 10% level for combined subjects †. Furthermore, as the coefficient was negative, older individuals were more satisfied with the way they coped. There was also a general trend of fitter individuals feeling more satisfied †. Printouts of statistical procedures with significant outcomes are detailed in Appendix G2.

4.3.3 Abandonment training evaluation

The physical aspects of the abandonment drills, especially the life raft motion, were rated as being most difficult to cope with by refresher subjects, though swimming did not figure as largely as might have been expected. Combined trainees, however, rated difficulties across the range of options, again as might be expected given their previous lack of training experience. (See Figures 9a & 9b in Appendix F.) At the 5% significance level, differences were found in the combined mean group response ages. According to Tukey's pairwise

p-value <0.10 †; <0.05 *: < 0.01 **; <0.001 ‡.

comparison the mean age of those rating general activity, 41 years, was significantly * higher than those rating life raft motion, 28 years, as the most difficult aspect to cope with.

Exercises relating to entering and righting rafts, and scramble nets were the most difficult for refresher subjects as seen from Figure 10a in Appendix F. Conversely, only one combined subject rated the life raft righting as the most difficult, most subjects found entering the rafts, and scramble nets to be the most difficult exercises (see Figure 10b in Appendix F). This may have been a reflection of the fact that raft righting was contained within the one session, along with HUET and simulated abandonment, for refreshers. The evaluation questionnaires being completed after this single session. The combined subjects, however, took part in a separate wet drill, during which righting of rafts was practised. The abandonment, and evaluation questionnaire, being completed later. Consequently the raft righting may not have been as fresh in the memory of combined subjects when completing the evaluation form. Significant differences were found relative to age for the combined responses to the most difficult exercise question. According to the Tukey's test, those individuals who rated the scramble net as the most difficult, had a significantly * higher mean age, 39 years, than those who rated entering life rafts, 30 years.

Neither self-rated fitness nor swimming ability was found to have any effects on the abandonment evaluation questions, except for the refresher responses to which exercise was the most difficult. Following one-way ANOVA, average self-rated fitness was found to differ significantly * among the refreshers' responses. Confidence intervals, as estimated by Tukey's paired comparison, showed that those who scored the raft righting and those who scored entering the raft were close to being significantly fitter, in their own rating, than those who scored scramble nets. Printouts of statistical procedures with significant outcomes are detailed in Appendix G3.

Again most subjects felt that they had coped either very well or well with the abandonment training. Two per cent (n = 1) of the refreshers felt that they did not cope at all well, and 12% (n = 6) of refreshers and 7% (n = 3) of combined subjects, were only somewhat satisfied with the way that they had coped. For refresher and combined subjects, significant age, swimming, and

p-value <0.10 †; <0.05 *: < 0.01 **; <0.001 ‡.

fitness effects were not found among those who felt they had coped very well, well or somewhat well with the abandonment training. Combined subjects who smoked were found to be less satisfied with the way they had coped *. No combined subjects felt that they had not coped well.

4.3.4 TEMPSC abandonment training evaluation

Generally, subjects scored across the range of possible responses for the aspect of the TEMPSC that was most difficult to cope with (see Figures 12a & 12b in Appendix F). The only notable factor was that, out of 97 individuals, only one rated general anxiety as difficult. This therefore was a strong indicator of the generally low levels of anxiety associated with TEMPSC training.

Figures 13a & 13b (in Appendix F) show that considerably more combined than refresher subjects found the handling at sea the most difficult exercise. This might have been expected given that only 30% (n = 14) of combineds had any previous life boat experience, in contrast to refreshers, 98% (n = 51) of who had previous experience. Coxswain training appeared to generate some difficulty. It was, however, frequently noted by trainees that this exercise was simply the 'least easy'.

Most refresher subjects felt that they had coped well if not very well, only 3 felt that they had coped somewhat well (see Figure 14a in Appendix F). All combined subjects felt that they had coped either well, 52% (n = 24), or very well, 48% (n = 22) (see Figure 14b in Appendix F).

No significant age, swimming ability, or fitness effects were found in any of the responses to how satisfied individuals were with the way they had coped with the TEMPSC training. As with the responses to the other abandonment, combined smokers were less satisfied with how they coped with the TEMPSC training *. Printouts of statistical procedures with significant outcomes are detailed in Appendix G4.

4.3.5 Changes in emergency coping abilities

When questioned on their capabilities for evacuating offshore, subjects responded with a general pattern of improved personal perception of coping

p-value <0.10 †; <0.05 *: < 0.01 **; <0.001 ‡.

ability (see Figures 15a & 15b in Appendix F). These improvements were especially obvious among the combined responses, 98% (n = 45) felt either moderately or much more able to evacuate safely from an offshore installation during an emergency than before the training course. No significant age related differences were found.

A general increase in perceived ability to cope with a fire can be seen for refresher subjects in Figure 16a (in Appendix F). According to the results of a Tukey's pairwise comparison test, the mean age of those refreshers who felt moderately more capable of coping with a fire, 42 years, was significantly * higher than those who felt slightly more able to cope, 32 years. No continual age trend, however, was seen in the overall responses. Combined trainees showed a marked increase in how capable they perceived themselves (see Figure 16b in Appendix F). A total of 97% (n = 44) felt either moderately or much more able to cope. Printouts of statistical procedures with significant outcomes are detailed in Appendix G5.

Refreshers generally felt more able to cope with a helicopter ditching (see Figure 17a in Appendix F). Their confidence in helicopter transport was, however, very obviously unchanged, 75% (n = 33) responding no change (see Figure 18a in Appendix F). Combined trainees showed a marked increase in their coping capabilities regarding helicopter ditching (see Figure 17b in Appendix F) 97% (n = 44) felt either moderately or much more capable. Combined subjects' confidence in helicopter transport also increased (see Figure 18b in Appendix F). Forty-nine per cent (n = 22) felt their confidence either somewhat or greatly increased, though approximately the same amount, 47% (n = 21), felt no change.

From Figure 19a (in Appendix F) it can be seen that refresher trainees considered their knowledge of survival techniques to have 30% (n = 13) slightly, 39% (n = 17) moderately, or 30% (n = 13) much improved, following the training course. This improvement, however, was not as marked as that shown by the combined trainees, 83% (n = 38) of who felt their knowledge was much improved. This was hardly surprising given that few had any experience of survival techniques before commencement of the course. The improvements in both groups demonstrated that the course was beneficial to refreshers as well as combineds, regarding learning techniques of survival in an offshore emergency.

4.3.6 Expectations & actuality - physical & emotional

Following training, refreshers demonstrated a less pronounced improvement in their perceptions of how much more they would be able to cope with other emergency situations than combined trainees (see Figures 20a & 20b in Appendix F). It was observed that combined trainees felt they would be 46% (n = 21) moderately or 54% (n = 25) much more able to cope in other emergency situations. It thus appeared that the survival training course had positive effects on overall coping ability.

The majority of refresher trainees did not receive any surprises regarding how physically demanding the training was (see Figure 21a in Appendix F). As the training was rated more physically demanding, a slight, though not significant, increase in the age of the volunteers was detected. On observing the responses to how emotionally demanding the course was (see Figure 22a in Appendix F) it was seen that for most refresher trainees their initial view of the training matched what they experienced. Eighty-six per cent (n = 38) of refreshers responded 'as expected'.

As might have been anticipated, the combined subjects' responses showed that their initial perception of the demands of training deviated more from the actual event than the refreshers (see Figures 21b & 22b in Appendix F). Following a Tukey's paired comparison test to the responses of how physically demanding the course had been, those who rated somewhat less were found to be significantly younger, 30 years, than those who had chosen much more as a response, 49 years. A trend of gradually increasing age was again seen, but with combined subjects this occurred in response to whether the training course was as emotionally demanding as expected. Printouts of statistical procedures with significant outcomes are detailed in Appendix G5.

4.4 Analysis of the State Trait Anxiety Inventory Results

The General linear model (GLM) approach to analysis of variance (ANOVA) was conducted on both the refresher and combined state anxiety inventory scores, using Minitab v8.0 extended. Various factors were considered for their possible ability of affecting state anxiety scores:

- The variation between subjects was investigated by assigning every subject with a unique number, these numbers were referred to as 'subject ' in GLM.
- Each subject's age was also considered as a possible influencing factor. As 'age' was a continuous parameter, it was also run as a covariate. Average scores per event are shown in Figures 23a & 23b and 25a & 25b, with divisions according to age groupings.
- Comparisons were also made as to whether or not subjects smoked, 'smoke', and according to self-rated fitness, 'fit', and swimming ability, 'swim'.
- All the state anxiety scores were compared with each other according to which specific training activity they had preceded, or, if an early morning questionnaire, on which morning they had been completed, e.g. HUET, fire training, enrolment. This factor was referred to as the 'event'.
- The order, or sequence, in which subjects completed the various aspects of the course. Each score was assigned a number, 1 to 9 for combined and 1 to 6 for refresher, depending on whether the corresponding anxiety questionnaire had been completed first, second, third, etc. In GLM, this factor was termed 'sequence' and run as a covariate.

To assess whether the order of conducting training or the day of training were significant a Repeated Measures technique using MANOVA was applied to the morning STAI scores. This was conducted using SPSS for Windows (v6.0).

Factor analysis of the combined subjects' early morning state anxiety scores was conducted, again using SPSS for Windows. SPSS uses the Principal Components Analysis (PCA) technique for factor analysis. This approach was used to reduce the number of variables to a more manageable form. This is possible because factor analysis produces "a general variable", when the variables under consideration are simply different ways of measuring this other general variable (Hedderson, 1991). The combined subjects' factor values were then used in Cluster Analysis. Cluster Analysis only was applied to refresher subjects' early morning state anxiety scores. There were just 3 morning's data for refreshers, reduction of the number of parameters using PCA was therefore not required.

For refreshers, those subjects with one or more missing STAI scores were extracted from the dataset (12 subjects in all). Mean STAI values of the total group are compared with those of the reduced subject group in Table 5. Additional analyses could then be conducted in the form of two-way ANOVA - unlike GLM, two-way ANOVA cannot be conducted with groups of data that contain missing values. The average event values were then used in a Tukey's wholly significant difference (WSD) test, this enabled determination of which events were significantly different from each other.

All scores, both combined and refresher, were given a single code according to when, and before which event they were recorded. This enabled the influence of the event and sequence effects to be considered in conjunction. A GLM analysis was subsequently carried out using these codes as a covariate of the STAI scores.

The values of major interest were the pre-event STAI scores. Hence the 45 refresher subjects with the full complement of pre-event scores were extracted for further analysis. GLM from first principles was conducted with subsequent orthogonal contrast calculations (Kirk, 1982). The following orthogonal contrasts were conducted:

- linear contrast, to investigate whether the scores changed linearly with the day of the course on which the training had been carried out;
- quadratic contrast, when considering the same training activity, but conducted on different course days, to determine if anxiety scores showed a peak or trough pattern;
- HUET versus fire scores directly, to determine whether HUET and fire anxiety scores differed significantly;
- HUET & fire versus TEMPSC, to determine whether TEMPSC anxiety scores were lower than HUET or fire scores.

Whether a factor was significant or not, and how significant depended upon the p-value that was determined from the statistical analyses. The following groupings of p-values are referred to in the results with their respective symbols, p less than: 0.1 †, 0.05 *, 0.01 **, or 0.001 ‡. These values represent increasing levels of significance. Refresher and combined subjects' results are presented separately.

4.4.1 Outcome of the refresher subjects' STAI analyses

This section will describe the demographic factors that had significant effect on the refresher subjects' STAI scores, the events that resulted in particularly high STAI scores, and the effects of sequence of completing the events.

As might have been expected, there was significant variation among the individual subjects' scores. Age was also found to have significant effect * (see Appendix G6). Furthermore, the value of the coefficient of age was negative, which suggested that average state anxiety scores gradually decreased as older individuals were considered. Mean age grouped scores were plotted (see Figures 23a & 23b) and a trend of decreasing state anxiety with age was seen in the pre-event scores.

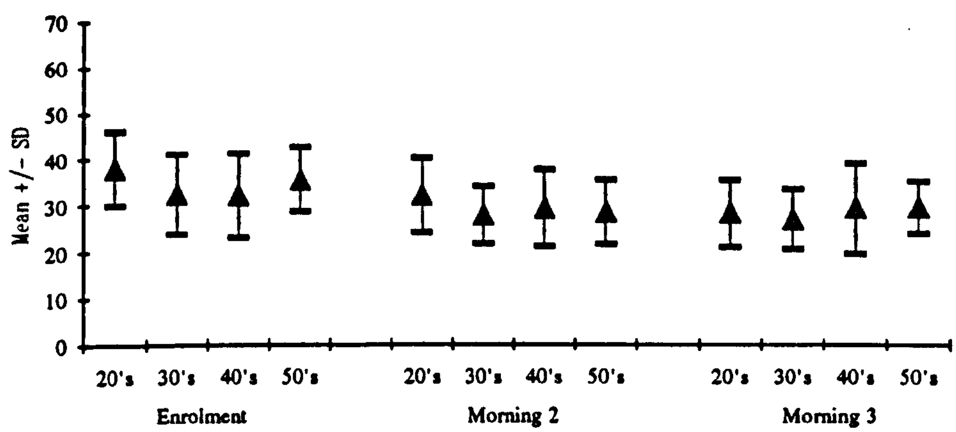


Figure 23a
Refresher subjects morning state anxiety scores according to age group

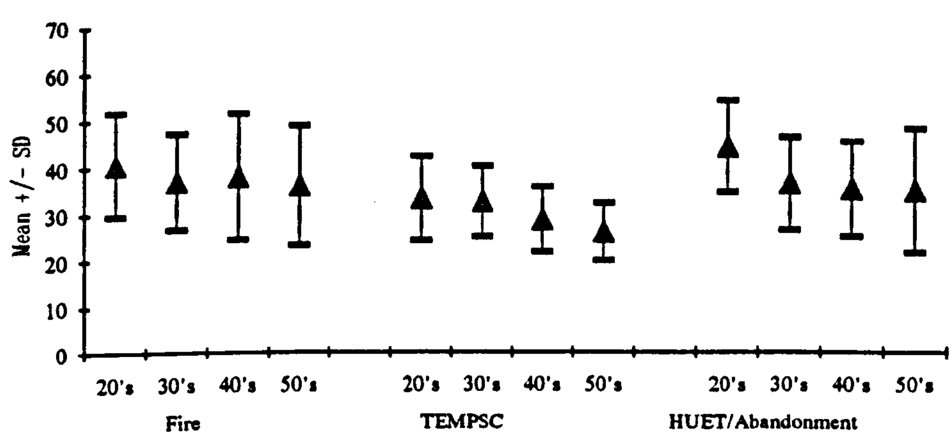


Figure 23b
Refresher subjects pre-event state anxiety scores according to age group

The possibility that age itself was not a direct causative agent was, however, investigated. It was hypothesised that younger individuals differed in some other aspect from older individuals, this other aspect being why age, as a factor, was shown to have a significant effect. Whether or not subjects smoked was, therefore, also analysed.

By determining the mean age of smokers, 37 ± 1 years, and non-smokers, 38 ±1 years, it was seen that there was little difference. The age factor, therefore, was not an indirect result of whether subjects smoke. Nonetheless, smoking did have a highly significant effect on scores ** (see Table 3). Again a negative coefficient value was calculated, implying that smokers manifested higher average state anxiety scores. When the trait anxiety levels were investigated, *via* one-way ANOVA and a Tukey's paired comparison, smokers had a significantly higher * mean trait anxiety inventory score, 36, than non-smokers, 32 (see Appendix G8). It would therefore have been expected that their state anxiety scores also be higher. Possibly those people who smoked were more anxious than average as a personality trait, rather than as a result of their smoking, and this was manifested in their responses to the training. ^

Table 3
Outcome of GLM of refresher subjects' STAI scores against event; with covariates smoke, fit & swim

Source	F	P	Term	Coeff	Stdev	t-value	P
			Constant	30.843	3.539	8.71	0.000
Smoke	9.90	0.002	Smoke	-3.495	1.111	-3.15	0.002
Fit	5.77	0.017	Fit	2.2788	0.9488	2.40	0.017
Swim	0.79	0.374	Swim	0.6190	0.6946	0.89	0.374
Event	12.14	0.000					

See Appendix G7 for additional detail of the statistical output.

The individual's self-rated fitness level was found to have a significant effect on anxiety scores* (see Table 3). The value of the coefficient suggested that as perceived fitness decreased, individuals scored higher in state anxiety. Self-rated swimming ability did not have a significant effect on the scores (see Table 3).

Repeated Measures analysis indicated that enrolment STAI scores were significantly higher than those on day 2 ‡ (see Appendix G9).

p-value <0.1 †; <0.05 *; <0.01 **; <0.001 ‡

Using Cluster Analysis, refresher subjects were divided into two groups or "clusters" according to their early morning state anxiety scores, their age, and whether they smoked. The ANOVA table within the Cluster Analysis indicated that anxiety scores on days 1 ‡, 2 ‡ & 3 ‡, as well as age *, were significantly different between the two clusters of subjects. There was not a significantly different number of smokers and non-smokers in the two clusters. The final cluster centres indicated that the older group of refresher subjects had higher morning STAI scores than the younger group. Further, the drop in STAI from day 1 was not as marked in the older group. This appears to contradict the outcome of the GLM analysis on the STAI scores. Differences may, however, have arisen due to differences in subject numbers, unlike GLM, Cluster Analysis requires complete data sets. Also, GLM was conducted on all the STAI scores, not just the morning state anxiety, and as was seen in Figures 23a & 23b the trend of decreasing anxiety scores with age groups was only observed in the pre-event anxiety scores. Possible reasons for the distinction of age effects in the morning and pre-event STAI scores are discussed in Section 4.7.2. Details of the Cluster Analysis print-out are contained in Appendix G10.

The sequence in which activities were conducted did not produce any significant effect on scores (see Appendix G11). Had the distribution of subjects among the different sequences been more uniform, a sequence effect may have been detected. A lack of significance may also have been a result of the short time span over which the refresher course was conducted, relative to the combined course. Table 4 contains the details of the various sequences as well as the number of subjects who followed each sequence.

Table 4

Sequence of events over which subjects were observed

	Number of subjects on courses of given sequence	
Sequence	Refresher	Combined
HAFT	8	21
AHFT	0	4
FHAT	3	4
FTHA	4	3
TAHF	0	7
THAF	22	7
TFAH	0	1
TFHA	15	0
Total: subjects	52	47
sequences	5	7

Key: H - HUET; F - Fire training; A - Abandonment to life raft; T - TEMPSC

On conducting GLM on all the state anxiety scores, the specific events were found to have a significant effect ‡ (see Table 3). To determine between which particular exercises significant differences lay, further analyses were conducted. Two methods were used, as follows.

First, those subjects with incomplete data sets were extracted from the refresher group. Two-way ANOVA was carried out, the calculated means are shown in Table 5.

Table 5
Mean STAI values, according to event, for complete and reduced refresher subject groups

Event	All 52 subjects Mean	40 subjects Mean	Difference in means
Enrolment	34.41	33.42	-0.99
Morning 2	29.57	28.50	-1.07
Morning 3	28.46	27.65	-0.81
Fire training	38.27	37.17	-1.10
TEMPSC	30.96	31.23	+0.27
HUET/Aband	38.50	37.40	-1.10

Table 5 shows that the mean values with 52 subjects differed little from the values calculated using Two-way ANOVA with 40 subjects. From the two-way analysis, both subject ** and event ** factors were again found to be significant. Details of the statistical output are contained in Appendix G12. Mean values for the specific activities were subsequently used in a Tukey's WSD test. The outcome of this test is shown in Table 6.

Table 6
Tukey's wholly significant difference test on refresher STAI results (complete data sets only) - showing means and differences between means

		Event					
		Morn 3	Morn 2	TEMPSC	Enrol	Fire	HUET
Event	*Mean*	*27.65*	*28.50*	*31.23*	*33.42*	*37.17*	*37.40*
			Differences between STAI Event means				
Morn 3	*27.65*		0.85	3.58	5.77	9.52*	9.75*
Morn 2	*28.50*			2.73	4.92	8.67*	8.90*
TEMPSC	*31.23*				2.19	5.94	6.17*
Enrol	*33.42*					3.75	3.98
Fire	*37.17*						0.23

** indicates significance at the 5% level using Tukey's WSD Test*

p-value <0.1 †; <0.05 *; <0.01 **; <0.001 ‡

The minimum difference value was calculated as 5.956. Any difference above this was deemed significant, at the 5% level. It was found, as seen in Table 6, that mean state anxiety scores prior to the fire training were significantly more than those obtained on the 2nd and 3rd morning, and close to being significantly more than the mean score prior to the TEMPSC. Further, the mean scores prior to the HUET were significantly more than the 2nd and 3rd morning scores and the pre-TEMPSC scores. The enrolment score was close to being significantly more than the 3rd morning score.

The second form of investigation, to determine between which events significant differences lay, involved setting up a code for each event/sequence combination. This enabled event and sequence effects to be considered simultaneously, from the whole group's scores. Table 7 shows the effect values, taken from GLM, and the number of subjects who carried out the particular exercises on the specified day. See Appendix G13 for the remaining statistical output, and the Glossary for an explanation of the difference between effect values obtained from GLM and mean values.

All refreshers completed the 3 morning state anxiety scores at the same stage of the course, that is on day 1, 2 and 3. Furthermore, their 2nd and 3rd morning values were clearly different from the pre-event values (see Table 7). The pre-event values were therefore investigated independently for any sequence related differences.

Table 7
Whole group refresher STAI values according to the event and the day of the course

Event	First day		Second day		Third day	
	Effect	No of subjects	Effect	No of subjects	Effect	No of subjects
Enrol	34.37	51				
Morn 2			29.63	51		
Morn 3					28.25	48
Fire	37.18	7	39.44	23	37.32	22
TEMPSC	32.60	33	31.56	4	30.24	8
HUET	38.82	6	38.53	25	38.63	19

GLM was conducted on the anxiety scores from the 45 subjects with all 3 pre-event values. The effect values obtained from this analysis (see Figure 24) were then used in orthogonal contrasts (see Table 7a). Contrasts enable the 'event' or effects of the HUET and abandonment, fire training and TEMPSC, and the 'order' or day of the course that the training was carried out, to be separated.

Table 7a
Summary of orthogonal contrasts conducted on Refresher pre-event STAI scores

Contrast	Σ Contrast * STAI value	Contrast SS	F-value	Significance of F
Linear	3.929	0.8898	0.3592	N S
Quadratic	-2.999	1.960	0.0950	N S
HUET v Fire	0.1818	0.6426	0.0011	N S
HUET & Fire v TEMPSC	35.89	5.367	4.968	$p<0.05$

N S - Not significant, Σ - sum of, SS - sum of squares

No significant differences were found in the sequence that activities were carried out, nor between HUET and fire training scores (see Table 7a). It was determined, however, that TEMPSC scores were significantly lower than both HUET and fire training scores. On viewing Figure 24, these differences are apparent.

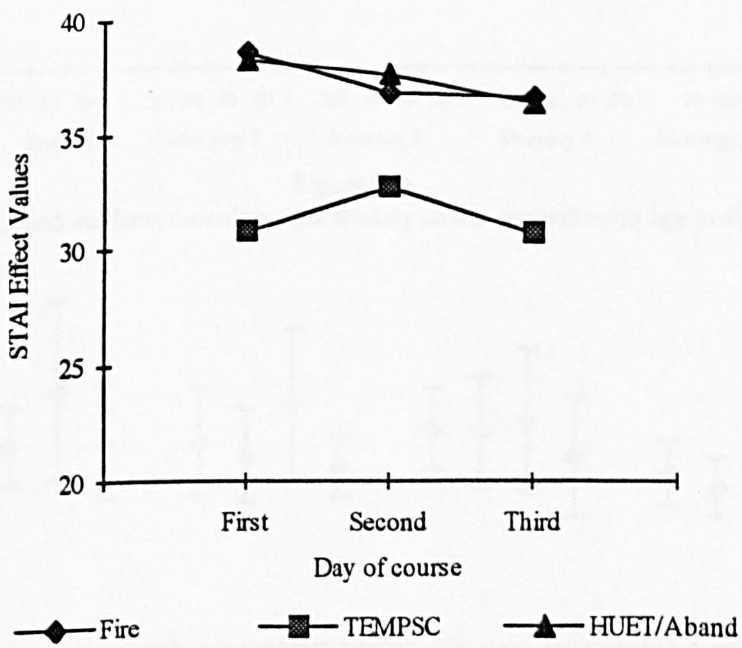


Figure 24
Refresher pre-event state anxiety effect values (45 subjects)

4.4.2 Outcome of the combined subjects' STAI analyses

This section will describe the demographic factors that had significant effect on the combined subjects' STAI scores, the events that resulted in particularly high STAI scores, and the effects of sequence of completing the events.

As with the refresher data, according to GLM, subjects' STAI scores varied significantly. From the GLM analysis, actual age was not found to have a significant effect on STAI scores (see Appendix G14). This agrees with the lack of a consistent trend in Figures 25a & 25b, which show STAI values plotted according to age group. It was proposed in Section 4.4.1 that any age effect would have been connected to experience. As few of the combined subjects had experience of survival training, age might therefore have been expected to have no significant effect.

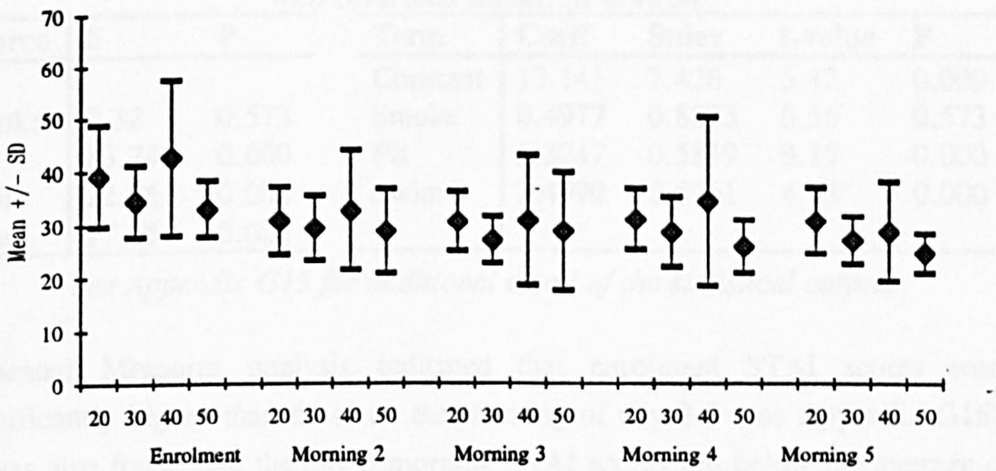


Figure 25a
Combined subjects morning state anxiety scores according to age group

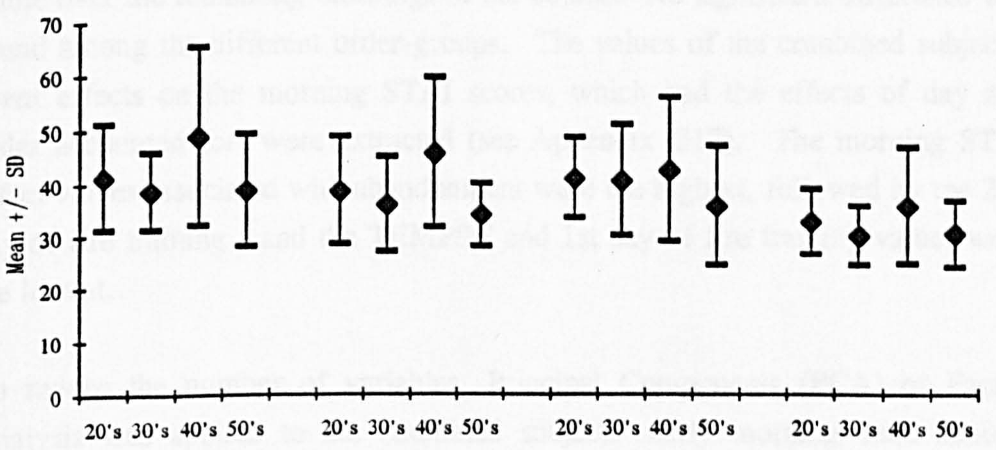


Figure 25b
Combined subjects pre-event state anxiety scores according to age group

Whether or not combined subjects smoked did not result in significant differences in STAI scores (see Table 8). Further, no relationship was found between trait anxiety score and whether or not subjects smoked. This concurred with the suggestion that state anxiety inventory scores were related to the individual's trait anxiety score.

Self-rated fitness was found to have a significant effect on STAI scores ‡. According to the coefficient value, STAI scores were higher for those who rated themselves less fit. Self-rated swimming ability also resulted in significant differences in anxiety scores ‡, the coefficient value indicated that those who rated themselves less able to swim scored higher in the anxiety inventory (see Table 8).

Table 8
Outcome of GLM of combined subjects' STAI scores against event; with covariates smoke, fit & swim

Source	F	P
Smoke	0.32	0.573
Fit	83.74	0.000
Swim	22.56	0.000
Event	17.65	0.000

Term	Coeff	Stdev	t-value	P
Constant	13.141	2.426	5.42	0.000
Smoke	0.4977	0.8823	0.56	0.573
Fit	5.3247	0.5819	9.15	0.000
Swim	2.4990	0.5261	4.75	0.000

See Appendix G15 for additional detail of the statistical output.

Repeated Measures analysis indicated that enrolment STAI scores were significantly higher than those on the morning of day 2 ‡ (see Appendix G16). It was also found that the day 3 morning STAI scores fell below the average of the morning values on days 1 & 2 *. The level of STAI scores then remained stable over the remaining mornings of the course. No significant difference was found among the different order-groups. The values of the combined subjects' event effects on the morning STAI scores, which had the effects of day and order accounted for, were extracted (see Appendix G17). The morning STAI effect values associated with abandonment were the highest, followed by the 2nd day of fire training , and the TEMPSC and 1st day of fire training values were the lowest.

To reduce the number of variables, Principal Components (PCA) or Factor Analysis was applied to the combined subjects' early morning state anxiety scores. One factor resulted from this analysis, and this accounted for 74.2% of

p-value <0.1 †; <0.05 *; <0.01 **; <0.001 ‡

the overall variance. The high percentage indicated that this one factor was representative of the 5 mornings of STAI scores. See Appendix G18 for eigenvalues and other details of the PCA.

Using Cluster Analysis combined subjects were then divided into 3 groups or "clusters" according to their morning STAI factor value, as derived from PCA, and their age. Full details of the Cluster Analysis output are contained in Appendix G19. The resulting clusters centred on 3 different ages, as can be seen in Figure 26. The 'oldest' group had the lowest morning STAI factor value cluster centre. Figure 26 also highlights one subject, in cluster number 3, with a higher factor value than anyone else. This indicated that this subject had relatively high overall early morning STAI scores. Furthermore, this subject was probably the cause of the apparently high STAI scores in the 40's group seen in Figures 25a & 25b.

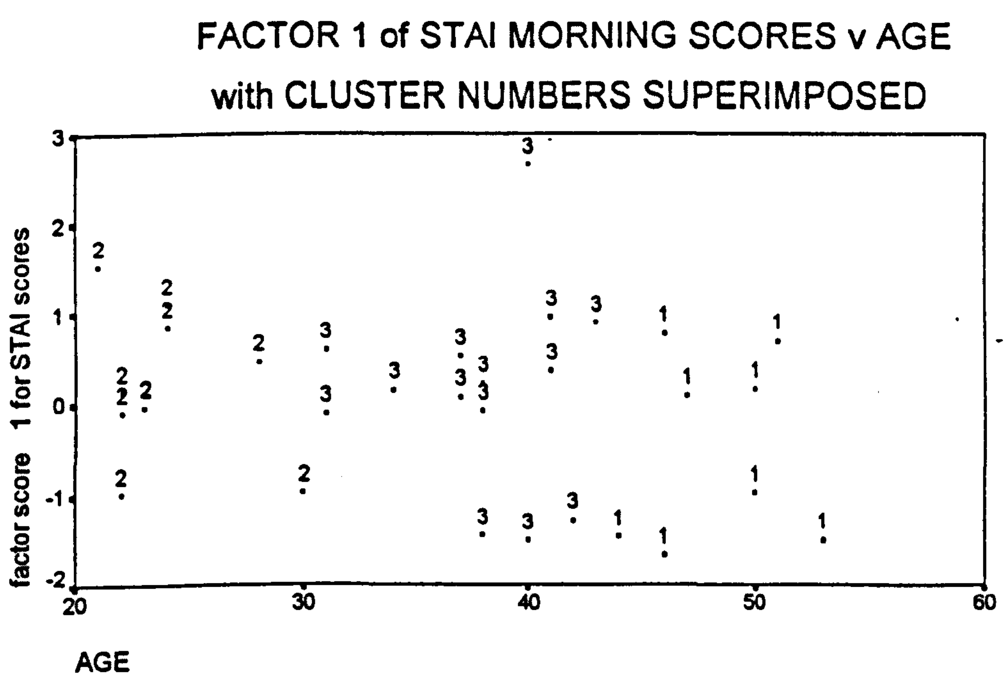


Figure 26
STAI morning factor values, as derived from PCA, versus age with cluster numbers superimposed (Imported from SPSS for Windows v 6.0.)

Although, unlike self-rated fitness and swimming ability, age did not produce significant correlations, it should be noted that the age recording was an absolute value, whereas the former were self-rated. The former could, therefore, have been a reflection of the individual's confidence in their own abilities, rather than a true indication of fitness and swimming ability.

When all the anxiety scores were considered together, the sequence in which events were conducted was found to have a significant effect ‡. Details of the analysis output are contained in Appendix G20. Furthermore, the coefficient value was negative, which demonstrated that STAI scores, as a whole, decreased as the week progressed. Seven different sequences of the combined course were observed (see Table 4).

GLM conducted on all state anxiety scores, revealed that there were significant differences among events ‡. Mean values for each event are shown in Table 9. As the number of combined subjects with complete STAI data sets, 26, was considerably smaller than the whole group, a Tukey's WSD test was not conducted.

Table 9
Mean STAI values, according to event, for all 47 combined subjects

Event	Mean	Standard deviation
Enrolment	38.15	10.63
Morning 2	30.72	7.91
Morning 3	29.47	8.28
Morning 4	30.80	9.93
Morning 5	28.45	6.69
HUET	42.26	12.02
Abandonment	39.31	11.27
Fire training	40.77	10.38
TEMPSC	32.51	7.77

The highest scores were recorded before the HUET, followed by the pre fire training and pre abandonment scores (see Figure 26a). Regarding the early morning STAI scores, the general impression from the combined scores was that, following the high enrolment value, the morning scores dropped to a steady plateau.

As with the refresher scores, analysis was conducted using a code for each event and sequence combination (see Appendix G21). The effect of sequence and event considered together was found to be significant ‡. This indicated that there were significant differences among the STAI scores recorded on different days. Effect values are shown in Table 10. The combinations of event and sequence were considerably more complex than that seen in the refreshers,

p-value <0.1 †; <0.05 *; <0.01 **; <0.001 ‡

compare with Table 7. Orthogonal contrasts were therefore not conducted. Thus, where the specific differences lay was not determined.

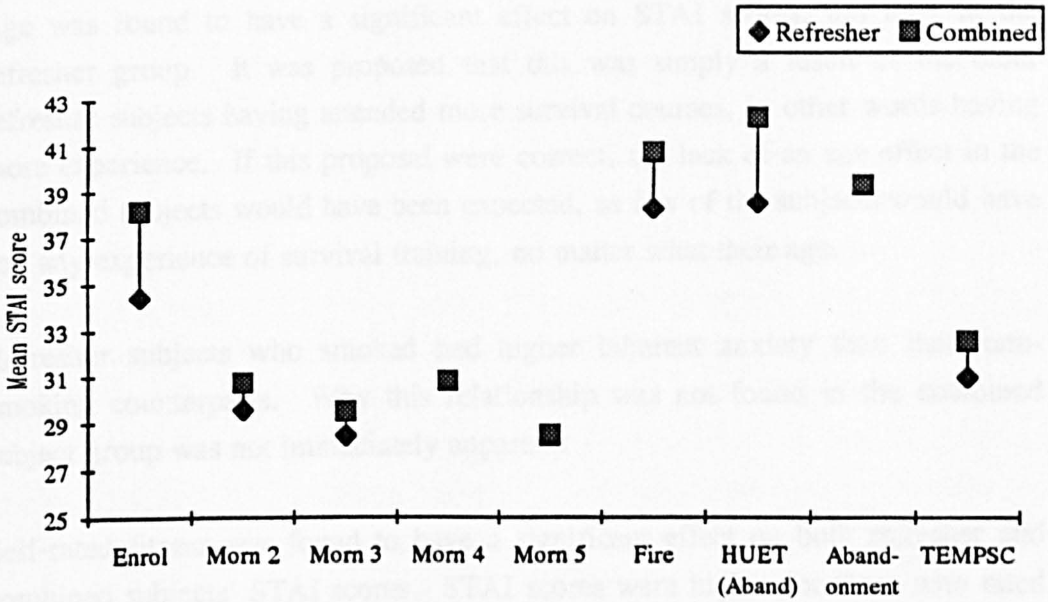


Figure 26a
Comparison of mean refresher and combined state anxiety scores

Table 10
Combined STAI effect values according to event and sequence of completion

	Sequence of completion								
Event	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Enrol	38.15								
Morn 2		35.55	30.52						
Morn 3				28.67	28.81				
Morn 4						31.94	28.01		
Morn 5								28.29	
HUET		43.37		40.43	44.78	41.47	37.88		47.57
Abandon		42.72		38.39		38.83	45.54		31.88
Fire			45.68		49.57		41.67		38.87
TEMPSC		36.85			28.21				30.70

The main reason why Table 10 was more complex than Table 7 was that, unlike the refresher course, the fire fighting training was completed over 2 days in the combined course. The single, representative, fire training event investigated occurred on day 2 of the combined course fire training. If subjects completed the fire training at the start of the course, the first STAI was completed at enrolment, the second on the morning of day 2, and the third prior to the fire training event. If subjects did not undertake the fire training at the start, the first STAI was completed at enrolment, the second prior to the event on day 1, and the third on the morning of day 2. This resulted in the morning STAI scores from days 2, 3 & 4 being completed at 2 different points in the overall sequence. Full investigation of the sequence effect would therefore not be possible if the day of completion only was considered.

4.4.3 Comparisons of refresher and combined subjects' STAI results

Age was found to have a significant effect on STAI scores, but only in the refresher group. It was proposed that this was simply a result of the older refresher subjects having attended more survival courses, in other words having more experience. If this proposal were correct, the lack of an age effect in the combined subjects would have been expected, as few of the subjects would have had any experience of survival training, no matter what their age.

Refresher subjects who smoked had higher inherent anxiety than their non-smoking counterparts. Why this relationship was not found in the combined subject group was not immediately apparent.

Self-rated fitness was found to have a significant effect on both refresher and combined subjects' STAI scores. STAI scores were higher for those who rated themselves less fit.

Unlike refreshers, when all the anxiety scores were considered together, the sequence in which events were conducted was found to have a significant effect on combined subjects' STAI scores. This effect of decreasing STAI scores over the duration of the week, may not have been detected in the refreshers because the course was just 3 days in length.

In Figure 26a, all the overall combined scores can be seen to be higher than the comparable refresher scores. It was also interesting to note that the final morning scores, i.e. morning 3 for refreshers and morning 5 for combineds, resulted in virtually the same score.

4.5 Relationships among STAI Scores, Evaluations of the Course and Outcome Perceptions

Analyses were conducted to determine if subjects' perceived self coping abilities were reflected in their anxiety scores. This took the form of one-way ANOVA, with Tukey's paired tests. The latter were conducted to a 5% significance level. Analyses were carried out between responses to the post activity evaluation questionnaires and the relevant state anxiety inventory scores, and between the perceived outcome responses and the relevant state anxiety scores.

4.5.1 Relating to HUET and abandonment to life raft training

The Tukey's test indicated that the mean state anxiety score of those refreshers who rated general anxiety as the most difficult aspect of the HUET to cope with, 46.7, was close to being significantly higher † than the anxiety score of those who rated swimming, breath holding, seat belt release, and finding the exit, considered together, 35.6. The former group were also close to significantly higher † than those who rated disorientation, 36.4, but not different from those who rated remembering instructions. There were, however, only 2 refreshers who found remembering instructions the most difficult aspect. No connection was found between refreshers pre-HUET anxiety scores and their rating for satisfaction of coping with the HUET training. Following a Tukey's comparison test, a significant difference was found, however, between the scores of those who felt more capable of coping with a helicopter ditching, 32.0, and those who felt no change, 47.0, following training. Thus, individuals with lower pre-HUET anxiety scores demonstrated greater improvements in self-coping ability, than those with higher pre-HUET anxiety scores. A relationship was also found between trainees' confidence in helicopter flight, following training, and their anxiety scores, though only at the 10% level. Pre-HUET anxiety scores were found to gradually increase as confidence in helicopter transport decreased.

On assessing combined subjects' data, significant differences in anxiety scores were found according to how satisfied subjects were with the way they coped with the HUET training. According to the Tukey's paired comparison test, those who were somewhat satisfied with the way they coped, scored significantly higher, 65.7, than those who coped well, 43.6, and than those who coped very well, 39.0. No significant effects were discerned accompanying changes in capability of coping with a helicopter ditching, nor with changes of confidence in helicopter transport.

Significant differences were found on relating combined subjects' anxiety scores prior to the abandonment to life raft with how well subjects felt they had coped with the exercise. A Tukey's test demonstrated that those who were very well satisfied with the way they had coped scored significantly lower, 32.9, than those who had coped well, 42.9. No relationship was found between pre-abandonment anxiety scores and perceived ability of coping with emergency evacuations in future. Further details of the statistical output pertaining to the above are contained in Appendix G22.

4.5.2 Relating to fire training

As very few individuals rated general anxiety as the most difficult aspect of the fire training, no correlations were conducted between these responses and the fire training anxiety scores. For refreshers, a Tukey's test demonstrated that those who were very well satisfied with the way they had coped with the fire fighting training, scored significantly lower, 34.4, than those who were somewhat satisfied, 48.8. A significant difference was also found in the combined subjects' responses *. Those who felt very well satisfied with the way they had coped scored significantly lower, 37.4, than those who felt they had coped well, 45.9, according to a Tukey's comparison test. Pre-fire training anxiety scores were not found to be related to perceived future ability of coping with a fire for refresher or combined subjects. See Appendix G23 for details of the statistical output.

4.5.3 Relating to TEMPSC training

Only one subject rated general anxiety as the most difficult aspect of the TEMPSC training to cope with. ANOVA was therefore not conducted between these responses and the TEMPSC anxiety scores. Satisfaction with how well subjects coped with the TEMPSC training was analysed, however, and significant differences were found. A general trend of increasing anxiety scores, with decreasing satisfaction in level of coping was observed in the refresher results. The Tukey's test indicated that those who were very well satisfied scored significantly lower, 28.1, than those who were somewhat satisfied, 39.7. A similar result was found in the combined data. Those who felt very well satisfied with the way they had coped scored significantly lower, 29.8, than those who were well satisfied, 35.6. Details of the statistical output are contained in Appendix G24.

4.6 Personality Scores

The two personality questionnaires administered were Rotter's Locus of control scale, and Zuckerman's Interest and Preference test, or Sensation Seeking Inventory. The refresher and combined subjects' scores for these scales are presented in Table 11.

The scores in Table 11 were correlated against age. It was found that older subjects were significantly more internally oriented in both the refresher and combined subject groups*. Significant correlations with age were only found in the disinhibition subscale of the Interest & Preference test *. Older subjects had lower disinhibition scores. The reference values in Table 11, showed that the subject population in this study had personality scores comparable with other local populations. Print-outs of the statistical tests conducted are contained in Appendix G25.

Table 11

Refresher and combined subjects scores of personality on the Locus of Control and Interest & Preference Test questionnaires

Questionnaire	Refresher		Combined		Reference values
	Mean	St dev	Mean	St dev	
Locus of Control	13.2	2.96	12.2	4.6	12.2*
Interest & Preference:					
Total	21.6	6.7	21.2	6.0	22.4§
Thrill & adventure seeking	6.8	2.6	6.6	2.4	7.1
Experience seeking	5.3	1.8	5.2	1.9	5.5
Disinhibition	5.5	2.4	5.7	2.2	5.9
Boredom susceptibility	4.0	2.1	3.8	2.1	4.0

A low locus of control score is indicative of internal orientation, while a high score is indicative of external orientation (see section 3.1.2).

** Offshore workers (Sutherland & Cooper, 1986)*

§ University of Aberdeen undergraduates (Blackman, in Zuckerman, 1979)

No consistent correlations were found between the two personality questionnaires. This agreed with Zuckerman's findings in American college students (1979).

4.7 Discussion of Questionnaire Results

4.7.1 Course Specific Questionnaires

4.7.1.1 Pre-course perceptions

The majority of refreshers had experience of working offshore, and of all four of the training activities considered in detail in the study. Although almost half of the combined subjects had worked offshore, generally less than one third had experience of any of the four exercises. The self-rated fitness and swimming ability profiles were similar for refresher and combined subjects, with a general bias towards an "adequate" level.

At the start of the course subjects perceived that the HUET and fire fighting training would be the most difficult. The HUET was found to be especially prominent within the combined group. It thus seemed likely that apprehensions were fostered before the course. Some means of reducing these anxieties would seem appropriate.

4.7.1.2 Post-event evaluations

Out of the possible range of difficulties, it was the physical, in the form of smoke, as opposed to the psychological aspects that were felt to be difficult within the fire training. That smoke was rated as the most difficult was reflected in the exercises that were perceived to be the most difficult. Any modifications to training would therefore seem most appropriately applied to the smoke.

Regarding helicopter underwater escape training, disorientation proved to be the major source of difficulty for both refresher and combined subjects. As disorientation appeared so prominently, and was experienced by trainees who had undertaken the training previously, as well as those new to the HUET, perhaps it should be given more consideration within the training schedule.

The responses to the life raft abandonment did not show any particular source of difficulty, though tasks such as entering and righting the raft and climbing scramble nets were clearly found to be physically demanding. On considering fitness, those refreshers who rated the scramble net as most difficult, also rated themselves as less fit, compared to the other subjects' self-ratings. The possibility that fitness could influence coping ability will be discussed later.

No particular problems were encountered with the TEMPSC training.

4.7.1.3 Perceived outcomes

Overall, there was a very positive picture of the subjects feeling more able to cope with various emergencies on completion of the course. Although the increases were most marked in the combined group, that the refreshers felt improvement implied that benefits could be obtained from repeating training. Additional benefits were seen in that improvements in coping ability were perceived as being able to be carried over to other emergency situations. This agrees with the suggestion that "self-efficacy gained from mastery in one situation generalises to other similar situations" (Smith, 1989). Self-efficacy relates to whether the individual perceives that he/she can respond to the stressful situation in such a manner as to result in a successful outcome (Bandura, 1977). Coping has been defined as "any response to external life strains that serves to prevent, avoid, or control emotional distress" (Pearlin & Schooler, 1978). High self-efficacy could therefore be considered as the potential for coping effectively.

In the emergency situation, higher self-efficacy could improve an individual's chances of escape over individuals with lower self-efficacy, even though basic abilities may not differ among individuals. This could arise from greater motivation and drive, as the individual with higher self-efficacy would have a stronger belief in their own abilities. Ultimately, therefore the aim of emergency response training is to improve the trainee's perception of self-efficacy regarding the particular emergency situation. This has also been referred to as developing positive response outcome expectancies (Hytten *et al*, 1989, Bolles, 1972), though the two concepts are different. Developing positive response outcome expectancies involves acquiring the knowledge that a certain response will lead to a positive outcome, without necessarily being able to carry out that response. An individual with high self-efficacy will, however, believe in their own ability to carry out the required response. The means by which this is achieved can be described using Bandura's (1977) words:

> *"Persistence in activities that are subjectively threatening but in fact relatively safe produces, through experiences of mastery, further enhancement of self-efficacy".*

4.7.2 Factors Influencing STAI and Evaluation Questionnaire Responses

Anxiety scores were found to vary significantly among the different subjects, for both refresher and combined. This would normally be expected, especially for a population taking part in a demanding course.

An age related decrease in anxiety was observed in refresher subjects when all STAI scores were assessed together. It was postulated that this could have been a result of older refreshers having more experience of survival training than their younger counterparts. As referred to earlier, stress induction could result from discrepancies between demand and the individual's self-perceived abilities (Cox, 1985), or imbalances in the "demand-capacity ratio" (Battman, 1989). It has been suggested that control can improve this ratio, therefore reducing the likelihood and/or extent of stress responses (Thompson, 1981). Furthermore, as a component of control, ability "may be enhanced on a long term basis due to learning by experience" (Battman, 1989). Thus, the additional experience of older trainees could have resulted in an increased feeling of control and ultimately decreased anxiety. Yet, although this age effect was considered to be primarily the result of experience, age related changes in state anxiety scores have been detected previously (Spielberger *et al*, 1983). It was found that, within a normal population, scores for those over 50 years tended to be lower in both state and trait anxiety. Generally, however, Spielberger found resting values to be notably constant across a wide age range.

Despite the reduction in anxiety felt by the older refreshers, within the responses to the perceived outcome questionnaire, there was a general trend of older individuals experiencing greater physical and emotional demands than expected. This suggests that older individuals did find the survival training more demanding, even though their manifest anxiety was lower. This was supported by the finding that refresher early morning STAI scores fell into two age related clusters. The older cluster had higher STAI scores. The morning STAI scores could be regarded as the basal anxiety level for the course. This would therefore provide a gauge of tonic activation, and an indicator of coping levels (Ursin, 1980). Thus, although older refreshers experienced less anxiety in relation to the individual events, the overall impact of the course was more demanding than in younger refreshers.

A positive relationship was found between smoking and level of state and trait anxiety, but only within the refresher group. No consistent smoking effect pattern was detected within the responses to the evaluation questionnaires, although the significant effects that were found indicated that smokers were less satisfied with the way they coped with training. The general impression was that smokers were likely to experience more anxiety, and cope less effectively with offshore survival training than non-smokers. Furthermore, trait anxiety was higher amongst refreshers who smoked, paralleling the higher state anxiety, and lower perceived coping abilities. Support was thus found within these results for the suggestion that high trait anxiety, with the implied increased susceptibility to developing state anxiety, may result in individuals experiencing greater amounts of, and more intensive stress (Strelau, 1989). As the link proposed by other authors between trait and state anxiety was restricted to situations of "an ego-threatening nature", it would seem that the training observed in the current study incorporated elements of such a situation (Kendal, 1976).

Previous studies have reported either a decrease or no change in anxiety levels following smoking of a cigarette (Pritchard *et al*, 1995). Individuals in the current study did not have the opportunity to smoke before the training events, therefore when anxiety was being measured. It might thus have been expected that whether subjects were smokers would not affect anxiety scores. As stated, however, a positive correlation was found between state anxiety and smoking. It is suggested that this correlation was not a result of cigarette smoking *per se*, but rather some other factor that may even predispose individuals to become smokers. Indeed, trait anxiety was also found to be elevated in refreshers who were smokers. It seems possible that these individuals with relatively high trait anxiety may continue to smoke partially because it reduces their state anxiety levels, while individuals with lower trait anxiety do not have this drive to smoke.

For all subjects, lower self-rated fitness was related to higher anxiety scores. Higher anxiety scores can ultimately be considered as an indication of a lower coping ability. These results therefore parallel the work of other authors whose findings support the proposal that higher levels of physical fitness contribute to the ability to cope more efficiently (Brooke & Long, 1987). Autonomic recovery from psychosocial stressors has, for example, been found to be faster in individuals undergoing an exercise training program as compared to less aerobically fit, untrained individuals (Keller & Seraganian, 1984). It was suggested that "this quicker autonomic recovery may allow the aerobically fit to cope more effectively with emotional stress". The ratings of fitness referred to here were, however, the individual's perceived fitness level, rather than their actual physical fitness. Yet, these recordings may have been suitable in this instance, as both self-rated fitness and anxiety involved the individuals' perception of themselves. Stress and anxiety have been argued as being related to the individual's perception of their own abilities (Cox, 1985). Furthermore, many studies of the link between physical fitness and coping ability and/or responsivity to stress have been criticised because of their use of ineffectual controls or inclusion of confounding factors within the subject group. The use of self-ratings of fitness may therefore present an appropriate indicator of fitness for studies where self-perceptions are considered to be important.

Swimming ability was found to be related to combined subject's anxiety scores, non-swimmers demonstrated the greatest pre-event anxiety. This was not entirely surprising, given the amount of water based activities, and the combined subjects' lack of previous experience, and therefore susceptibility to exaggerated accounts of the course content.

For all but the refresher post HUET evaluation, greater self-satisfaction with the way individuals coped with the training was found to be associated with lower pre-event anxiety scores. Also, refreshers who perceived the greatest improvements in their ability of coping with a helicopter ditching in future, and increased confidence in helicopter transport, scored the lowest in the pre-HUET anxiety. This agreed with the findings from a study on underwater escape training at NUTEC, where "Perceived training effect was found to be inversely related to anxiety during training" (Hytten *et al*, 1989).

4.7.3 STAI Scores

Analysis of the refresher anxiety scores showed that the pre-HUET and pre-fire training scores were significantly greater than all the other recordings, except the enrolment anxiety score. A very similar pattern was established in the combined group, though their pre-event and enrolment scores tended to be higher than the equivalent refresher recordings. Spielberger, referring to recordings from over 1300 American working males, cited mean resting anxiety values of around 35. It would thus seem that the mean values obtained early in the morning of around 30 and those prior to the less demanding exercises were reasonably low (see Tables 5 & 9). The HUET, fire fighting, and enrolment scores, and abandonment for the combined subjects, were within the range of values obtained from individuals taking part in free-fall lifeboat training (Hytten *et al*, 1990). Mean anxiety scores ranged from 35.5 (± 6.7) on the first fall up to 37.4 (± 11.3) on their third fall. Overall anxiety values in the present study were found to be elevated prior to the more demanding exercises, but not any more than has been observed in other related training situations.

4.7.4 Pre-Course Apprehensions and Anxiety Reduction Techniques

That the higher of the anxiety scores were further elevated in the combined group, and that the morning values demonstrated an initial peak, then dropping to a plateau, suggests that a large contributor to the anxiety experienced by individuals new to training resulted from pre-course apprehensions. Further indications that apprehensions built up prior to the course contributed significantly to elevating anxiety scores, were found when sequence effects were investigated within the combined data. A significant sequence effect was detected that indicated that the combined trainees were at their most anxious at the beginning of the course.

The possibility of reducing anxiety by providing trainees with additional information before starting the course is discussed in Section 5.4.1. Additionally, trainees could be given instruction in dealing with anxiety or the effects of stress, for example, Stress Inoculation Training (SIT) (Meichenbaum & Jaremko, 1983), Biofeedback or Relaxation techniques. When applied in other related situations, SIT has included an introduction to what stress and stress responses are (Hytten *et al*, 1990). Furthermore, instruction was provided on controlled breathing techniques and the use of positive self-statements, and individuals received detailed information on what to expect during the situation. Biofeedback refers to "methods for learning to control internal physiological events using immediate feedback from electronic sensing devices" (Beatty, 1983). It might therefore be envisaged that trainees could, for example, control a racing heart beat that had resulted from an anxiety provoking situation. However, there is some doubt whether this technique is any more effective than simple relaxation instructions. Alternatively, relaxation training aims to instil awareness of the physical sensations of muscular tension and muscular relaxation. The techniques provide relief from muscular tension, and enable individuals to detect the physical signs of anxiety. Individuals can therefore identify anxiety provoking situations and act to reduce anxiety levels.

5 Results and Discussions - Physiology

5.1 Analysis of the Physiological Reactions - Heart Rate

Heart rate (HR) data were downloaded directly into a computer without any significant problems. Codes, which had been established for subjects, individual course days, and activities, were adapted for use in labelling heart rate recordings. Heart rate recordings could be viewed as continual traces. A trace from one subject's exercise test is shown, Figure 28, as well as typical traces for each of the selected exercises, e.g. Figure 29. The sections of these traces that were deemed the most important during the pilot study (see Section 3.4.1), and therefore those analysed most closely, are described. Averages were calculated for before, during, and after the four training exercises. Resting heart rate and the level attained at each workload were calculated from the exercise test. The minimum period for analysis was set at 1 minute.

Means were calculated for each interval, considering refresher and combined subjects separately, and according to age group. Values for each of the training exercises are shown in graphical form in Appendix H. Whole group means are also given in Tables 12 to 15.

Subsequently, t-tests of the paired differences between the pre-event recording, treated as the baseline, and the during and post-event heart rates were conducted for each event. Whether differences were significant or not, and how significant depended upon the p-value determined from the t-tests. The following groupings of p-values are referred to in the results with their respective symbols, p less than: 0.1 †, 0.05 *, 0.01 **, or 0.001 ‡. These values represent increasing levels of significance. See Appendix I for details of t-tests and actual p-values.

5.1.1 Aerobic fitness test

The trace in Figure 28 shows that the heart rate reached a plateau at each of the workloads. Means were taken from these "steady state" periods. Mean resting heart rates for refresher and combined subjects are plotted according to age group in Figure 27.

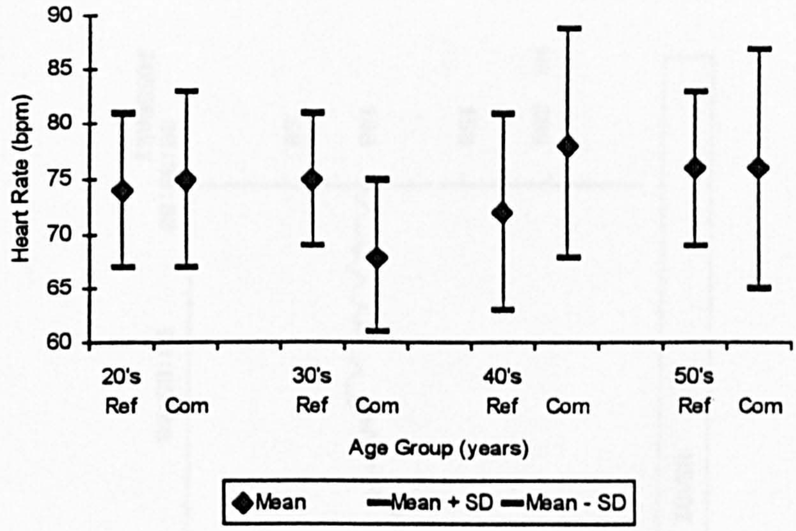


Figure 27

Combined and refresher subjects' resting heart rate means ± SD, recorded prior to the exercise test, and divided according to age group

From Figure 27 it can be seen that resting heart rate values were very similar, both between the two training groups, and among the different age groups. The combined 30's appeared to have lower mean values. One-way ANOVA, of heart rate against age code, did demonstrate that the combined 30's group were close to being significantly lower in resting heart rate than the combined 40's group †. None of the other groups, however, were significantly different. There may have been some factor, other than age, that had resulted in these differences. This possibility seems likely given that age is a continuous variable and no continuous trend effect was observed. Overall, it appeared that age had no significant effect on resting heart rates for this sample population. This had implications for the changes in heart rate seen during the training course. Specifically, when considering the levels of heart rate attained during the training, account did not have to be taken for initial differences in resting heart rate due to age.

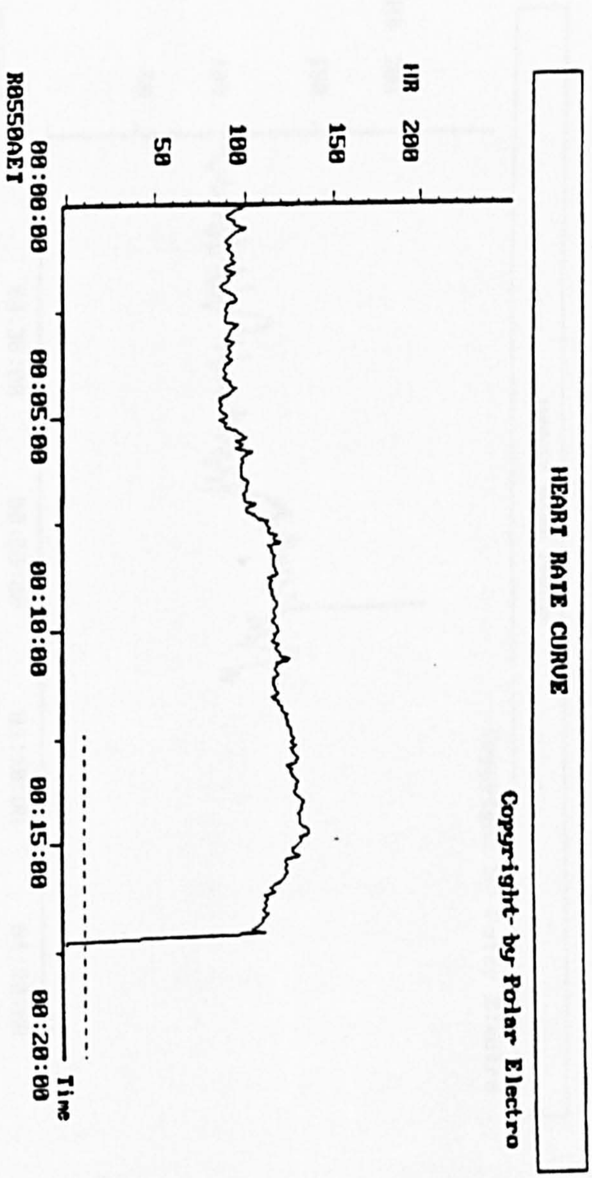


Figure 28

Heart rate trace from one subject during the aerobic fitness test

During the first 5 minutes of the trace the subject was seated at rest. The first step, up to 7½ minutes, represents the time the subject spent cycling with no resistance on the ergonometer flywheel. This subject's initial work load was 50 watts, the third section in the trace, during which a plateau was reached within the first minute. The last workload was 75 watts, up to approximately 16 minutes. This last workload resulted in a more gradual increase to a plateau. The final section shows the subject's heart rate during the recovery period.

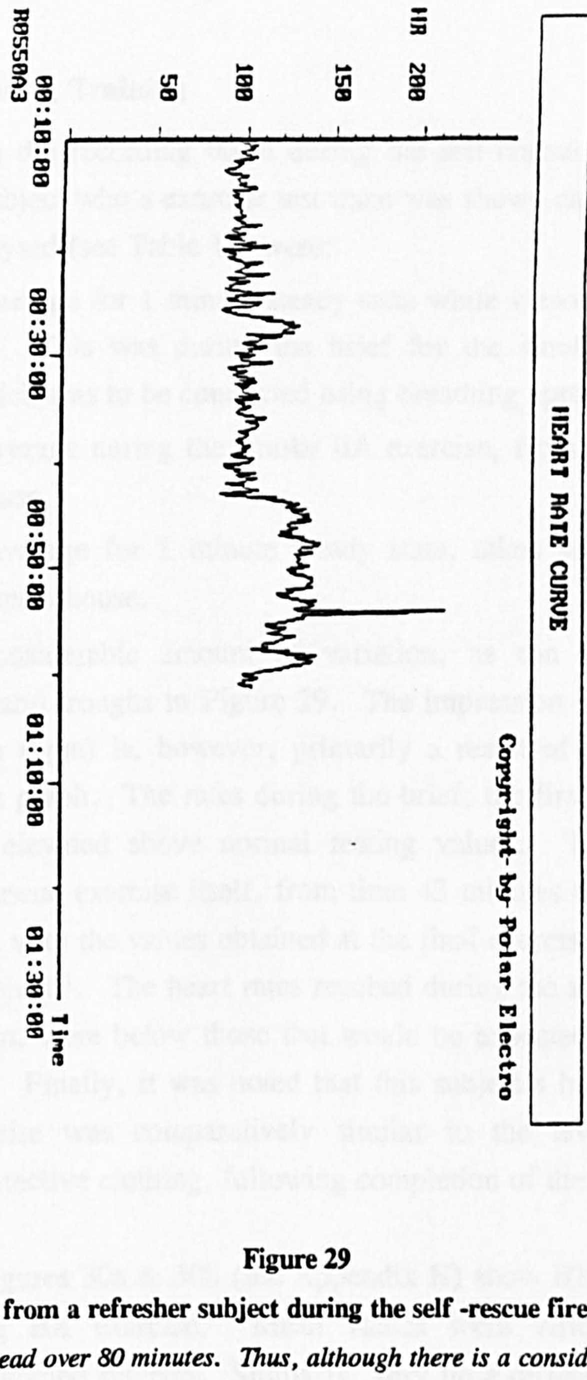


Figure 29

Heart rate trace from a refresher subject during the self -rescue fire training exercise

This trace is spread over 80 minutes. Thus, although there is a considerable amount of variation, the initial impression of rapid changes in heart rate is primarily a result of the relatively large time scale. The first 10 minutes of the trace, from time 10 to 20 minutes, represent the subject's heart rate during the smoke house brief. The trainees then left the classroom and assembled outside of the smokehouse. This subject undertook the self-rescue exercise from time 43 to 50 minutes. An initial rapid increase in heart rate was observed. Following completion of the exercise, trainees removed their protective clothing. This subject's heart rate remained elevated during this time. The spike seen at time 55 minutes was taken to be an artefact, possibly due to a sharp knock to the watch as the subject changed out of the protective clothing.

5.1.2 Fire Fighting Training

Figure 29 shows the recording taken during the self-rescue brief and exercise from the same subject who's exercise test trace was shown earlier. The sections of heart rate analysed (see Table 12) were:

- Heart rate average for 1 minute steady state while viewing the smokehouse layout slide. This was during the brief for the smokehouse self-rescue exercise, which was to be conducted using breathing apparatus (BA).
- Heart rate average during the smoke BA exercise, from entering to exiting the smokehouse.
- Heart rate average for 1 minute steady state, taken within 3 minutes of exiting the smokehouse.

There was a considerable amount of variation, as can be seen from the numerous peaks and troughs in Figure 29. The impression of rapid changes in beats per minute (bpm) is, however, primarily a result of the relatively long time scale on the graph. The rates during the brief, the first 10 minutes of the trace, appeared elevated above normal resting values. The values attained during the self-rescue exercise itself, from time 43 minutes to time 50 minutes, were comparable with the values obtained at the final exercise test workload, 75 watts for this subject [1]. The heart rates reached during the self-rescue exercise, mean of 129 bpm, were below those that would be expected during an aerobic exercise session. Finally, it was noted that this subject's heart rate during the self-rescue exercise was comparatively similar to the level reached whilst removing the protective clothing, following completion of the exercise.

The graphs in Figures 30a & 30b (see Appendix H) show HR means during the self-rescue using BA exercise. Mean values were virtually identical for refresher and combined subjects. Similarly, very little difference was discerned among the different age groups. The 50's groups did appear slightly lower. The 50's groups did contain smaller numbers, however, so the apparent difference may have been artificial.

[1] *If the subject were to commence on a fitness program, using Karvonen's formula (see Lamb, 1984), he would be advised to aim for a minimum training heart rate of 147 bpm. (This was calculated with the subject's resting heart rate of 74 bpm, and a maximum heart rate of 220 minus age, therefore 196 bpm. Minimum training heart rate equals the resting heart rate plus 60% of the difference between the maximum and resting heart rates.)*

Generally, the pre-event HR values were slightly elevated compared to the resting recordings. A large increase occurred during the self-rescue exercise itself. Heart rates fell after subjects had exited the smokehouse, though not returning to the baseline level. A return to baseline would not normally have been expected so soon after completion of the exercise.

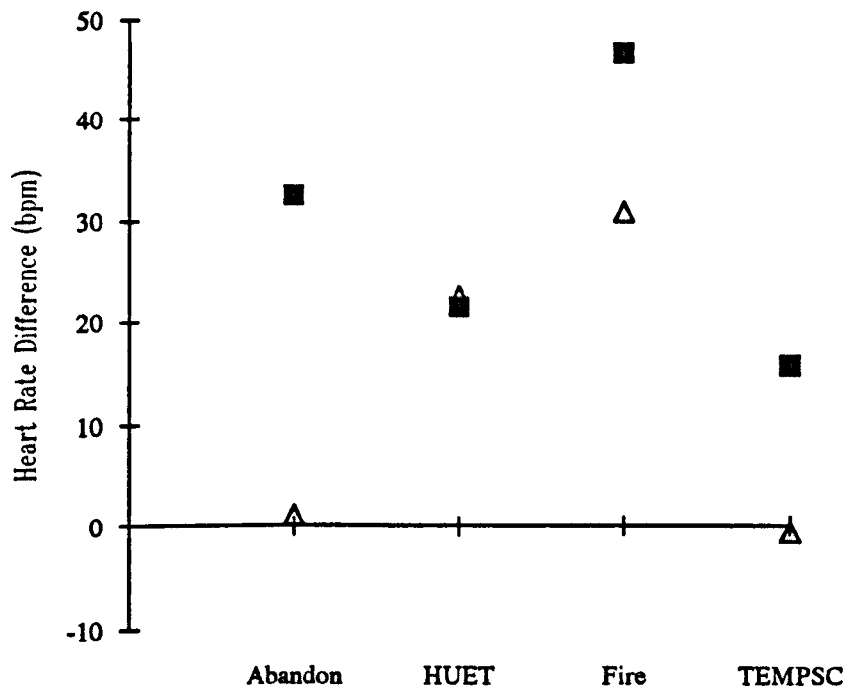
Paired difference t-tests showed that both the during and post event values were significantly higher than the pre-event heart rates ‡ (see Appendix I for details of the statistical output). The mean increases were very similar for refresher and combined subjects. Of all the events the largest changes were recorded during the self-rescue training exercise (see Figures 31a & 31b).

Table 12

Whole group mean heart rates during the self-rescue from the smokehouse, using BA

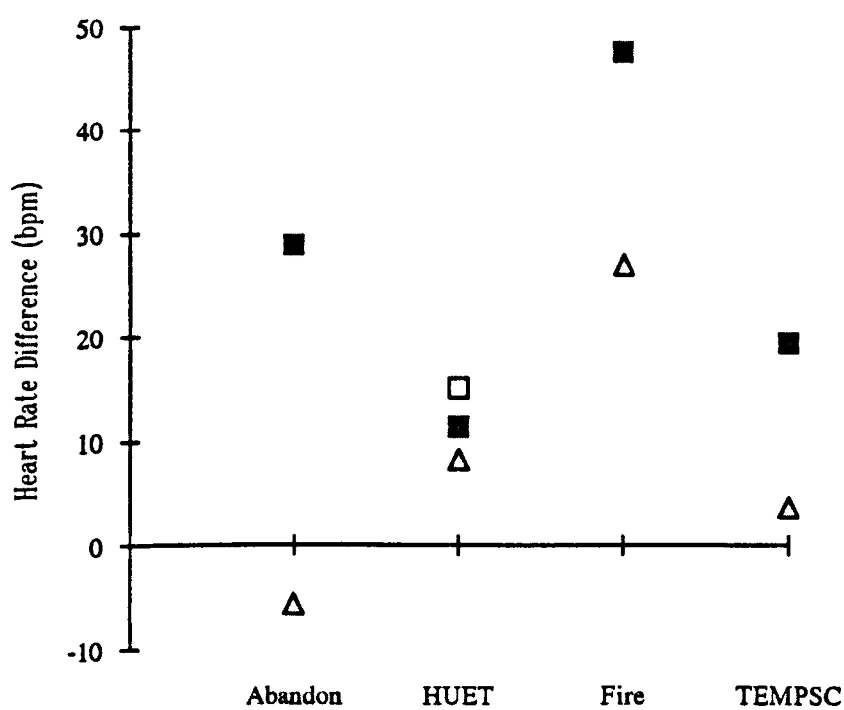
Stage of activity	Refresher HR (bpm)			Combined HR (bpm)		
	Mean	Stan devn	No of subjects	Mean	Stan devn	No of subjects
Fire exercise:						
Before	92	15	48	92	13	34
During	139	19	48	142	16	43
After	123	20	48	122	15	43

p-value <0.1 †; <0.05 *; <0.01 **; <0.001 ‡



Key: ■ HR during event minus HR before event
Δ HR after event minus HR before event

Figure 31a
Refresher subjects' mean paired heart rate differences



Key: ■ HR during event minus HR before event
□ HR during capsize exercises of HUET minus HR before
Δ HR after event minus HR before event

Figure 31b
Combined subjects' mean paired heart rate differences

5.1.3 HUET

As the refresher and combined courses differed in the extent and order of the HUET exercises, traces from subjects on each of these courses are shown (see Figures 32a & 32b). Note that the time scales are different, also, unlike the refresher course, the HUET exercises on the combined course were split into two sessions, with trainees waiting at the pool side in between. The slow and fast capsizes occurred at 46 and 48 minutes respectively for the combined course subject (see Figure 32a). The time of the fast capsize coincided with the highest peak in HR for that subject. The surface impact simulation, the partial submersion, and the fast capsize occurred at 37, 39, and 42 minutes respectively for the refresher course subject (see Figure 32b). Peaks in that subject's HR were seen to correspond with the partial submersion and the capsize, both of which involved the subject being submerged.

The sections of heart rates analysed (see Table 13) were:

All subjects:

- Heart rate average over 5 minutes immediately after commencement of the HUET brief (this was not calculated during a video showing, nor during the demonstration of the impact position) - 'Brief'.
- Heart rate average over 1 minute steady state immediately prior to entering the water for the HUET exercises - 'Before'.

Combined subjects:

- Heart rate average during surface impact and partial submersion exercises, from entering the water to surfacing after the submersion - 'Upright exercises'.
- Heart rate average during slow and rapid capsizes, from entering the water to surfacing after the final exercise - 'Capsizes'.

Refresher subjects:

- Heart rate average during refresher HUET exercises, surface impact, partial submersion and rapid capsize, from entering the water to surfacing after the final exercise - 'Upright exercises and rapid capsize'.

All subjects:

- Steady state heart rate average immediately post HUET exercises - 'After'.

The graphs in Figures 33a & 33b, contained in Appendix H, show HR means during the HUET brief and exercises. Again values were very similar for refresher and combined subjects, although this was slightly less obvious than during the fire training due to the differences in HUET training procedures. Mean values obtained during the HUET brief appeared higher than the mean resting values calculated from the aerobic exercise test. This suggested that individuals experienced some kind of activation. As they were seated "at rest" at this time, it would appear that this activation was psychological. The post values did not appear to return to the baseline. This was explained by the fact that trainees were still in the water at the time of the post exercise recording. As the subjects were observed in a situation where training was taking place, the ideal "resting" post value could not be obtained.

Again paired difference t-tests demonstrated that the during and post event HR values were significantly greater than the pre-event HRs ‡ (See Appendix I). The mean increases appeared greater in the refresher group, though no direct statistical comparisons were made between the two groups due to the variations in the training program. The HRs attained by the combined subjects during the two capsizes were found to be significantly greater than those achieved during the surface impact and partial submersion **.

Table 13

Whole group mean heart rates during the HUET exercises

Stage of activity	Refresher HR (bpm) Mean	Stan devn	No of subjects	Combined HR (bpm) Mean	Stan devn	No of subjects
HUET:						
Brief	82	11	44	88	14	42
Before	95	16	49	104	15	46
Upright exercises				116	13	42
Capsizes				119	13	42
Upright exercises & rapid capsize	116	14	45			
After	119	15	42	112	19	39

p-value <0.1 †; <0.05 *; <0.01 **; <0.001 ‡

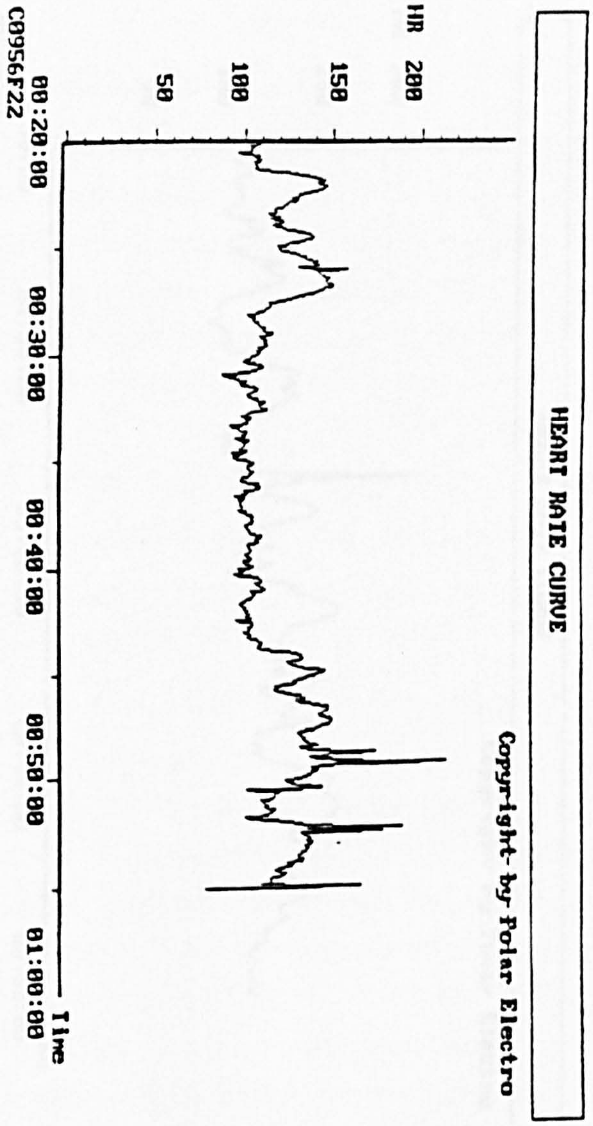


Figure 32a

Heart rate trace from one subject during the combined HUET exercises

The increases at the start of the trace correspond to the subject descending a set of stairs. This was followed by a period of relatively constant heart rate as the subject waited at the poolside, prior to entering the pool at time 44 minutes. As the combined course was split into two sessions, with trainees waiting at the pool side in between, the recording during the surface impact and partial submersion are not shown for this subject. The slow and fast capsizes occurred at 46 and 48 minutes respectively. A rapid rise in heart rate, the smaller of the two peaks just before 50 minutes, occurred as the subject swam to the surface after the rapid capsize.

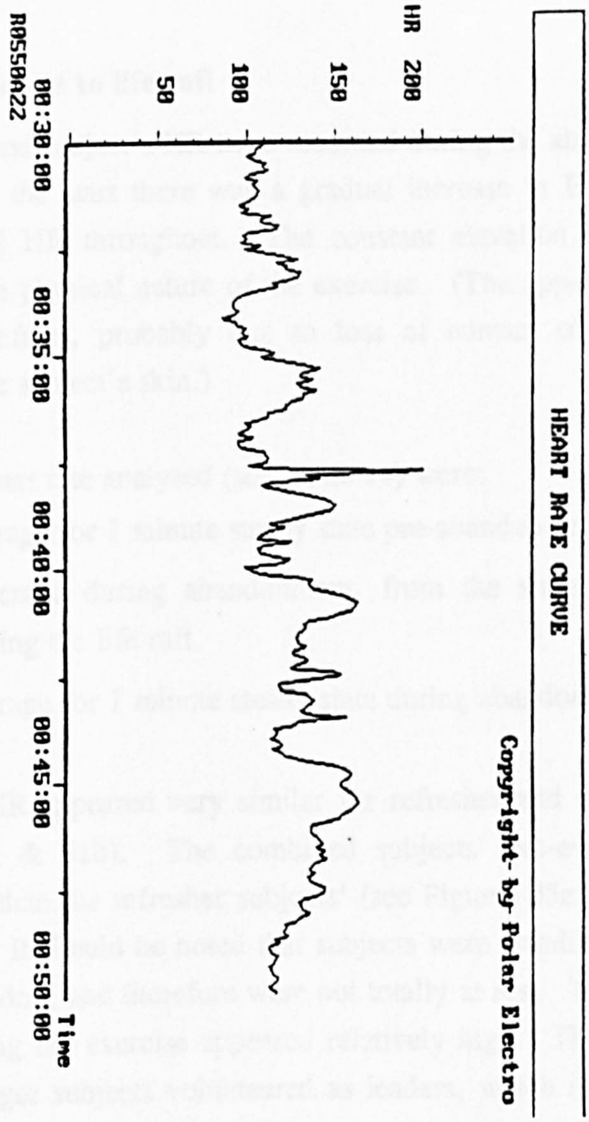


Figure 32b

Heart rate trace from one subject during the refresher HUET exercises

The trace shows the subject's HR on entering the water at time 33 minutes, a general elevation in heart rate occurred at this time. HR then fell while the subject waited to enter the HUET. The surface impact simulation, the partial submersion, and the fast capsize took place at 37, 39, and 42 minutes, respectively. HR peaks in the trace thus corresponded with the partial submersion and the capsize, both of which involved the subject being submerged. The increased HR around time 45 minutes was a result of the subject exiting the water and proceeding up a set of stairs to await the next set of exercises.

5.1.4 Abandonment to life raft

Figure 34 shows one subject's HR trace recorded during the abandonment to life raft exercise. At the start there was a gradual increase in HR followed by a relatively elevated HR throughout. The constant elevation could have been expected given the physical nature of the exercise. (The apparent drops in HR to zero were artefacts, probably due to loss of contact of the sport tester electrodes with the subject's skin.)

The sections of heart rate analysed (see Table 14) were:

- Heart rate average for 1 minute steady state pre-abandonment.
- Heart rate average during abandonment, from the siren sounding to the individual exiting the life raft.
- Heart rate average for 1 minute steady state during abandonment debrief.

The changes in HR appeared very similar for refresher and combined subjects (see Figures 31a & 31b). The combined subjects' pre-event means were, however, higher than the refresher subjects' (see Figures 35a & 35b, contained in Appendix H). It should be noted that subjects were standing whilst awaiting the signal to abandon, and therefore were not totally at rest. The combined 20's group's HR during the exercise appeared relatively high. This may have been because the younger subjects volunteered as leaders, which involved additional physical activities such as righting upturned life rafts, therefore resulting in higher heart rates.

The paired difference t-tests showed that post event HR values were lower than the pre-event HRs for combined subjects only ** (see Appendix I). This was probably a result of the apparently higher combined pre-event means. Such elevation may have been due to apprehension of the unknown on the part of combined subjects. The HRs during the event were significantly greater than the pre-event values for both refresher and combined subjects ‡.

p-value <0.1 †; <0.05 *; <0.01 **; <0.001 ‡

Table 14

Whole group mean heart rates during the abandonment exercise

Stage of activity	Refresher HR (bpm) Mean	Stan devn	No of subjects	Combined HR (bpm) Mean	Stan devn	No of subjects
Abandonment:						
Before	103	15	44	113	15	41
During	135	14	43	142	17	38
After	105	16	38	108	17	38

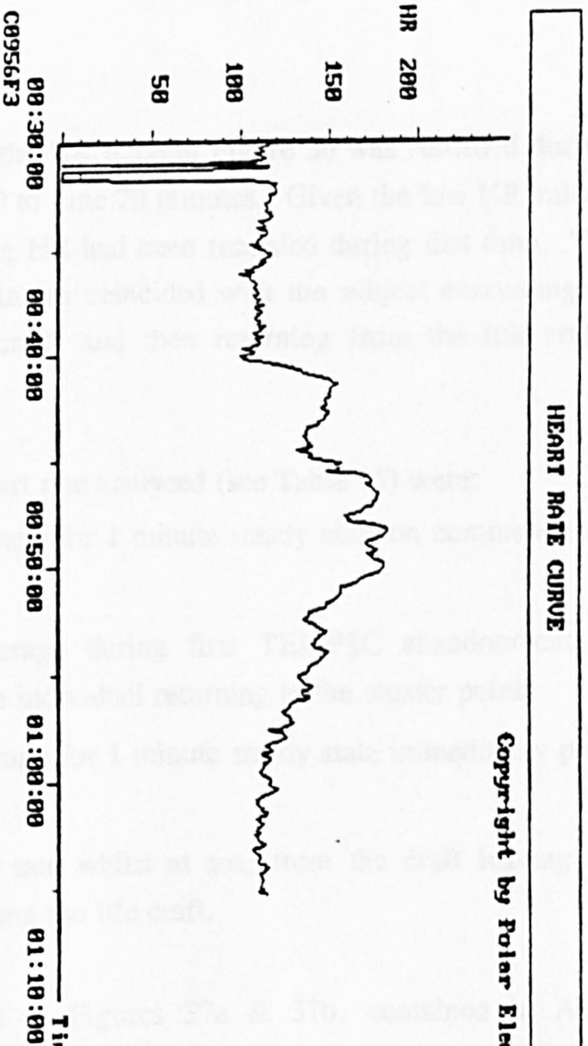


Figure 34

Heart rate trace from a combined course subject during the abandonment to life raft exercise

A briefing for the exercise was delivered, finishing at time 35 minutes. The siren signalling the start of the exercise sounded at time 41 minutes. An initial increase in HR occurred as the subject proceeded upstairs to the platform. The subject stepped off the platform at time 45 minutes, HR again rose as the subject swam to and boarded the life raft. The exercise was completed at time 54 minutes, when the subject exited the life raft and returned to the muster area for a debrief. (The apparent drops in HR to zero were artefacts, probably due to loss of contact of the sport tester electrodes with the subject's skin.)

5.1.5 TEMPSC

The initial part of the HR trace in Figure 36 was recorded during the TEMPSC brief, from time 10 to time 20 minutes. Given the low HR values it is clear that the subject's resting HR had been recorded during that time. The peaks seen at time 25 and 35 minutes coincided with the subject evacuating from the muster point to the life craft, and then returning from the life craft to the muster station.

The sections of heart rate analysed (see Table 15) were:

- Heart rate average for 1 minute steady state on commencement of TEMPSC brief.
- Heart rate average during first TEMPSC abandonment, from the siren sounding to the individual returning to the muster point.
- Heart rate average for 1 minute steady state immediately post first TEMPSC abandonment.
- Average heart rate whilst at sea, from the craft leaving the davits to the individual exiting the life craft.

The mean values in Figures 37a & 37b, contained in Appendix H, were obviously lower than the HRs elicited by the other three training activities. The before values were clustered around the resting HR means, as seen in Figure 27. According to the t-tests of paired differences, the HRs during the TEMPSC abandonment exercise itself increased significantly from the before values ‡ (see Appendix I). HRs were shown to have returned to the baseline following the exercise, as no significant difference was found between the before and after values. Generally, the HRs during the TEMPSC abandonment were low relative to what might occur in everyday activities such as walking up stairs.

p-value <0.1 †; <0.05 *; <0.01 **; <0.001 ‡

Table 15
Whole group mean heart rates during the TEMPSC abandonment exercise and at sea training

Stage of activity	Refresher HR (bpm) Mean	Refresher HR (bpm) Stan devn	Refresher HR (bpm) No of subjects	Combined HR (bpm) Mean	Combined HR (bpm) Stan devn	Combined HR (bpm) No of subjects
TEMPSC exercise:						
Before	80	14	46	80	12	41
During	95	13	47	97	12	40
After	80	16	45	81	16	40
TEMPSC at sea training	84	13	37	86	11	34

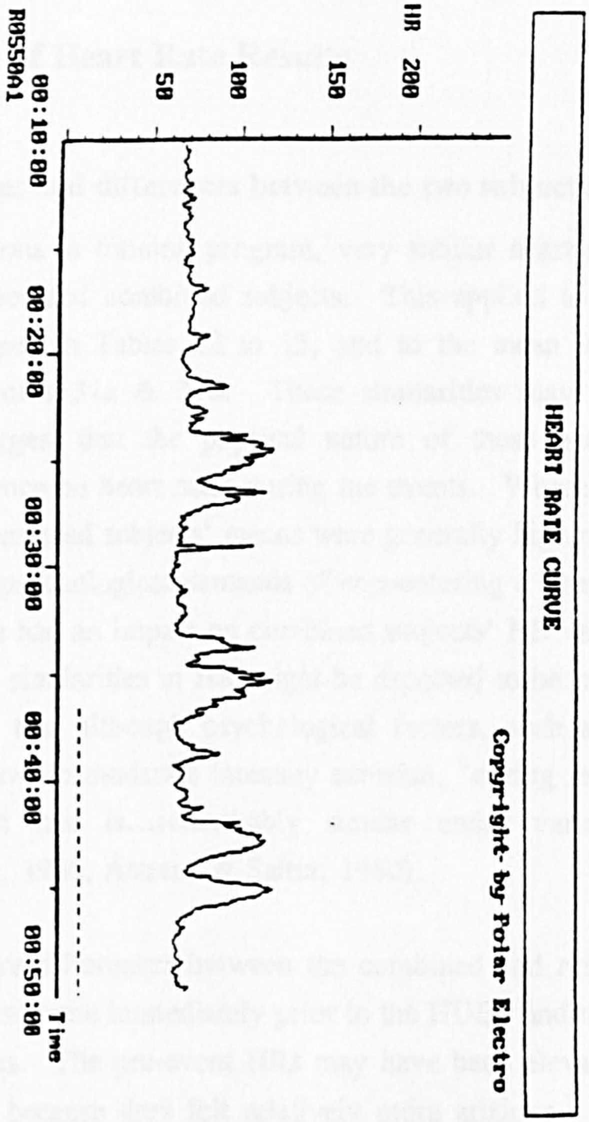


Figure 36

Heart rate trace from a refresher course subject during the abandonment to TEMPSC exercise

The TEMPSC abandonment brief, which finished at time 21 minutes, was delivered with subjects seated. This subject's heart rate increased following the sounding of the evacuation siren at time 24 minutes. Subjects then proceeded from the muster point to the TEMPSC, after donning a lifejacket. The peaks seen at time 35 minutes coincided with the subject returning from the life craft to the muster station. (The peak seen at time 29 minutes coincided with the TEMPSC being launched from the davits, and thus probably represents an artefact resulting from interference with the Sports Tester.)

5.2 Discussion of Heart Rate Results

5.2.1 Similarities and differences between the two subject groups

Despite the variations in training program, very similar heart rates (HR) were reached by refresher and combined subjects. This applied to both the whole group means as seen in Tables 12 to 15, and to the mean individual paired differences in Figures 31a & 31b. These similarities may well have been expected, and suggest that the physical nature of these exercises was the predominant influence on heart rates during the events. Where any differences were found, the combined subjects' means were generally higher. This suggests that the additional psychological demands of encountering a stressor for the first time may still have had an impact on combined subjects' HR values. For more demanding events, similarities in HR might be expected to be more likely since it has been stated that although psychological factors, such as anxiety, may affect HR during low to moderate intensity exercise, "during repeated maximal exercise the heart rate is...remarkably similar under various conditions" (Åstrand & Rodahl, 1986, Åstrand & Saltin, 1960).

The instances where differences between the combined and refresher subjects' overall HRs did arise were immediately prior to the HUET and the abandonment to life raft exercises. The pre-event HRs may have been elevated more in the combined subjects because they felt relatively more anxious. This possibility was supported by the fact that the combined subjects' mean HR was also slightly higher than the refreshers' during the classroom HUET brief. This occurred despite the brief being essentially the same for both courses. In addition, all subjects were seated throughout, it would therefore seem that the higher combined subjects' mean HR resulted from some greater psychological activation. Other studies have also investigated changes in physiological parameters prior to stressful events. In one such study, anticipation of the Trier Social Stress Test (TSST) was found to result in increases in HR from 70bpm to approximately 86bpm (Kirschbaum *et al*, 1993). These values are comparable with the mean HR values from the HUET brief, particularly in the combined subject group.

It is suggested that the relatively greater activation seen in the combined subject group could have been anxiety. Indeed, Figure 26a demonstrated that the largest difference in state anxiety scores between the refresher and combined subjects occurred before the HUET. During the refresher course, the abandonment immediately followed the HUET exercises, a pre-abandonment anxiety score was therefore not taken for refresher subjects. Thus no comparison could be made between the pre-abandonment state anxiety scores.

5.2.2 "Additional heart rate"

The phenomenon of the heart beating at a rate above that predicted from the oxygen consumption at the time is known as "additional heart rate" (Strømme et al, 1978). It seems likely that this may have occurred in some subjects during the HUET brief, given that subjects were seated at rest, and some subjects' HRs were well above the resting values recorded prior to the exercise test. No direct measurements of oxygen consumption (VO_2) were, however, made during the exercise test. VO_2 was not measured during the offshore training either, though it would not have been feasible to measure $\dot{V}O_2$ during some of the practical activities. The physical and psychological effects on HR could therefore not be separated. Distinction between physical and psychological factors, however, "is not easily established" (Rompelman *et al*, 1980). Future work could involve assessing oxygen consumption as well as HR during the HUET brief.

Another approach would be to take electromyographic measures from subjects' thigh muscles. This technique has been used to provide an indicator of the level of subject's physical activity (ACT), but only to the point of distinguishing between running and walking within subjects (Anastasiades & Johnston, 1990). It does not yet appear to be sufficiently precise to provide an "absolute measure of individual differences in physical activity". If the ACT index were calibrated against "energy expenditure", however, the authors suggest that field measures of heart rate could be adjusted according to the ACT measure, and thus enable estimation of the extent of additional heart rate. This would presumably have advantages because direct measurement of VO_2 in the field, as in the current study, can be impractical.

The mechanisms behind additional heart rate have not been entirely elucidated. In the case of the HR increases observed during the HUET brief, it might be proposed that subjects were concentrating on the brief, and the increases were a result of cognitive activation. On initially reading Walter & Porges 1976 paper, however, the HR increases observed during the HUET brief would not have been purely the result of sustained attention. Their theory states that sustained attention, as opposed to reactive attention, is associated with "a generalised inhibition of motor and autonomic activity", i.e. decreased HR. The investigations of sustained attention reported were, however, over a period measured in seconds, rather than the 45 minutes of the HUET brief. Furthermore, Walter & Porges go on to state that "deceleration is not a necessary component of sustained attention". Sustained attention may therefore have been part of the cause of the HR increases.

Initial contradictions were also found with Lacey & Lacey's (1970) hypothesis that HR change depends on the stimulus. Their theory predicted that during times of "simple environmental reception" HR would decrease. Clearly, this was not the case during the HUET brief, nor prior to the fire exercise, even though it could be assumed that subjects were attending to their environment, i.e. observing slides, listening to the trainer. The pre fire exercise HRs were also recorded while subjects were seated and receiving instructions on the forthcoming exercise. This suggests that either some other factor triggered a strong sympathetic influence, or that briefings of forthcoming potentially demanding situations require more than "simple environmental reception".

5.2.3 Heart rates and particular activities

Heart rates during the activities can be compared to those reached by a group of naval divers during simulated offshore conditions, that is at an average temperature of -2.5°C and wind velocity of 2.8m/sec (Vaernes *et al*, 1988). These subjects conducted two minutes each of a hand tool task, finger dexterity, heavy muscular work and mental arithmetic, followed by 10 minutes of immobility. This sequence was repeated eight times. After 80 minutes, HR had increased from 91bpm to 119bpm. The subjects were young divers from the Norwegian Navy, average age 23.8 years, and therefore most probably fitter than the subjects in the offshore training study. The mean HRs during the HUET exercises were 116bpm for refreshers and 119bpm for combined subjects. This suggests that HRs of subjects conducting manual work offshore would at least equal and, given offshore workers' lower fitness levels, probably exceed those reached during the HUET.

The mean HRs described in a study designed to investigate cardiac responses to thermal stress were slightly higher than those found during any of the offshore training exercises (Taggart *et al*, 1972). In Taggart *et al*'s study, subjects were assessed following a 10 minute sauna bath. Normal subjects, ranging in age from 21 to 54 years old, showed increases in HR from resting levels of 78bpm to 145bpm after the sauna. It would thus appear that having a sauna resulted in increases in HR slightly above those recorded during the offshore training exercises. It should be noted, however, that the changes in the pattern of the HR, that is the electrocardiogram (ECG), may be different in response to these situations. Preliminary investigations of offshore training were conducted using ambulatory ECG recorders (unpublished). More extensive investigations using such devices would be worthwhile, to determine whether ECG anomalies arise during the training.

Overall, the HRs elicited during the four training exercises followed a similar pattern to that of the state anxiety scores. Most activation, in the form of high levels of HR, large changes from baseline, and slower returns to baseline following completion of the exercise, was observed in the recordings of the fire and HUET exercises. The slow return to baseline may have been a result of the restrictions of this applied situation. This meant that true post resting HR values could not be obtained after the HUET and fire training. Large changes in HR were seen within the abandonment to life raft recordings, but HRs virtually returned to the baseline on completion of the exercise. It was also concluded that the abandonment to TEMPSC was not very demanding, as pre-event HR values were equivalent to resting HRs, the values during the TEMPSC abandonment were not especially high, and HR returned to baseline shortly after completion of the abandonment.

Correlations were not carried out on heart rates among the four exercises because of the differences in recording intervals.

5.2.4 Possible influencing factors on heart rates

There were no obvious differences among the different age groups. Heart rates elicited at a given submaximal workload have been shown not to vary with age (Åstrand, 1960). No age related HR difference would therefore be expected when considering physical effects. The recordings of resting HR agreed with the generally accepted view that normal resting HRs vary between 60 and 80bpm.

Previous studies have found that smoking leads to decreases in HR (Pritchard *et al*, 1995). This was proposed to occur as a result of "nicotine acting on the sympathetic nervous system", but could be overridden by severe stressors. It was also found that fairly rapid acclimatisation occurred, i.e. HR increases were reduced following subsequent cigarettes. Actual consumption of cigarettes was not assessed in the current study, and furthermore subjects were not free to smoke immediately before, during or after the training events. As HRs were only recorded at these times, whether subjects smoked was not investigated as a possible influencing factor on HR. Future work would benefit from assessing cigarette consumption to aid in the investigation of the effect of smoking on HR, and on anxiety and cortisol.

The HRs recorded during the exercise tests were not analysed to the same extent as other parameters in the study. They did, however, demonstrate the wide range of aerobic abilities among the subject population. Furthermore, individuals were not confined by their age. As can be seen in the data tables in Appendix L, page 108A, one subject in his twenties could only manage to cycle at 75 watts. This wattage has been described as equivalent to a person of 71kg walking at less than 7km/hr but faster than 5km/hr (Åstrand & Rodahl, 1986). Alternately, there was a 51 year old subject who achieved 150 watts without exceeding the 150bpm limit. These observations are particularly pertinent for this population as decisions regarding individual's medical fitness to work offshore consider age.

It should be noted that the older offshore population may be "fitter" than their onshore counterparts as a result of self and work related selection processes. This could occur due to the demanding nature of offshore work, with older individuals realising the implications and either electing not to continue to work offshore, or maintaining their physical fitness as they become older. Furthermore, medically unfit individuals are likely to be selected out of the population by the medical screening process that all offshore workers are required to go through at increasingly short intervals as they age.

5.3 Analysis of the Physiological Reactions - Cortisol

Samples of urine and saliva were collected at various points throughout the training course, as described in Section 3.2.2. These were analysed, using radioimmunoassay, to determine free cortisol concentrations. Urinary free cortisol was taken as a ratio of creatinine, to provide a measure that was independent of urine flow rate. Analyses of some samples proved to be impossible due to staining and/or viscosity of the saliva.

The data were thus of two types, salivary free cortisol (SC) and early morning, single sample urinary free cortisol (UFC). Although some individual subjects had values of SC or UFC that were significantly different from other subjects, none of these values were improbable in terms of human variability, and so no values of SC or UFC were excluded as statistical outliers from the analysis. Initially, dot plots were made of the SC and UFC data by the day of the course on which they were collected (Day), and then by the training activity conducted on that day (Event). As SC had been measured before and after each exercise, paired differences were also plotted for this parameter.

Whole group means and standard deviations were calculated. Means and standard deviations were also calculated with the data split in several different ways, by:

- Day
- Event
- Event and simultaneously the order in which activities were conducted (Order)
- Day and simultaneously by Event.

The plots of these values, along with the dot plots of the basic data, facilitated detection of patterns, groups, etc.

The general linear model (GLM) approach to analysis of variance (ANOVA) was applied using Minitab (v8.0 ext), in a manner similar to that used on the anxiety scores. This involved assessing the following factors for their ability to affect the level of urinary cortisol:

- Whether particular training activities had significant effects was assessed using the activity that subjects were undertaking on the day that the sample was collected, referred to as 'event', and the previous day's activity, referred to as 'previous event'.

- The day that samples were collected was included to determine if there were changes over the duration of the course.
- Each subject's age was considered as a possible influencing factor. The term 'age' was also run as a covariate.
- Comparisons were also made as to whether or not subjects smoked, 'smoke', and according to self-rated fitness, 'fit', and swimming ability, 'swim'.

The urinary cortisol analyses were based on Model 1 (see Section 5.3.1 for explanation of the symbols).

Model 1

$$\frac{d}{dt}(\mathrm{Log(UFC)}) = A - B * \mathrm{Log(UFC)}$$

$$\mathrm{Log(UFC(t))} = \frac{A}{B}(1 - e^{-Bt}) + \mathrm{Log(UFC(0))}e^{-Bt}$$

$$\mathrm{Let}\ \rho = e^{-Bt}$$

$$\mathrm{Log(UFC(t))} = \frac{A}{B}(1 - \rho) + \rho * \mathrm{Log(UFC(0))}$$

$$\mathrm{Log(UFC(t))} - \rho * \mathrm{Log(UFC(t\text{-}1))} = \mathrm{Constant}$$

$$= s_i + D_t + E_{jt} + \mathrm{Error}$$

More complex statistics were then conducted, again applying the GLM approach to ANOVA to the UFC data. A three stage procedure was undertaken to prevent any of the effects of the previous day "carrying over" and masking other significant factors. This involved starting with single morning analyses, to determine a value for the "carry-over" coefficient. The 'previous day's' urinary cortisol level was then multiplied by this coefficient. This was essentially the "carry-over" of the previous day, and was therefore subtracted from the 'present day' urinary cortisol level. GLM was then conducted on the whole set of data with the carry-over effect removed. This process was carried out for both combined, five day course, subjects and refresher, three day course, subjects.

ANOVA is based on the assumption that the data follow a normal distribution. As the cortisol data in this study were found to be skewed from normal, they were logarithmically transformed. Logarithmic transformation was used as the underlying model on which the cortisol analysis was based was expected to contain exponential components (Bolton, 1984). Normality was later checked in SPSS using Q-Q plots, and in Minitab by plotting histograms of residuals. The above process of accounting for carry-over followed by GLM was then repeated. The model applied can be described as:

Model 2

$$Log(UFC(t,i,j_t)) - \beta * Log(UFC(t-1,i,j_{t-1})) = D(t) + E(j_t) + s(i) + n(t,i,j)$$

The following procedure was then applied to extract both the carry-over and possible subject effects. Firstly, each subject's average UFC level over the duration of the course was calculated. This value was subtracted from each of that subject's individual recordings. The above GLM analyses were then conducted using logarithmic data.

Multiple analysis of variance (MANOVA) was conducted to determine if there were any correlations among the measures taken simultaneously at enrolment, these were UFC, SC, and state anxiety (STAI). MANOVA was also applied to the data that were collected early on each morning of the course. These were the UFC and STAI scores.

Calculations were performed to assess whether particular orders of carrying out activities, and particular days had significant effects on the UFC levels, see Model 3. A Repeated Measures technique using MANOVA was applied (Hand & Taylor, 1987), with the aid of SPSS for Windows statistical software (v6.0). Such analyses, using this particular software, require complete data sets for each subject. There were 45, out of 52, subjects on the refresher course, and 35, out of 47, subjects on the combined course with complete UFC data sets. On the combined course the fire training was spread over two days. As UFC was assessed on the morning of each day the effects of fire training on day 1 were considered along with those on day 2. Logarithmic transformation was used to normalise the data. An iterative method determined the size of the carry-over effect and the data were adjusted so that the carry-over effect was removed. As there were only 19 subjects out of the whole sample population with complete SC data sets, excluding the exercise test data, the Repeated Measures technique was not applied to the SC data.

Model 3

$$Log(UFC(t,i,j_t)) - \beta * Log(UFC(t-1,i,j_{t-1})) = C + D(t) + OD(t,j) + s(i) + n(t,i,j)$$

Whether a factor was significant or not, and how significant depended upon the p-value that was determined from the statistical analyses. The following groupings of p-values are referred to in the results with their respective symbols, p less than: 0.1 †, 0.05 *, 0.01 **, or 0.001 ‡. These values represent increasing levels of significance. (More extensive details of statistical tests referred to in the text are contained in Appendices J1-J13.)

5.3.1 Key to symbols used in the cortisol section

The following symbols are used in Models 1, 2 & 3, as appropriate in the graphs of cortisol data, and in the appendices detailing the cortisol statistical analyses.

UFC(t,i,j) is the urinary cortisol reading on day t from subject i within order group j;
A is equivalent to secretion rate, this could be affected by subject, event or day effects;
B is equivalent to excretion rate;
s(i) is a random factor due to the individual subject;
D(t) is the (fixed) effect of day t;
E(j_t) is the (fixed) effect of anticipating the exercise j, to take place on day t;
β is a constant corresponding to the 'carry-over' effect;
n(t,i,j) is the observational error with a normal distribution;
C is a constant;
O(j) represents the (fixed) effect of the order group to which the subject s(i) belongs.

5.3.2 Results of urinary cortisol analyses

Figures 38a & 38b show a first morning high followed by a drop in the level of UFC. This pattern of daily UFC was seen in both the combined and refresher subjects' data. The UFC values then reached a plateau. This is clearer in the combined group as samples were collected over 5 days rather than just 3. The variation seen amongst subjects for individual mornings was large, but this is normal for UFC values from a set of healthy volunteers.

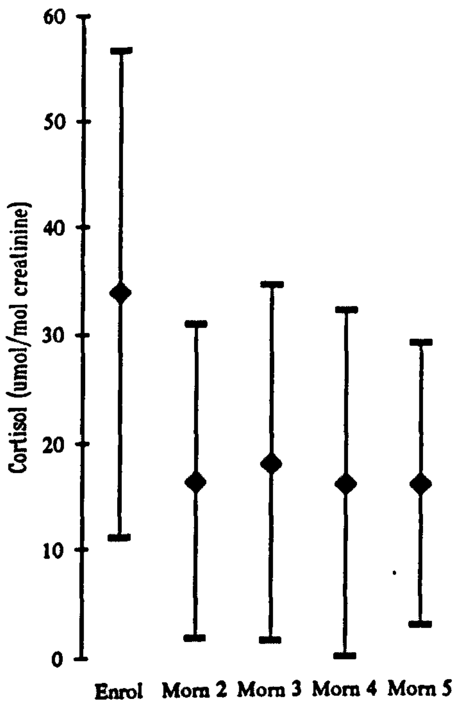


Figure 38a

Combined subjects' daily urinary ratios of cortisol to creatinine - means ± SD

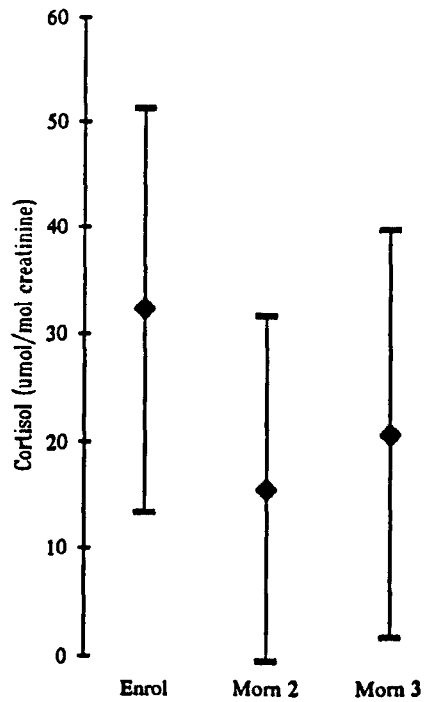


Figure 38b

Refresher subjects' daily urinary ratios of cortisol to creatinine - means ± SD

Combined & Refresher subjects

GLM analysis on combined subjects' data demonstrated that age, self-rated swimming ability, and whether subjects smoked, did not affect the concentration of cortisol in the urine samples collected at enrolment (see Appendix J1). Subjects self-rated level of fitness did have an effect on cortisol †. For refresher subjects no significant effects were found with UFC values at enrolment for any of these factors, age, self-rated swimming ability, whether subjects smoked, nor self-rated fitness level (see Appendix J2).

MANOVA on STAI, UFC and SC data from day 1 resulted in similar conclusions to those described above (see Appendices J3 & J4). The main exception was that in the refresher subjects, those who smoked were found to have higher UFC levels at enrolment * compared to those who did not smoke. This anomaly between the outcome of the two types of analyses probably resulted from the requirement for complete data sets for MANOVA. Only 33

p-value <0.10 †; <0.05 *: < 0.01 **; <0.001 ‡.

refresher subjects' data were therefore analysed by this technique, as opposed to 49 in the GLM analyses. When all of the morning UFC values were analysed, smoking was not found to be a significant factor.

Repeated Measures analyses of the overall change in daily cortisol in the subjects with complete datasets, were then conducted to determine how the UFC changed from one day to the next. The subjects were divided into five 'order-groups'. These were defined according to the order that the subjects in the group had carried out the HUET/abandonment, fire and TEMPSC exercises (see Table 4). (Note that the exercise carried out by a subject on a particular day can be identified from the 'order-group' to which the subject belonged.) Enrolment UFC values were significantly higher than day 2 values for both combined subjects ‡ and refresher subjects * (see Appendices J5 & J6, respectively). For combined subjects the UFC values rose slightly from day 2 and then remained stable on days 3, 4 and 5. Overall there was a pattern of initial highly elevated UFC values, followed by a drop, and then a slight elevation to a plateau. The drop on day 2 to below the course baseline, could possibly be interpreted as a result of the cortisol axis recovering from the hyper-activation of the previous day.

Combined subjects

The combined subjects' data were plotted by order-groups and event, then analysed using Repeated Measures. The only significant effect found was an order by event interaction effect ‡ (see Appendix J7). The interaction of order with event was equivalent to the effect of day. Individual differences were detected, but these were predominantly when an event had occurred on the first day of training. These were most probably a result of general course anxiety, rather than being related to the particular event. This seems especially likely as subjects did not know which event they would be completing on the first day. Event assessed as a factor by itself was not significant.

Although event was not found to be significant for combined subjects, this could have been the result of the compounding effect of day and event. This can be seen in Table 16. The distribution was such that one particular event predominately occurred on one particular day. The event effects could therefore have been masked by the day effects. As the events were conducted by other

p-value <0.10 †; <0.05 *: < 0.01 **; <0.001 ‡.

subjects on the other days of the week, however, event and day were not entirely coincident. To be able to assess the effect of event without the influence of day effects, all the events would have to be conducted by all the subjects in one day.

Table 16

Distribution of combined subjects completing particular events over the days of the course

Activity	Number of subjects on:				
	Day 1	Day 2	Day 3	Day 4	Day 5
HUET	21	11	11	3	1
Abandon	4	28	7	5	3
Fire day 1	7	1	25	14	0
Fire day 2	0	7	1	25	14
TEMPSC	15	0	3	0	29

As each event was completed only once by each subject, it was not possible to conduct a Repeated Measures analysis with event as the repeating factor. The interaction of each order with each day did, however, correspond to a particular event. It was therefore possible to extract a measure of the effect of each event. The event effect values were extracted from the outcome of the Repeated Measures analysis on the combined subjects' $\log_e$ UFC data (see Appendix J8). It was found that UFC was highest on the second day of the fire training and lowest on the day of the TEMPSC training for combined subjects. The ranking of the other events can be seen in Figure 40. Given the unbalanced distribution of the events over the days of the course, it was difficult to calculate whether there were significant differences among the events. Day 2 of the fire training did, however, appear very much higher than the others. This suggested that the combined subjects experienced most concern regarding the next event prior to the 2nd day of fire training, and this was manifested in higher UFC values.

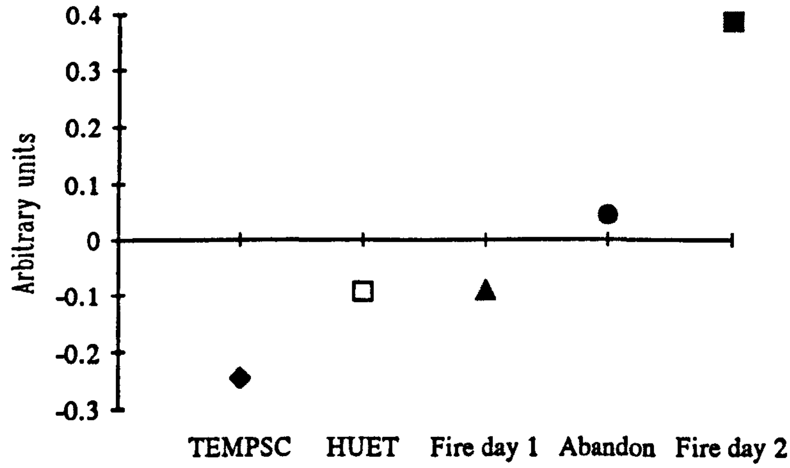


Figure 40

Event effects on combined subjects' $\log_e$ UFC values
The effects of event, taken from Repeated Measures analyses on combined subjects logged UFC, and therefore adjusted for day and order.

UFC values, when considered all together, demonstrated an overall significant carry over effect from one day to the next for combined subjects ‡. The significant carry-over implied that the extent of cortisol activation was partially influenced by the effects of the previous day (see Appendix J9).

Models were fitted with different values of β, the carry-over coefficient, but none of these showed significant event effects. The day of the course did, however, affect UFC significantly **, as demonstrated in Appendix J10, where β=0.4.

Refresher subjects

The UFC data from the refresher subjects were log transformed (log UFC) and GLM analysis showed that the average on enrolment was highest, followed by the average on day 3, and the average on day 2 was lowest (see Appendix J11). Since only 3 days of data were available for refresher subjects, estimates of individual subject levels were considered to be inappropriate. UFC values from the day of enrolment were not included in the Repeated Measures or GLM analysis below. This was because no pre-course UFC value was available, therefore an enrolment value adjusted for carry-over could not be calculated. Furthermore, subjects were not informed beforehand which exercise would take place on the day of enrolment. It might thus be expected that the type of event could not have any effect on enrolment UFC values.

Repeated Measures analysis was applied to determine the overall change in daily cortisol for subjects with complete data sets. The results of this analysis showed that there was no significant difference among the five order-groups of subjects, but that there was a significant difference among days** and among some of the 'order-groups' on particular days*, though the latter was not significant overall (see Appendix J6). The Repeated Measures analysis was repeated with subjects again divided into 'order-groups', but also investigating the differences between events (see Appendix J12). It was found that the TEMPSC exercise appeared to cause higher log UFC values than the fire or HUET/abandonment exercises. The GLM analysis of the log UFC data from days 2 and 3, adjusted for carry-over from the previous day, also provided adjusted means for the exercises (see Appendix J13). These adjusted means were highest for the TEMPSC, then HUET/abandonment, and lowest for the fire exercise. These seemed the opposite to expected, and may have been due to the large number of refresher subjects who practised the TEMPSC exercise on day 1 (see Table 17), when the other factors indicated that anxiety levels were high. The balance of events on days 2 & 3 were therefore distorted. Ideally, each of the 3 events should have been undertaken by an equal number of subjects on each of the days. Furthermore, one order group, who had completed the TEMPSC training on day 2, had a totally different pattern from the remaining groups (see Figure 39 in Appendix H). One subject in particular from this group had an especially high day 2 UFC value, which affected the event mean values.

Table 17

Distribution of refresher subjects completing particular events over the days of the course

Activity	Number of subjects on:		
	Day 1	Day 2	Day 3
HUET/Abandonment	8	25	19
Fire	7	23	22
TEMPSC	37	4	11

p-value <0.10 †; <0.05 *: < 0.01 **; <0.001 ‡.

The main findings of the analyses of the urinary free cortisol ratios can be summarised as follows:

- There was an initial peak in UFC values on the first morning of the course. This was followed by a drop after which UFC values remained relatively constant. Overall, the day on which the sample was collected was significant for refresher and combined subjects' UFC.
- The UFC value of the previous day had significant carry-over effects to the current day.
- The event conducted on the day that the sample was collected did not have significant effects on combined subject's UFC levels. When carry-over was accounted for and the data were converted into logarithmic form, significant event effects were found in the refresher subjects' UFC data.
- The refresher subjects' UFC values were highest on the day of the TEMPSC training. This probably resulted from most of the TEMPSC training being carried out on the first day, and therefore the one individual with an unusually high TEMPSC value, had an especially strong influence on the small group who completed the TEMPSC later in the week. For combined subjects, UFC measured on the second day of fire training appeared to be higher than those collected on the other days.
- UFC was found to be higher in refresher subjects who smoked compared to non-smokers, at enrolment only. No other strongly significant correlations were noted with age, or self-rated swimmming ability or fitness.

5.3.3 Results of salivary cortisol analyses

The values of salivary cortisol at enrolment, when subjects were not involved in any particular task, stand out as relatively high when compared to the values obtained after the 4 chosen events (see Figures 41a & 41b). This was the case for both combined subjects, and refresher subjects, even though the latter had previously attended survival training. The elevation of the enrolment SC concentration reflects the high urinary cortisol values found at enrolment (see Figures 38a & 38b). The profile plots of salivary cortisol also demonstrated that, rather than having a normal distribution, the data were skewed towards lower values.

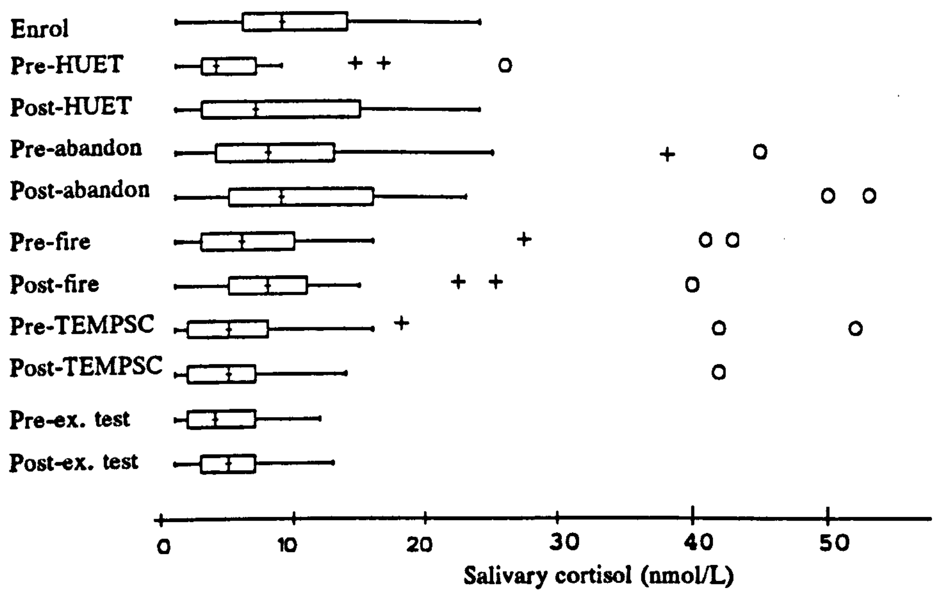


Figure 41a

Profile of combined subjects' salivary cortisol data

Combined subjects' pre and post activity salivary cortisol data. Median, upper and lower quartiles, as well as minimum and maximum adjacent values were plotted. The + are possible outliers, the O are probable outliers. The activities included the helicopter underwater escape training, HUET; the abandonment to a liferaft, abandon; the self-rescue from a smoke filled room, fire; the abandonment to a lifecraft, TEMPSC; and the exercise test, ex-test. One subject was found to have unusually high values before and after the exercise test, 80.0 & 82.0 nmol/L respectively. These values were not included in the above plot.

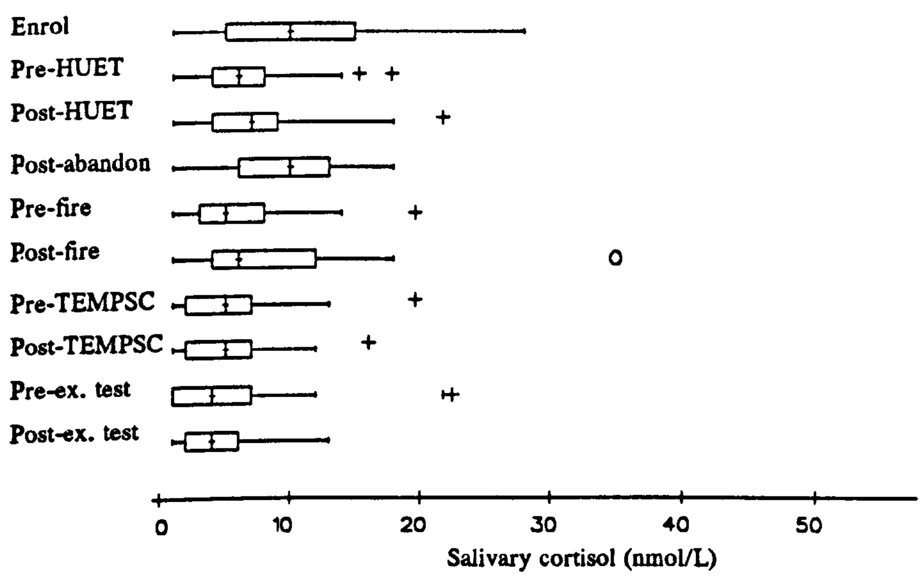


Figure 41b

Profile of refresher subjects' salivary cortisol data

Refresher subjects' pre & post activity salivary cortisol. Median, upper and lower quartiles, as well as minimum and maximum adjacent values were plotted. The + are possible outliers, the O are probable outliers. No pre abandonment saliva samples were collected, see Section 3.2.2. The activities included the helicopter underwater escape training, HUET; the abandonment to a liferaft, abandon; the self-rescue from a smoke filled room, fire; the abandonment to a lifecraft, TEMPSC; and the exercise test, ex-test.

Most activities were found to result in an increase in the salivary cortisol median. The combined subjects appeared to have decreased salivary cortisol following the selected TEMPSC training exercise. Little change was seen following the exercise test nor the TEMPSC training for refresher subjects.

Salivary cortisol results were then assessed in terms of the difference between the pre and post activity values. Unlike the absolute values, the profile of the differences did not indicate that the data were skewed. One sample t-tests of the differences demonstrated that, for combined subjects, both the HUET * and abandonment * post SC values had increased significantly from the pre activity SC values (see Table 18). Conversely, SC values did not change significantly following either the fire training or the TEMPSC exercises.

Table 18
Student's t-tests of Combined subjects' paired differences of post minus pre activity salivary cortisol values

Activity	No	Mean	St.Dev	t	p-value
HUET	34	2.462	5.892	2.44	0.020
Abandon	33	1.985	4.958	2.30	0.028
Fire	32	1.225	4.458	1.55	0.13
TEMPSC	35	-1.286	6.643	-1.15	0.26
Exercise test	38	0.745	2.820	1.63	0.11

Unlike the combined subjects, the refresher subjects' SC values increased significantly after the fire training exercise* (see Table 19). Ursin and Olff (1993) concluded that cortisol levels increase, in response to a stressor, 10 minutes after the onset of the stressor. Although, the refresher fire training exercise was approximately 2 minutes longer than the combined, it therefore seems doubtful that this was the reason a significant difference was only detected in the refresher group. It seems more likely to have been a result of the more complicated and strenuous route through smoke filled rooms that refresher subjects underwent compared to combined subjects.

No change in SC values was detected after the TEMPSC exercises. Similarly, no change was detected after the refresher subjects' HUET exercises. This could have been due to the short time scale of the exercise in the refresher course (11 minutes) compared to the combined course (32 minutes). In

p-value <0.10 †; <0.05 *: < 0.01 **; <0.001 ‡.

addition, samples collected after the refresher exercise may not have entirely encompassed the peak of the cortisol response to the training event stressor. As the HUET was followed immediately by the abandonment exercises (see Section 3.2.2) no pre-abandonment saliva samples were collected. The cumulated effect of HUET and abandonment exercises was assessed by analysing the difference between the pre-HUET and post-abandonment cortisol values. Following this, a significant increase was detected ‡.

Table 19
Student's t-test of Refresher subjects' paired differences of post minus pre activity salivary cortisol values

Activity	No	Mean	St.Dev	t	p-value
HUET	28	0.839	3.667	1.21	0.24
Post-Abandon minus Pre-HUET	31	2.500	3.777	3.69	0.0009
Fire	27	2.489	4.887	2.65	0.014
TEMPSC	31	0.190	3.932	0.27	0.79
Exercise test	28	-0.225	2.207	-0.54	0.59

MANOVA was conducted on the enrolment values only. This showed that, for combined subjects, age was close to significance at the 10 % level, p=0.106. As the coefficient was negative, this indicated that older combined subjects were inclined towards lower enrolment salivary cortisol values. Conversely, age did not have a significant effect on refresher subjects. Refreshers who smoked were, however, found to have higher salivary cortisol values at enrolment than non-smokers **.

The main findings of the salivary cortisol analyses can be summarised as:

- SC values were relatively high at enrolment.
- SC generally increased from pre to post activity, except for the exercise test and the TEMPSC abandonment.
- Significant increases were detected following the HUET and abandonment to life raft exercises in the combined subjects. For the refresher subjects significant increases were detected following the fire training and when the HUET and abandonment, completed in one session during the refresher course, were considered together.
- SC was higher at enrolment in refresher subjects who smoked compared to non-smokers.
- Older combined subjects were found to have lower SC values at enrolment, though the significance level of this was low.

5.4 Discussion of Cortisol Results

5.4.1 Enrolment peak - a result of pre-course anxiety?

An initial high peak in early morning urinary free cortisol (UFC) values was detected, as was a high level observed in the state anxiety inventory scores (STAI) measured on day 1. The peak was found in the recordings taken when subjects had just enrolled on the course, and therefore not carried out any training activities. It thus seemed likely that in most subjects the peak was a result of pre-course anxieties. Some degree of pre-course anxiety might be expected prior to attendance of any course. This was not, however, simply a result of the novelty of the course as individuals with previous training experience, refresher subjects, as well as those new to the course, combined subjects, demonstrated an initial peak.

Both combined and refresher subjects also demonstrated salivary cortisol (SC) levels at enrolment that were comparable with, if not higher than the values obtained after the four chosen events. Cortisol release, however, follows a circadian pattern. Cortisol thus generally reaches its zenith in the hours around the time of waking in the morning and then falls during the day (Weitzman *et al*, 1971). The enrolment samples were collected early in the morning, and the post-event samples were associated with events that took place later in the day. The former would therefore almost certainly be higher than the latter in a control sample, and might be expected to be relatively higher in the present sample population. However, as demonstrated by Weitzman *et al* (1971), cortisol peaks may occur later in the day that equal early morning values. In the training situation, as the events chosen were demanding, post-event values exceeding early morning values might have been expected. Generally, this was not found to have occurred. It is, however, possible that the enrolment SC values were elevated above resting values, although, due to the applied nature of the situation under study, it was not feasible to collect resting or basal samples. The true nature of the enrolment SC samples can therefore not be stated with complete certainty.

Kirschbaum and Hellhammer (1989) conducted a large scale study on 662 healthy adults and found early morning SC values of 14.3 ± 9.1 nmol/L. In comparison, the mean enrolment SC values obtained from this study, which were taken within 2 hours of rising, were slightly lower at 10.0 ± 5.7 nmol/L for combined and 11.0 ± 6.9 nmol/L for refresher subjects. Full details were not given of Kirschbaum and Hellhammer's sampling and analysis protocol, however, hence differences could have arisen due, for example, to the use of different assay techniques. Conversely, on considering urinary levels of cortisol at enrolment, 33.9 ± 22.8 and 32.3 ± 19.0 µmol cortisol/mol creatinine for combined and refresher subjects respectively, values did appear high when compared to the upper limit of 25 µmol cortisol/mol creatinine used by the Department of Clinical Biochemistry at Aberdeen University Medical School, based on unpublished data from 200 routine checks on patients referred by GPs (PH Whiting, personal communication). This difference between relative salivary and urinary levels almost certainly was a result of the fact that there is a delay in cortisol entering the urine from plasma (Fillenz, 1993). UFC therefore reflects chronic activation of the hypothalamic-pituitary-adrenal (HPA) axis. UFC data would thus have encompassed the activation resulting from anxiety felt since the last time that urine was voided, which would generally have been the previous evening. Alternately, SC has been shown to provide a virtually instantaneous correlate of the level of plasma free cortisol, and having a half-life of approximately 60 minutes is thus an acute measure (Umeda *et al*, 1981; Kirschbaum & Hellhammer, 1989). Enrolment SC values would therefore more closely reflect HPA activation experienced at the time of enrolment.

Overall, the results suggest that as UFC levels were elevated at enrolment, individuals were experiencing some concern before coming on the course. Despite the fact that the enrolment SC means were possibly slightly lower than Kirschbaum and Hellhammer's reference population data (1989), values were still comparable with the higher of the post-event SC recordings. This occurred even though subjects were not involved in any particularly demanding task at the time of enrolment. Subjects were therefore showing physiological signs of concern at the time of enrolment. The latter was corroborated by the finding that STAI, or state anxiety levels, were higher on the day of enrolment than on the following mornings of the course.

In addition to recommendations made by Harris *et al* (in press) for reducing pre-course anxiety, benefit might be gained by providing trainees with a video or fact sheet that could be distributed before the start of the course. This could include a realistic outline of the contents of the course, with frank comments by previous trainees. The importance of reinforcing the realities of any event before it occurs was noted by Lazarus (1966) who stated that "threat arises from present cues about future harms." A video, or similar device, could therefore serve to overcome the problem of anxiety arising from unrealistic expectations of the forthcoming training events. This is especially important as anticipation of a threat or stressor has been shown to result in physiological stress responses at least equal to the stressor itself (Hodges & Spielberger, 1966).

5.4.2 Carry-over in urinary cortisol data

A significant carry-over effect was found in the daily UFC values. UFC concentrations were consequently affected by the level of UFC on the previous day. UFC, as discussed above, is a chronic measure of the level of cortisol production and therefore provides some indication of the level of activation of the HPA axis. It might therefore have been expected that the previous day's UFC value, or indirectly the level of HPA axis activation, would affect the UFC value of the current day. Whether this carry-over effect is present in every-day life does not appear to have been investigated and reported in the literature. The carry-over effect could have been the result of some form of psychological effect that meant the previous day's experiences were affecting the level of cortisol axis activation. Using Ursin's (1980) definition of the manifestation of coping as being "the gradual development of a response decrement", i.e. a decrease in tonic activation, subjects did, however, appear to demonstrate chronic coping ability. This could be concluded as the level of urinary cortisol, an indicator of tonic activation, was seen to fall from the start to a plateau, rather than accumulating over the week. Also, the majority of subjects showed a fall in STAI after the first morning, suggesting that they returned to a 'baseline' level of state anxiety.

An anomaly in the pattern of change of STAI and UFC values was, however, found on day 2. UFC values demonstrated a dip relative to days 3, 4 & 5, whereas early morning STAI did not. This may have been a result of the hyperactivation of the first day temporarily taxing the HPA axis, and thereby reducing its excretory capacity on day 2. Given the above, and the absence of a dip on day 2 for STAI recordings, it is possible that the state anxiety inventory gave a more accurate instantaneous indication of how subjects were feeling first thing in the morning than single urinary cortisol samples. As UFC is a chronic rather than an acute measure, this might have been expected.

5.4.3 Factors influencing interindividual variability in cortisol responses

Refresher subjects who smoked were found to have higher levels of cortisol in both urine and saliva, relative to non-smokers, but only at enrolment. This could have been a chance effect or a result of subjects being especially anxious about the course before and during the enrolment, and therefore smoking more than on the remaining mornings of the course. Anxiety levels were also higher at enrolment in refresher subjects who smoked, compared to non-smokers. A direct smoking effect on cortisol readings might have been expected, as a recent study has indicated that "acute nicotine exposure in habitual smokers" stimulated the release of various hormones, including cortisol (Strasburger & Kirschbaum, 1994). In contrast, it was found that the smokers' SC responses to a psycho-social task were diminished, relative to a comparable group of non-smokers. However, the effects of a mental stressor combined with nicotine intake were found to have additive effects on cortisol response in another study (Pomerleau & Pomerleau, 1990). Subjects generally did not have the opportunity to smoke before the practical training activities, which might explain why no overall smoking effect was detected.

Smoking thus represents one source of the wide interindividual variability found in cortisol responses to stressors. Other possible influencing factors that were investigated in this study included self-rated fitness and swimming ability, and age. Among these only age was found to have a negative correlation with combined subjects' salivary cortisol, and then at a low significance level, $p<0.10$. Brandtstädter *et al* (1991) studied salivary cortisol in 767 adults, and found no age related effect in men. A negative correlation with age was found among women volunteers. It was suggested, however, that this could have been linked to "age-graded changes in life patterns (e.g. in occupational or family demands)" rather than an age effect *per se*. A study assessing circadian and circannual patterns, therefore conducted at four points in the year, found that plasma free cortisol was higher in elderly subjects than in young men of 24 years (Touitou *et al*, 1983). Differences were not, however, noted in total plasma cortisol concentrations. The elderly subjects were also found to have lost the circannual patterns of cortisol. It was hypothesised that this may be part of the age related decrease in capacity to adjust to external seasonal influences. Subject numbers were, however, very small at 25, six of who were elderly and demented, and no females were included in the young age group. Further work has been performed in which the possibility of age by gender differences in 24-h urinary free cortisol excretion has been investigated in 121 males and 114 females (Nakamura & Yakata, 1984). After correction of cortisol level for creatinine, a pattern of decreasing cortisol with age was found, especially in men. This contradicted the observations of Touitou *et al* (1983), despite the fact that urinary free cortisol might be expected to parallel plasma free cortisol (Beisel *et al*, 1964). Additionally, as in the present study, the level of significance for this age effect was low, $p < 0.1$. Furthermore, such studies can be problematic as the completeness of 24-h urine collections cannot always be guaranteed.

Most studies, however, have agreed with that of Brandtstädter *et al*, and observed that basal morning levels of cortisol remain unchanged by age, though there may be a trend of elevated basal levels in the evening in healthy, ageing individuals (Waltman *et al*, 1991, Pavlov *et al*, 1986). The glucocorticoid cascade hypothesis has, however, provided a model of the links between age and glucocorticoids (Sapolsky *et al*, 1986). Based on observations from the rat, this hypothesis suggests that with time stress can lead to down-regulation of glucocorticoid receptors in the hippocampus and therefore the sensitivity to glucocorticoid negative feedback in the HPA axis is decreased and glucocorticoid hypersecretion occurs in older individuals. Components of the model do apply to the human, but glucocorticoid hypersecretion only seems to occur when "senescence is coupled with a pathological state". Waltman *et al* (1991) point out that other stressors or afflictions such as depression may add to cortisol secretion "via neurochemical mediators other than CRH", providing an alternative to down-regulation.

Another explanation, rather than changes in absolute levels with age, could be that cortisol circadian rhythms are advanced in older individuals. Sherman *et al* (1985) for example, demonstrated that in males over 40 years plasma cortisol circadian rhythm was advanced by three hours. Peak and nadir values therefore occurred earlier than in younger subjects. For the enrolment SC values in the present study, the time of collection was probably within 2 hours of rising, and therefore close to Weitzman *et al's* (1971) "main secretory phase". It would thus be expected that cortisol circadian rhythm would be approximately at its peak at the time of enrolment. If the peak advanced by three hours in older individuals, then SC enrolment values would be lower in older individuals. Overall, however, given that an age related effect was only detected in the combined subject group, it seems probable that, like the age related effect detected by Brandtstädter *et al* (1991), it was due to some other factor linked to age.

Additional factors found by others to have significant influence on cortisol variability include gender. Responses to the Trier Social Stress Test (TSST) have been investigated (Kirschbaum *et al*, 1992b). The TSST is a psychological stressor that involves subjects speaking in public, and performing mental arithmetic, while being recorded on video (Kirschbaum *et al*, 1993). Males were found to demonstrate higher cortisol responses to the TSST. In the same group, however, gender differences were not found in response to CRH injections, nor exhausting exercise. As there was only one female subject in the present study, gender effects could not be assessed.

Finally, psychological variables, such as personality have frequently been forwarded as sources of interindividual variability. Kirschbaum *et al* (1992a) failed to find significant correlations between various personality measures, including Zuckerman's Sensation Seeking Scale, and cortisol responses that resulted from exposure to the TSST. It has, however, been suggested that the possibility of a correlation between cortisol responses and personality cannot be excluded until a questionnaire is developed that takes into account relevant biochemical and physiological factors (Kirschbaum *et al*, 1992a). Indeed, Kirschbaum has forwarded neuroticism as one facet that may be important as it has been linked with a "robust cortisol response" (Kirschbaum, personal communication). This would support the work of psychologists who have found neuroticism, or negative affectivity, to provide an indicator of reactivity to stress, high neuroticism scorers showing greater vulnerability (Parkes, 1990). Indeed, Eysenck (1989) considered neuroticism to be one of the main personality related indicators of susceptibility to stress.

Two theories seem to exist with regard to factors that influence interindividual variability in glucocorticoid responses. One states that the variability is derived from the extent of the subject's experience of stress. Hubert *et al* (1989) have supported this by pronouncing that "subjective mood states and novelty to a stressor are more important factors in human endocrine stress response than personality traits." Alternately, variability could be due to differences in "personality traits, coping styles, or cognitive appraisal of stress situations" (Berger *et al*, 1987). Some authors are quite strong proponents of one view or the other, but it seems possible that there could be some overlap, or that both could apply. By suggesting that the source of variability may change depending on the time of day, Kirschbaum *et al* (1990) accommodate both views. Their data suggest that the majority of variance in morning cortisol samples is linked to trait variables, whereas later in the day situational variables have a stronger influence. A more recent study by the same group did not, however, find any significant correlations "between perceived stressfulness of the situation, mood changes and cortisol responses" following administration of the Trier Social Stress Test (Kirschbaum *et al*, in press). This was despite measures being made between 4pm and 7:30pm, and therefore when it would have been expected that situational variables had a strong influence.

In the current study analyses were conducted to assess correlations among early morning SC and UFC, and state anxiety. Some correlations between UFC and state anxiety were close to significance. Had subject numbers been larger more definite patterns may have emerged. If state anxiety is regarded as a measure of subjectively experienced stress, these findings suggest that at least some overnight and morning variability may be due to subjective experiences. In the present study, such subjective experiences might have included anxiety about the forthcoming training events or, as mentioned previously, about attending a work related course. No analyses were conducted in the current study to assess the extent of the variance. Other studies, for example, looking at students over a 2½ month period, have also found correlations between early morning serum cortisol and state anxiety, using the STAI (Francis, 1979). Relationships among the parameters measured in the current study will be discussed in more detail in Section 6.

Ultimately, therefore it seems that the words of Hubert and de Jong-Meyer in 1989 remain appropriate:

"The prediction of cortisol response variability still remains open."

5.4.4 Salivary cortisol in relation to particular events

For refresher and combined subjects, the pre and post event SC values indicated that the abandonment exercise appeared to be associated with the highest levels of response. Although Mason (1968) stated that "psychological influences are among the most potent natural stimuli known to affect pituitary adrenal activity", it seems likely that the predominant influence in the abandonment to life raft exercise was physical activity. This can be surmised from the responses to the course specific questionnaires; subjects rated the physical aspects of the abandonment exercise as the most difficult.

Significant changes were seen following the HUET and abandonment exercises for the combined subjects' data, and following the fire training for the refresher subjects' data. Differences may not have been detected for the combined fire training exercise and the refresher HUET exercises due to the short time scale of these exercises. Furthermore, the smokehouse used for the refresher training was more complex, and therefore more demanding both physically and mentally. The change in cortisol during the fire training exercise could thus have been more intense in the refresher subjects, resulting in a significant change from pre to post. Ursin & Olff (1993) have stated that in response to a stressor, cortisol does not peak until 10 minutes after the onset of the stressor. Samples collected within that time may therefore not have encompassed a cortisol peak. This agrees with the findings of Hubert & de Jong-Meyer (1989) that following a psychological stimuli, cortisol peaked after 20 to 30 minutes. The time from stimulation to peak cortisol response does, however, vary depending on the intensity of the stimuli and "(probably) the nature of the situation" (Kirschbaum & Hellhammer, 1989). Future studies involving series of saliva samples, possibly taken every 10 or 20 minutes, would provide more detail as to the overall pattern of cortisol change, and the time of onset of the response. Comparison could also be made between samples taken during the training and in a control situation.

The pre-HUET mean SC values were compared to those from Hytten *et al*'s study (1989), which included similar measurements on 70 HUET trainees at the NUTEC training centre in Bergen. They found pre-event salivary cortisol values of 13.6 ± 8.5 nmol/L, therefore, somewhat higher than the values of 5.9 ± 4.9 nmol/L for 37 combined subjects and 6.8 ± 3.8 nmol/L for 39 refresher subjects in this study. As with the combined subjects in the current study, Hytten *et al* found that salivary cortisol increased significantly from pre to post HUET ditchings. The extent of previous HUET experience was not detailed in Hytten *et al's* paper, but the number of ditchings was the same as for the combined subjects. Unfortunately, comparisons among different studies can be misleading, primarily because of the anomalies that can arise as a result of the use of different biochemical analytical techniques. Some saliva cortisol responses found by other authors are, however, summarised in Table 20.

Table 20

Changes in Saliva Cortisol found by other authors in various demanding situations

Authors	Subject Population	Stressor situation	Saliva Cortisol Response
Bassett *et al* (1987)	22 male & 7 female bank employees	15 minute public lecture, as part of a 2 week training course	An increase from approximately 9nmol/L before to 12nmol/L after speaking. Both of these were significantly higher than values recorded at the same time on a control day.
Bohnen *et al* (1991)	24 healthy females	4 hours continuous mental tasks	Values were compared with those obtained on a control session day. Aside from the first sample, 1 hour into the mental task session, all mental task samples were significantly higher. Mean increases ranged from 0.66 to 1.16nmol/L
Hubert & de Jong-Meyer (1992)	32 healthy males	2 hour suspense film - "Shining"	Subjects were divided by median split into high and low anxious (LA) groups, depending on their scores in the STAI - trait form. Only subjects in the LA group showed significant saliva cortisol increases from approximately 3.5 to 4.75nmol/L.
Hubert *et al* (1989)	12 male medical students, 5 male non-medical students	Venepuncture associated with a LHRH test	Subjects were split depending on whether they were familiar or unfamiliar with venepuncture, therefore medical and non-medical students. Only unfamiliar subjects showed increases in cortisol from approximately 6 to 13nmol/L.
O'Connor & Corrigan (1987)	8 healthy males	30 minute bicycle exercise at 75% of previously determined VO_2 max.	Relative to values obtained on a control rest day, significant increases were not observed after 15 minutes of exercise. Saliva cortisol did, however, increases from approximately 18nmol/L at the start of the exercise, to approximately 40nmol/L 15 minutes after cessation of the exercise.

Based on a table by Kirschbaum & Hellhammer (1989)

The general impression from the SC results was that demands on the individual sufficient to lead to significant short term increases in SC only occurred during the HUET and abandonment exercises for the combined subjects, and the fire training for the refresher subjects. Furthermore, the significant changes that did occur were not very much larger than the changes in SC seen as a result of the exercise test. This suggests that the training exercises were not especially demanding, as assessed by changes in SC, especially when compared to the outcome of an exercise test that most subjects did not perceive as difficult. Had further samples been collected after the training exercises, later peaks, or further increases, may have been detected. It seems probable, however, that later samples would not have resulted in a significantly different outcome than was observed. This can be surmised from the finding that the difference between refresher subjects' pre-HUET and post abandonment samples, which were therefore approximately 40 minutes apart and included the cumulative effects of the HUET and abandonment exercises, was not significantly greater than that between the pre and post HUET samples in the combined subject group.

6 Conclusions: Relationships & Future Work

6.1 Correlation of Cortisol Concentrations with Anxiety

Despite the finding that all the parameters measured at enrolment on the first morning were relatively high, no overall correlations were found among the combined subjects' enrolment urinary cortisol, salivary cortisol, and state anxiety inventory scores (See Appendix K1). A positive, significant correlation was, however, found between the refresher subjects' salivary cortisol and urinary free cortisol values at enrolment ‡.

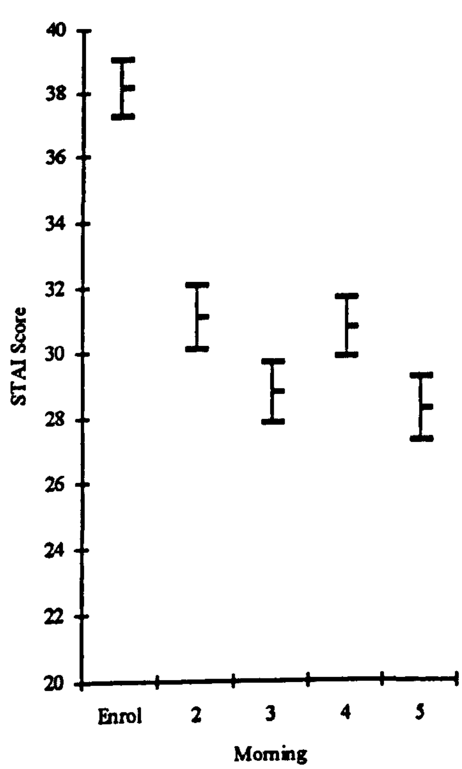


Figure 42a
Means ± SD of combined subjects' morning state anxiety scores

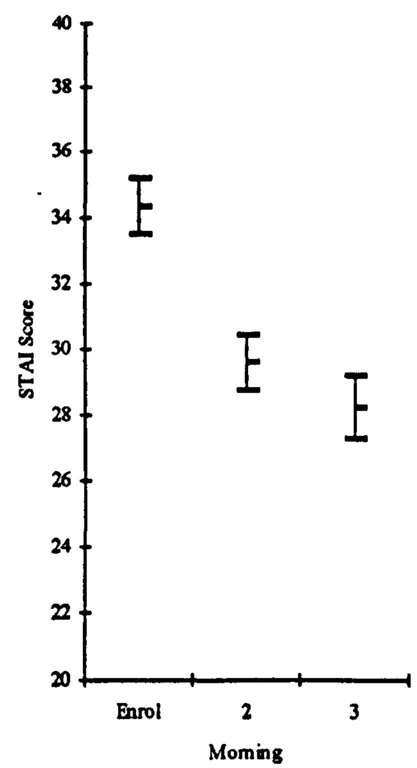


Figure 42b
Means ± SD of refresher subjects' morning state anxiety scores

A comparison of Figures 42a & 42b with Figures 38a & 38b showed that the mean morning STAI values appeared to follow a similar pattern to the morning UFC values. Mean log UFC values taken from the results of GLM analysis, and therefore adjusted for event, subject and carry-over (see Appendix J10), were compared with mean STAI values. This indicated that a difference existed between the UFC and STAI patterns on day 2. The adjusted UFC value for day 2 was *lower* than those for days 3, 4 & 5. The mean STAI score for day 2, however, appeared *higher* than days 3 & 5, and little different from day 4. Thus, unlike UFC, no dip in the STAI scores was detected on day 2 relative to the remaining days. For the refresher results, this pattern was not discernible as the course only lasted 3 days.

Aside from day 2, the patterns of day to day change were similar for UFC values and morning STAI recordings. Like the UFC values, enrolment STAI scores were found to be significantly higher than those on day 2 for refresher ‡ and combined subjects ‡ (see Sections 4.4.1 and 4.4.2). The STAI scores on day 3 then fell below the average of day 1 & 2 for refresher ** and combined * subjects. The level of state anxiety, like the UFC, then remained stable over the rest of the course for the combined subjects.

The values of the combined subjects' event effects on STAI, which had the effects of day and order accounted for, were extracted from Repeated Measures analysis (see Section 4.4.2 and Appendix G17). The trends were found to be similar to those of the UFC data (see Figure 40). Like the UFC values, the STAI effect values associated with the 2nd day of fire training were high, and the TEMPSC were low. Differences from the pattern of UFC values were, however, found. The STAI effect values associated with the abandonment were higher than for the UFC, and the 1st day of fire training were lower than the UFC.

Further support for links between cortisol and STAI was found in the salivary cortisol data. The outliers seen in the plots of salivary cortisol, when singled out, were found to have relatively high scores on the pre-event STAI. This was found especially in the combined subjects group.

p-value <0.10 †; <0.05 *: < 0.01 **; <0.001 ‡.

6.2 Correlations Among STAI, HR, UFC & Questionnaire Data

Principal Components Analyses (PCA) were applied to the data from the current study to reduce the number of parameters to a more manageable set for later Cluster Analyses. (Although, some Cluster Analyses were conducted using the full set of parameters.) Cluster Analysis was used to divide subjects into groups according to their scores on particular parameters. Relationships among parameters could then be detected that may not otherwise have been.

6.2.1 Refresher subjects

PCA of refresher scores on the sub-scales of the Sensation Seeking Scale (SSS) resulted in one factor, referred to as the SSS factor. PCA conducted on the STAI state and trait scores, and then on the morning UFC values, each produced one representative factor. These were referred to as the STAI and UFC factors, respectively. PCA of the responses to the course specific questions resulted in five representative factors. The factor that accounted for the largest percentage of the overall variance was used in later Cluster Analyses and referred to as the CourseQ factor. All of the average HR values, except the post abandonment and post HUET values, were factor analysed together using PCA. This resulted in three representative factors. The first of these accounted for 56% of the variance, indicating that it was a strong representative of all the HR values. This was therefore the HR factor that was used in Cluster Analysis. (Detailed statistical output of the PCA conducted on refresher subjects' data are contained in Appendix K2.)

Cluster Analysis was conducted on all the data from the refresher subjects, except the salivary cortisol values (see Appendix K3). The salivary cortisol values were excluded due to the extent of missing values. The analysis was, however, considered to be invalid as there were only 7 subjects who had no missing values, and complete data sets are required for Cluster Analysis.

When the HR values were clustered with just the morning UFC values, the two clusters were found to differ significantly in their UFC values at enrolment ‡ but not in the UFC values from the second, p=0.369, nor third morning, p=0.586

p-value <0.10 †; <0.05 *: < 0.01 **; <0.001 ‡.

Appendix K4). This was confirmed when the UFC values on the morning of enrolment were clustered with the HR factor (see Appendix K5). The two clusters that formed had significantly different enrolment UFC values ‡ and HR factor values *. The final cluster centres and membership numbers are shown in Table 21.

Table 21

Cluster Analysis of refresher subjects' enrolment UFC & Heart Rate factor - final cluster centres

Cluster No	No of subjects in Cluster	Cluster Centres for: Enrol UFC value	HR Factor
1	17	17.86	-0.3237
2	11	48.76	0.4568

The cluster centres in Table 21 illustrate that high urinary cortisol values on the day of enrolment, were associated with relatively higher HRs during the later training events. (Note that the factor matrix in the PCA indicated a positive relationship between actual HR and the HR factor values.)

Clustering with the HR values and the individual STAI state and trait scores indicated that as well as significant differences in HRs in the two clusters, the fire STAI scores were significantly different * (see Appendix K6). As this was the only STAI value that had a significant effect, anxiety scores were not considered to be the source of the split of the refresher subjects into two groups with different HRs.

All five of the factors derived from Principal Components Analysis, the HR, SSS, STAI, Course Q, & UFC factors, were combined in a single Cluster Analysis. The physiological parameters were not significant, but a link among the psychological and course questionnaires was indicated (see Appendix K7). A subsequent Cluster Analysis was conducted on the SSS, STAI and CourseQ factors. The two clusters formed were significantly different in SSS factor score *, in STAI factor ‡, and Course Q factor ‡ (see Appendix K8). From the cluster centres the most interesting finding was that high SSS scores were associated with relatively higher anxiety scores and low SSS scores were associated with low anxiety scores.

6.2.2 Combined subjects

Principal Components Analyses were conducted on the Sensation Seeking Scale sub-scales, resulting in one factor, the SSS factor. PCA of the five morning UFC values and of the five morning STAI scores also each resulted in one factor, referred to as the UFC and STAI factors, respectively. PCA of all the HR values, except the three fire training and during abandonment values, resulted in two factors with eigenvalues of greater than one. The HRs mentioned were excluded due to the number of missing values. The number of subjects with complete datasets in the remaining HR parameters was 24. (Detailed statistical output of the PCA conducted on combined subjects' data are contained in Appendix K9.) These factors were then used in Cluster Analyses to identify any groupings among the different measurement parameters.

Cluster Analyses were conducted on the STAI, UFC, and SSS factors and on the more dominant HR factor. The three resulting clusters differed significantly in their UFC ‡, SSS ‡ and HR ‡ factor values, but not in their STAI factor scores, $p=0.251$ (see Appendix K10). Cluster analysis was repeated just including the significant factors. With the cluster number set at three only one individual was contained in one of the clusters. Analysis was therefore repeated, but set at two clusters, and one individual with a particularly high UFC factor score was removed. The resulting two clusters were significantly different in UFC factor scores *, SSS factor score ‡, and HR factor score ‡ (see Appendix K11). The cluster centres are contained in Table 22.

Table 22

Cluster Analysis of combined subjects' UFC, SSS & HR factors - final cluster centres

Cluster No	No of subjects in Cluster	Factor: UFC	SSS	HR
1	9	-0.0848	-1.0847	0.4905
2	6	-0.4979	0.8382	-0.6423

The cluster centres in Table 22 demonstrate that one group of subjects had low SSS scores, relatively high HRs and moderate morning UFC values. The other cluster had high SSS scores, low HRs and low morning UFC values. (Note that the factor matrices in the PCAs indicated that positive relationships existed between actual UFC, HR and SSS and the respective factor values.)

Cluster Analysis excludes all the data from subjects if one or more pieces of data are missing. This resulted in only 15 combined subjects being included in the analysis referred to in Table 22. The results of these analyses therefore can only indicate trends, though stronger relationships would probably have been obtained had there been less missing values.

Direct correlations of subjects' HR, SSS, STAI, and UFC factors indicated that a significant negative correlation existed between the HR and SSS factors *, and that significant positive correlations existed between HR and UFC factors ‡, and HR and STAI factors †. (See Appendix K12 for the full correlation coefficients table.)

6.3 Discussion of Inter-Variable Relationships

As both saliva cortisol and state anxiety are indicators of acute activation, it might have been expected to find stronger correlations between these two measures when recorded simultaneously. Indicators of links between cortisol and state anxiety were found, but these were not consistently significant. This may have been a result of the missing cortisol data. As already mentioned, there were only 19 complete sets of SC data in the whole subject population (n=99). The missing values created various problems at the statistical analysis stage, for example, techniques had to be used that accounted for missing values, or subjects with incomplete data sets had to be omitted, therefore reducing subject numbers. Most of the missing values were a result of the situation under study, which although more realistic than stressors applied in a laboratory, could not be so easily controlled.

For refresher and combined subjects, relationships were found between the HR and UFC data. In the refreshers, HR data recorded during the training and UFC values at enrolment were positively related among clusters. When the combined subjects' SSS, HR and UFC factor scores were grouped into clusters, a positive relationship was again detected between HR and UFC data. Additionally, significant correlation coefficients were found between combined subjects' HR and UFC factors. Measures of cortisol in spot, early morning urine samples, therefore, seemed to provide an indicator of which subjects were likely to experience relatively high HRs during the training course.

HR and salivary cortisol responses were not correlated in this study. Other researchers investigating the effects of the Trier Social Stress Test (TSST) have, however, failed to find significant correlations between heart rate responses and salivary cortisol responses (Kirschbaum *et al*, 1993). This seems contradictory to the current study's findings of correlations between HR and urinary cortisol. It may be, however, that the measures of urinary cortisol performed early on each morning, as suggested earlier, indicated the subject's chronic coping ability or even reactivity. Subjects with high morning UFC values would therefore have had higher reactivity indices, and responded to later stressors with higher HRs.

By treating high sensation seeking scale (SSS) scores as an indicator of extroversion, the relationships detected between SSS and STAI in the current study appeared to contradict Gray's (1986) theory of personality. Gray proposed that there exists a personality dimension 'trait anxiety', which ranges from stable extrovert to neurotic introvert. It might therefore have been expected that subjects who scored high on the SSS were more extroverted, and would thus have lower anxiety scores, and *vice versa*. In the refresher group, cluster analysis demonstrated that subjects with high SSS factor scores had high STAI factor scores, and *vice versa*. However, it was also found that combined subjects who were low SSS scorers manifested higher physiological responses to the training, i.e. higher heart rates and higher morning urinary cortisol values. The low SSS scorers could possibly be "repressing" their anxiety, and therefore scoring lower on the STAI, but still demonstrating signs of physiological activation via the measures of HR and UFC.

6.4 Summarised Conclusions and Recommendations

Salivary cortisol, urinary free cortisol and state anxiety were all found to be relatively high at enrolment. The means of the latter two, recorded early on each morning, dropped to a plateau after the initial high of the enrolment day. It was suggested that the high enrolment values resulted from pre-course apprehensions. The results of this study therefore seemed to suggest that attention should be directed toward reducing pre-course apprehensions. One approach to this could be to provide trainees with additional information before enrolling on the course. This could take the form of a brief information leaflet outlining the course contents, or a short video of the main training areas. Anxiety resulting from uncertainty over what may be involved in the course, and what will be required of trainees could therefore be reduced.

The salivary cortisol (SC) data, representing acute measures of stress, was found to have the highest absolute values during the abandonment to life raft exercise. The general impression, however, was that demands on the individual sufficient to lead to significant short term increases in salivary cortisol only occurred during the HUET and abandonment exercises for the combined subjects, and the fire training for the refresher subjects. Overall, SC during the course was not found to be particularly high relative to other training activities.

Analysis of the state trait anxiety scores (STAI) revealed that:

- For the refresher group overall, the older the subject, the lower the anxiety scores were. The lack of a significant age effect in the combined subject group suggested that the refresher age effect was a result of older individuals having had more experience of survival training, and possibly offshore life, which includes practising emergency drills.
- Subjects who smoked generally experienced more anxiety and less positive coping benefits than non-smokers. It was suggested that these effects were probably linked to personality, individuals who smoked having higher levels of anxiety as a personality trait, rather than as an immediate result of the smoking.
- Non-swimmers were more anxious than subjects who could swim. Increasing the availability and emphasising the utility of water confidence classes could therefore aid in reducing the additional anxieties experienced by non-swimmers.

Among the anxiety scores the pre-HUET (helicopter underwater escape training) and pre-abandonment to life raft values were the highest. On comparison with other training situations, however, the values were not especially high. Yet, in line with the findings of Hytten *et al* (1989), subjects in this study with greater self-satisfaction in coping with training, had relatively decreased pre-event state anxiety. This negative relationship between anxiety and perceived coping emphasised the need to minimise the extent of anxiety experienced during the course, in order to maximise the benefits to trainees.

Methods of reducing anxiety particularly associated with the HUET exercises could include highlighting the aspects of helicopter safety during the HUET brief and possibly steering the emphasis away from the HUET itself.

Regarding heart rate, refresher and combined subjects' values were found to be similar except at times when psychological stressors, eg anticipation, were the main source of stress. Differences were seen in the heart rates of the two groups, prior to the HUET and abandonment, and during the HUET brief. The possibility that the elevations in the latter was an incidence of "additional heart rate" was discussed.

Heart rates reached during the HUET - which was perceived by trainees as the most difficult - were comparable with, if not lower, than those that might be expected during moderate, manual, external work offshore (Vaernes *et al*, 1988). Relatively higher heart rates were found during the abandonment to life raft and fire training exercises. These were probably a reflection of the physical nature of these exercises. Overall, the judgements that were made from the heart rate levels reached, changes in heart rate, and time to return to baseline supported the conclusions that were drawn from the STAI results. Studies using ambulatory electrocardiograph (ECG) recorders would have to be conducted in order to determine whether pathological changes, in relation to the heart, occur during training.

Several conclusions were drawn from the results of the course evaluation questionnaires. These suggested that:

- A reduction in the extent of smoke contact within the fire training could reduce levels of physiological and psychological activation.

- Additional allowance could be made to alleviate the disorientation experienced during the HUET exercises. This seemed especially pertinent since significant numbers of experienced refresher subjects, as well as combined or novices, rated disorientation as difficult. Disorientation could be reduced by initially allowing trainees to wear goggles, and providing the option of taking part in additional capsizes.
- The drills associated with the abandonment to life raft exercise were found to be physically demanding. Special consideration should therefore be placed on assessing trainee's physical fitness to take part in the training.
- Both combined and refresher subjects felt that they had coped well with the training. Individuals also felt, though to a slightly lesser extent in the refresher group, that the training had improved their ability to cope with future offshore emergencies.

General methods of reducing anxiety might include providing trainees with instruction on stress reduction techniques, and including more extensive debriefing following the exercises. The latter could be directed to put the accent on individual's positive experiences of the training and to enhance the system of support within the group. Emphasising the positive aspects should aid in developing positive response-outcome-expectancies, i.e. improving self-perceptions of ability. Group or social support could be beneficial by acting as a "stress buffer". Additionally, confidence building classes could be provided for trainees who were not satisfied with their own performance and felt that they would benefit from additional practice, instruction and / or feedback.

In answer to the final question posed in Section 3.5, little evidence was found of statistically significant relationships between the physiological and psychological measures conducted during this study. Very similar patterns of response were, however, detected between some of the measures, for example, early morning urinary free cortisol and state anxiety.

6.5 Future Work

Many laboratory based studies are initiated to attempt to answer one or more questions, possibly with respect to particular theories. This study, however, was set within a real-life situation, and although clearly defined objectives existed from the start, the study's goal was ultimately to determine problem areas and possibly propose practical solutions. The realities of conducting a study in such a situation thus meant that it was not always possible to obtain sufficient control values. In addition, if the study were to be repeated, particular parts of the study would be altered, though it seems likely that every scientific investigation could be improved upon, especially with the benefit of hind sight. It is suggested that two particular aspects be altered so that:

- measurements of basal values for some of the parameters are included,
- conducting the study around a more balanced design is considered.

Basal measures of salivary cortisol could be estimated by sampling saliva at times corresponding to the collections made while subjects are on the course, therefore early morning, 8-9am, midmorning, 10:30am-12pm, mid afternoon, 3-4pm, and possibly early evening, 6-7pm. These samples could be collected on days when the subjects are resting at home or else on a normal day's work. Similarly state anxiety (STAI) questionnaires could be completed by subjects at home or work. The early morning measures of state anxiety did, however, partially fulfil this role. Paired comparisons could then be made between basal and the levels reached on the course, thus enabling the effects of training to be distinguished.

It would seem particularly appropriate for subjects to collect samples away from the environment of the stressor, as it has been shown that true baseline values may not be achieved if measures are performed during rest periods before or in between stressors. Whitsett *et al* (1987) suggested that during such rest periods subjects may "anticipate the impending situation, thus elevating their levels of physiological activity even during periods of presumed rest". Indeed, this phenomenon was encountered in the current study during the HUET brief, when some subjects' HR were elevated even when seated "at rest".

Regarding a more balanced design, subjects could be selected from particular classes. This would result in an even spread of subjects over the different possible orders of event, therefore removing the possibility of confounding day and order effects.

Given the strong indications that trainees were anxious before commencing the course, it would be beneficial to conduct an investigation into the best means of reducing these anxieties. This could include assessing the suitability and efficacy of various stress reduction techniques, such as relaxation training, or stress inoculation training, as well as investigating the impact of providing individuals with additional information before the start of the course.

Of the parameters measured in this study, only heart rate was recorded during the HUET brief. Especially large increases in heart rate were, however, observed in some subjects. This situation therefore seems to have been perceived as a stressor by subjects. It would thus be interesting to measure other parameters, such as pre and post brief salivary cortisol and pre-brief state anxiety, during this time. This would be particularly interesting as the brief would represent a predominantly psychological stressor since the only physical activation would be from speech and maintaining a seated posture. Furthermore, it could be possible to compare the results with other studies that have investigated the effects of anticipating stressors (Kirschbaum *et al*, 1993).

Bohnen *et al* (1990) found that subjects with high cortisol responses following a 4 hour continuous mental task stressor had decreased levels of attention compared to a control session. Alternatively, subjects with no differences in cortisol levels between the 2 sessions demonstrated no change in attention levels. If additional measures were performed in the HUET brief it would be possible to assess whether a relationship between cortisol and attention existed in the offshore training situation. Furthermore, if this were observed to occur, measures of salivary cortisol could be used to identify subjects likely to benefit from more individal instruction.

More detailed analyses of relationships between personality and responses to the training, as well as other additional measures of personality could also yield interesting results. For example, direct measures of negative affectivity could be applied as a broad personality trait that encompasses low self-esteem as well as emotionality/neuroticism. This could produce some interesting correlations as high negative affectivity has been found to "inflate associations between work perceptions and affective symptoms" as well as being a moderator of reactivity (Parkes, 1990). Future work could therefore include extending the study and including assessments of whether perception of risk affects responses to training.

Future studies could also incorporate objective measures of performance to enable more direct assessment of training outcomes.

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APPENDIX A - COURSE CONTENT

COMBINED BASIC OFFSHORE SURVIVAL FIREFIGHTING FIRST AID COURSE

Duration: 5 Days
<u>SURVIVAL</u>
ENROLMENT/MEDICAL SCREENING

COURSE BRIEF to include: a. Course aims and objectives; b. Terminal objectives; c. Course Programme; d. Safety Procedures; e. Facilities available

DRY LIFERAFT DRILL to include: a. Davit launch; b. Conventional launch; c.Construction; d. Liferaft equipment; e. Boarding and righting techniques

WET DRILL (PRACTICAL) to include: a. Entering water from a height; b.Boarding a liferaft; c. Righting an inverted raft; d. Rescue techniques

HELICOPTER SAFETY to include: a. Procedures before flight; b.Embarking; c. Equipment inside the helicopter; d. Disembarkation; e. Emergency landing on land; f. Emergency landing on water

HELICOPTER UNDERWATER ESCAPE (PRACTICAL) to include: a.Ditching on water; b. Surface evacuation into a heliraft; c. Partial submersion; d.Rapid capsize; e. Aviation lifejacket inflation; f. Helicopter winching exercise

SAFETY to include: a. Health and Safety at Work Act 1974; b Defining an accident; c. Safe systems of work; d. Permit to work; e. Work site safety

FIRST AID to include: a. Principle aims; b. Preservation of life; c.Prevention of worsening; d. Promotion of recovery; e. Identification of treatment; f.Priorities in an emergency

RESUSCITATION (PRACTICAL) to include: a. Expired air resuscitation (EAR); b. Single man rescue; c. Double man rescue; d. External chest compression (ECC); e. Airway; f. Breathing; g. Circulation; h. Recovery position

PHYSIOLOGY to include: a.Immersion; b. Post immersion; c.Initial immersion; d. Short term immersion; e. Long term immersion; f. Effects of hypothermia; g. Rapid recovery; h. Re-warming by immersion

LOCATION AIDS to include: a. Visual location aids; b. Sea cell powered light; c.Waterproof signal torch; d. Heliograph mirror; e. Pyrotechnics; f. Personal location devices and EPIRB; g. Radar transponder; h. Emergency radios

ABANDONMENT EXERCISE (PRACTICAL) to include: a. Survival techniques using survival suits and lifejackets; b. Liferaft inflation; c. Casualty care; d. Water entry from a height

SURVIVAL TECHNIQUES to include: a. Preparation; b. Protection; c.Location; d. Water; e. Food; f. Rescue

TEMPSC INTRODUCTION to include: a. Types of TEMPSC and construction details; b.Capacity, seating arrangement and use of seat belts; c. Self righting capability; d. Inherent buoyancy; e. Function of TEMPSC; f. Engine and helm position controls; g. Primary and secondary method of engine start; h.Deluge system; i. Life support system; j. Fuel system and location of valves.; k.Ancillary equipment; l. Compass; m. Clearing installation and taking up safe position

DAVIT EXERCISE to include: a. Operation of lowering and release mechanism; b. Clearing away and preparation of TEMPSC prior to abandonment; c. Pre-abandonment checks; d. Boarding procedures; e. System of recovery

ABANDONMENT EXERCISE to include: a. TEMPSC muster; b. TEMPSC Preparation; c. Embarkation; d.Lowering and release

SEA EXERCISE to include: a. Steering; b. Recovery of man overboard; c.Streaming and recovery of sea anchor; d. Operation and firing of parachute rocket

TEMPSC THEORY to include: a. Single fall; b. Double fall; c. Use of TEMPSC emergency equipment and supplies.

<u>FIREFIGHTING</u>

ADMINISTRATION/INTRODUCTION to include: a. Course objectives; b.Programme; c. Safety

COMBUSTION THEORY to include: a. Fire spread; b. Methods of Extinction

BREATHING APPARATUS THEORY to include: a. Full duration; b. Short duration; c. Escape types

PROTECTIVE CLOTHING to include: a. Types; b. Issues

BREATHING APPARATUS DONNING AND WALKABOUT to include: a.Donning; b. Walkabout in open air

HOSE AND MONITOR DEMONSTRATION to include: a. Dry hose running; b. Wet hose running; c.Branch handling

HYDROCARBONS AND CYLINDER FIRES to include: a. Liquid hydrocarbon; b. Contained spill; c. Cascade; d. Pressure and Class A fires

EXTINGUISHER Theory to include: a. Current types; b. Water; c. Foam; d.CO_2; e. Halon demo

EXTINGUISHER (PRACTICAL) to include: a. Extinguishing fires with various types of extinguisher

VALVE ISOLATION EXERCISE to include: a. Team working on various fire props isolating a pressure fire

SELF RESCUE to include: a. Practical self rescue exercise in smoke with emphasis on moving correctly and assisting others

PLATFORM HAZARDS to include: a. Risk areas; b. Fire protection areas

GOOD HOUSEKEEPING to include: a. Fire prevention; b. Actions in an emergency

COMBINED OFFSHORE SURVIVAL AND FIREFIGHTING REFRESHER COURSE

Duration: 3 Days
SURVIVAL
ENROLMENT/MEDICAL SCREENING

COURSE BRIEF to include: a. Course aims and objectives; b. Terminal objectives; c. Course programme; d. Safety procedures; e. Facilities available

RESUSCITATION (PRACTICAL) to include: a. Expired air resuscitation (EAR); b.Single man rescue; c. Double man rescue; d. External chest compression (ECC); e. Airway; f. Breathing; g. Circulation; h.Recovery position

LOCATION AIDS to include: a. Visual location aids; b. Sea cell powered light; c.Waterproof signal torch; d. Heliograph mirror; e. Pyrotechnics; f. Personal location devices and EPIRB; g. Radar transponder; h. Emergency radios

RESCUE to include: a. Search and rescue operations and techniques; b.Reception of evacuees and survivors; c. Rescue techniques using surface vessels, aircraft, fixed wing and helicopters

PHYSIOLOGY (physiological aspects of cold water survival): to include: a.Immersion; b. Post immersion; c. Initial immersion; d. Short term immersion; e.Long term immersion; f. Effects of hypothermia; g. Rapid recovery; h.Re-warming by immersion

WET DRILL (PRACTICAL) to include: a. Entering water from a height; b.Boarding a liferaft; c. Righting an inverted raft; d. Rescue techniques

HELICOPTER UNDERWATER ESCAPE (PRACTICAL) to include: a. Ditching on water; b. Surface evacuation into a heliraft; c. Partial submersion; d. Rapid capsize; e. Aviation lifejacket inflation; f. Helicopter winching exercise

ABANDONMENT EXERCISE (PRACTICAL) to include: a. Survival techniques using survival suits and lifejackets; b. Liferaft inflation; c. Casualty care; d. Water entry from a height

TEMPSC INTRODUCTION to include: a. Types of TEMPSC and construction details; b. Capacity, seating arrangement and use of seat belts; c. Self righting capability; d. Inherent buoyancy; e. Function of TEMPSC; f. Engine and helm position controls; g. Primary and secondary method of engine start; h. Deluge system; i. Life support system; j. Fuel system and location of valves; k.Ancillary equipment; l. Compass; m. Clearing installation and taking up safe position

DAVIT EXERCISE to include: a. Operation of lowering and release mechanism; b. Clearing away and preparation of TEMPSC prior to abandonment; c. Pre-abandonment checks; d. Boarding procedures; e. System of recovery

ABANDONMENT EXERCISE to include: a. TEMPSC muster; b. TEMPSC Preparation; c. Embarkation; d.Lowering and release

SEA EXERCISE to include: a. Steering; b. Recovery of man overboard; c.Streaming and recovery of sea anchor; d. Operation and firing of parachute rocket

TEMPSC THEORY to include: a. Single fall; b. Double fall; c. Use of TEMPSC emergency equipment and supplies.

FIREFIGHTING

ADMINISTRATION/INTRODUCTION/REVISION OF BASIC FIREFIGHTING to include: a. Introduction; b. Objectives; c. Programme; d.Safety

COMBUSTION THEORY to include: a. Fire spread; b. Fire extinction; c.Classes of Fire

SELF RESCUE THEORY to include: a. Movement in smoke; b. Escape breathing apparatus; c. Assisting others; d. Escape procedures; e. Self rescue

BA EXERCISE (PRACTICAL) to include: a. Protective clothing issue; b.Donning BA; c. Walkabout; d. Visual Inspection; e. Operation of smoke hoods

SMOKE HOUSE EXERCISE (PRACTICAL) to include: a. Group exercise; b.Don short duration sets; c. Assisting each other; d. Subjection to real fire and smoke conditions

GOOD HOUSEKEEPING to include: a. Fire prevention; b.Actions in an emergency

PRACTICAL EXERCISE to include: a. Hose running dry; b. Hose running wet; c. Monitor and branch pipe

EXTINGUISHER EXERCISE (PRACTICAL) to include: a. Extinguishing a pan; b.Extinguishing fires with water; c. Extinguishing fires with foam; d.Extinguishing fires with CO2

APPENDIX B - COURSE SPECIFIC QUESTIONNAIRES

CONFIDENTIAL

SUBJECT DETAILS - 1

Course: ....

Personal Code: ....**Date:** ....

Order of Events (number from 1 to 4)

Firefighting ....HUET .... Abandonment ....TEMPSC ....

Name: ....

Address: ....

....

....

Phone No: .... (Home): .... (Aberdeen if different)

Age yrs: .... M/F

Occupation: ....

Have you declared on the medical screening form that you are fit to undertake the practical aspect of the course with safety, and that you are free from significant disease?

Tick Box

Yes ☐ **No** ☐

SUBJECT DETAILS - 2

PERSONAL CODE: ....**DATE:** ....

Directions: Please answer all questions below which are applicable to you. Be frank and where details are required be as specific as possible. Where "Yes" and "No" options are given, tick the appropriate box.

		Yes	No
1	Are you presently in employment?	☐ (1)	☐ (2)
2	Have you ever worked offshore?	☐ (1)	☐ (2)

3 If yes; when was your last visit? Give date:.......................

4 When was your first visit? Give date: ....

5 On average, how many weeks per year do/did you spend offshore? ....wks

		Yes	No
6	Have you taken part in survival training on a previous occasion?	☐ (1)	☐ (2)

7 If yes; what courses have you attended? Please give details of course type, place where the course was held and dates:

....

....

		Yes	No
8	Do you smoke?	☐ (1)	☐ (2)

9 If yes; number of cigarettes per day?...........

10	Do you regularly participate in exercise or sport?	☐ (1)	☐ (2)

11 If yes; give details of exercise/sport type and how frequently you take part:

....

SUBJECT DETAILS - 3 PSE

PERSONAL CODE: ....**DATE:** ....

Please answer all of the following questions. If you have any queries ask the Research Officer. Where several options are given for your answer, please circle the option that you feel is most appropriate to you. Give answers which reflect yourself as honestly as possible. The information you supply may be used to improve the quality of course content in future.

12 What is your main reason for completing the offshore survival course?

"Tick One"

a) It will help me to get a job ☐ (1)

b) It is a requirement for me to continue in my present job. ☐ (2)

c) Other ☐ (3)
Please specify..

....

13 How would you rate your physical fitness?

Very fit (1) **Quite fit (2)** **Adequate (3)** **Unfit (4)**

14 How would you rate your swimming ability?

Very good (1) **Quite good (2)** **Adequate (3)** **Non-swimmer (4)**

Do you have any previous knowledge or experience of:

		Yes	**No**
15	Helicopter underwater escape? If yes, give details	☐ (1)	☐ (2)
16	Abandonment procedures? If yes, give details	☐ (1)	☐ (2)
17	Firefighting? If yes, give details	☐ (1)	☐ (2)

		Yes	No
18	Lifeboats? If yes, give details	☐ (1)	☐ (2)

....

19 Of the following four exercises, which do you think you will handle <u>most</u> effectively?

"Tick One"

Lifeboats	☐ (1)
Firefighting	☐ (2)
Helicopter underwater escape	☐ (3)
Abandonment procedures	☐ (4)

20 Of the following four exercises, which do you think you will handle <u>least</u> effectively?

"Tick One"

Lifeboats	☐ (1)
Firefighting	☐ (2)
Helicopter underwater escape	☐ (3)
Abandonment procedures	☐ (4)

21 How much of an achievement would you consider completion of the course to be?

Great (1) **Moderate (2)** **Slight (3)** **Zero (4)**

Refreshers Only:

		Yes	No
22	Do you think that completion of the refresher course will improve your <u>confidence</u> in your knowledge of survival techniques?	☐ (1)	☐ (2)

23 Which aspects of survival training do you think need to be practised at regular intervals?

....

....

FIREFIGHTING EVALUATION

PERSONAL CODE: ....**DATE:** ....

Direction: Please answer all questions as honestly and frankly as possible. Where appropriate, tick the box which most applies to you, at this moment. All information will be treated in a confidential manner. The results of the evaluation may be used to modify training methods for the benefit of others.

26 Which aspect of the firefighting training did you find most difficult to cope with?

- Smoke ☐ (1)
- Dark ☐ (2)
- Claustrophobia ☐ (3)
- Disorientation ☐ (4)
- Physical Exertion ☐ (5)
- Heat ☐ (6)
- Flames ☐ (7)
- Remembering instructions ☐ (8)
- General Anxiety ☐ (9)

27 Which exercise did you find to be the most difficult?

- BA donning and walkabout ☐ (1)
- Cosmetic smoke exercise ☐ (2)
- Real smoke and no BA ☐ (3)
- Extinguisher practise ☐ (4)
- Valve isolation ☐ (5)
- Escape BA exercise - self rescue ☐ (6)

Why did you find this to be the most difficult?.....................................

....

28 Are you satisfied with the way you coped with the firefighting training? (Please circle the response which you think best describes your feelings).

Very well (1) **Well (2)** **Somewhat (3)** **Not at all (4)**

HELICOPTER UNDERWATER ESCAPE EVALUATION

PERSONAL CODE..**DATE:**..

Directions: Please answer all questions as honestly and frankly as possible. Where appropriate, tick the box which most applies to you, at this moment. All information will be treated in a confidential manner. The results of the evaluation may be used to modify training methods for the benefit of others.

29 Which aspect of the helicopter underwater escape did you find most difficult to cope with?

- Swimming ☐ (1)
- Holding breath ☐ (2)
- Disorientation ☐ (3)
- Releasing seat belt ☐ (4)
- Finding exit ☐ (5)
- General anxiety ☐ (6)
- Remembering instructions ☐ (7)

30 Which exercise did you find to be the most difficult?

- Upright escape ☐ (1)
- Slow capsize ☐ (2)
- Fast capsize ☐ (3)

Why did you find this to be the most difficult?.....................................

....

....

31 Are you satisfied with the way you coped with the helicopter underwater escape training? (Please circle the response which you think best describes <u>your</u> feelings).

Very well (1) **Well (2)** **Somewhat (3)** **Not at all (4)**

ABANDONMENT EVALUATION

PERSONAL CODE:..DATE:............................

Directions: Please answer all questions as honestly and frankly as possible. Where appropriate, tick the box which most applies to you, at this moment. All information will be treated in a confidential manner. The results of the evaluation may be used to modify training methods for the benefit of others.

32 Which aspect of the abandonment training did you find most difficult to cope with?

Swimming in calm water	☐ (1)
Swimming in waves	☐ (2)
General physical activity	☐ (3)
Motion of liferaft	☐ (4)
General anxiety	☐ (5)
Remembering instructions	☐ (6)

33 Which exercise did you find to be the most difficult?

"Step off" water entry - low	☐ (1)
"Step off" water entry - high	☐ (2)
Descending knotted rope	☐ (3)
Climbing scramble nets	☐ (4)
Righting upturned liferaft	☐ (5)
Entering liferaft from water	☐ (6)
Towing casualty in water	☐ (7)

Why did you find this to be the most difficult? ....

....

34 Are you satisfied with the way you coped with the abandonment training? (Please circle the response which you think best describes <u>your</u> feelings).

Very well (1) **Well (2)** **Somewhat (3)** **Not at all (4)**

TEMPSC EVALUATION

PERSONAL CODE:..**DATE:** ....

Directions: Please answer all questions as honestly and frankly as possible. Where appropriate, tick the box which most applies to you, at this moment. All information will be treated in a confidential manner. The results of the evaluation may be used to modify training methods for the benefit of others.

35 Which aspect of the TEMPSC training did you find most difficult to cope with?

Boarding the craft	☐	(1)
Finding seat and strapping in belt	☐	(2)
Claustrophobia	☐	(3)
Motion	☐	(4)
Smell	☐	(5)
Steering the craft	☐	(6)
General anxiety	☐	(7)
Remembering instructions	☐	(8)

36 Which exercise did you find to be the most difficult?

Cosxwain and mechanic training	☐	(1)
Abandonment and launch from davits	☐	(2)
Boat handling at sea	☐	(3)

Why did you find this to be the most difficult? ....

....

Coxswain and mechanics: Any specific problems? ....

....

37 Are you satisfied with the way you coped with the TEMPSC training? (Please circle the response which you think best describes <u>your</u> feelings).

Very well (1) **Well (2)** **Somewhat (3)** **Not at all (4)**

PERCEIVED OUTCOME

PERSONAL CODE:...DATE:................................

Please circle the response which you think best describes your feelings.

38 How much more capable do you now feel of safely evacuating from an offshore installation, during an emergency, than you did prior to this training course?
Much (1) Moderately (2) Slightly (3) No change (4)

39 How much more capable do you now feel of coping with a fire, than you did prior to this training course?
Much (1) Moderately (2) Slightly (3) No change (4)

40 How much more capable do you now feel of coping with a helicopter ditching, than you did prior to this training course?
Much (1) Moderately (2) Slightly (3) No change (4)

41 Has the training altered your confidence in helicopter transport?
Greatly increased (1) Somewhat increased (2) No difference (3)

Somewhat decreased (4) Greatly decreased (5)

42 Do you feel that the course has improved your knowledge of survival techniques?
Much (1) Moderately (2) Slightly (3) No change (4)

43 Do you think that the training has made you more able to cope with other emergency situations?
Much (1) Moderately (2) Slightly (3) No change (4)

Finally:

44 Was the training course as physically demanding as you expected?
Much more (1) Somewhat more (2) As expected (3)

Somewhat less (4) Much less (5)

45 Was the training course as emotionally demanding as you expected?
Much more (1) Somewhat more (2) As expected (3)

Somewhat less (4) Much less (5)

46 Was there any parts of the training which you consider to be more demanding than necessary?
Please give details; ....

....

....

APPENDIX C - EXERCISE TEST PROTOCOL

PROTOCOL FOR AEROBIC FITNESS TEST

Fit subject with Heart Rate monitor (set at 5 second intervals) and ECG leads. With subject seated note resting heart rate.

Adjust seat height of cycle, such that subject's leg is virtually straight, when pedal is at the lowest point.

Ask subject to commence cycling for 3 minutes at 50 RPM, with no load.

Stage	**Qualifying criteria**	**Work Rate Increase (Watts)**	**Duration**
First	Age (years)	Sedentary Active	Until HR reaches a steady state*. Over a mininum of 4 minutes and a maximum of 6 minutes.
	> 40	50 75	
	< 40	75 100	
	Steady State HR (bpm)	All	
Second	< 110	50	Until steady state HR reached, as above
	> 110, < 130	25	
	> 130	0	Discontinue, providing a steady state HR has been reached.
Third	< 125	50	Until steady state HR reached, as above.
	> 125, < 150	25	
	> 150	0	Discontinue, as above.

Continue as per the third stage.

* Steady State Heart Rate - whereby a value is found which is the same on 3 consecutive readings.

BICYCLE ERGOMETER TEST

Personal Code..
Date...........................

Resting Heart Rate seated (bpm)..................................

Heart Rates (bpm)

Stopwatch Time (Minutes)	Work Rate (Watts)	Heart Rates (bpm) at minute:					
		1	2	3	4	5	6

APPENDIX D - DATASET CODES

No	Title	Code
	Subject number	SUBJCT
	Refresher (1) or Combined (2)	ROC
1	Are you presently in employment?	MPLOY
2	Have you ever worked offshore?	OFSHORE
3	If yes, when was your last visit? Give date (Year)	LASTVYY
4	When was your first visit? Give date (Year)	FIRSTVYY
5	On average how many weeks do/did you spend offshore?	WKS
6	Have you taken part in survival training on a previous occasion?	TRNING
8	Do you smoke?	SMOKE
9	If yes; no. of cigarettes per day?	CIGS
10	Do you regularly participate in exercise or sport?	SPORT
11	Sport - times per week?	FREQ
12	What is your main reason for completing the offshore survival course?	REASON
13	How would you rate your physical fitness?	FIT
14	How would you rate your swimming ability?	SWIM
15	Experience of HUET?	H_EXP
16	Experience of Abandonment procedures?	A_EXP
17	Experience of Firefighting procedures?	F_EXP
18	Experience of Lifeboats?	L_EXP
19	Which exercise do you think you will handle most effectively?	MEFCT
20	Which exercise do you think you will handle least effectively?	LEFCT
21	How much of an achievement would you consider the course to be?	ACHIEVE
22	Do you think that completion of the refresher course will improve your confidence in your knowledge of survival techniques?	R_CONFID
26	Which aspect of the Firefighting training did you find most difficult to cope with?	F_COPE
27	Which exercise did you find to be the most difficult?	F_DIF
28	Are you satisfied with the way you coped with the firefighting training?	F_SATIS
29	Which aspect of the HUET did you find most difficult to cope with?	H_COPE
30	Which exercise did you find to be the most difficult?	H_DIF
31	Are you satisfied with the way you coped with the HUET training?	H_SATIS
32	Which aspect of the abandonment training did you find most difficult to cope with?	A_COPE
33	Which exercise did you find to be the most difficult?	A_DIF
34	Are you satisfied with the way you coped with the abandonment training?	A_SATIS
35	Which aspect of the TEMPSC training did you find most difficult to cope with?	T_COPE
36	Which exercise did you find to be the most difficult?	T_DIF

37	Are you satisfied with the way you coped with the TEMPSC training?	T_SATIS
38	How much more capable do you now feel of safely evacuating from an offshore installation, during an emergency, than you did prior to this training course?	EV_CAPBL
39	How much more capable do you now feel of coping with a fire, than you did prior to this training course?	F_CAPBL
40	How much more capable do you now feel of coping with a helicopter ditching, than you did prior to this training course?	HD_CAPBL
41	Has the training altered your confidence in helicopter transport?	H_ALTER
42	Do you feel that the course has improved your	ST_ALTER
43	Do you think that the training has made you more able to cope with other emergency situations?	ES_ALTER
44	Was the training course as physically demanding as you expected?	PHYSCAL
45	Was the training course as emotionally demanding as you expected?	EMOTION
46	Day of last visit offshore?	LASTVDD
47	Month of last visit of offshore?	LASTVMM
48	Day of first visit offshore?	FIRSTVDD
49	Month of first visit offshore?	FIRSTVMM
50	Height (cm)	HGHT
51	Weight (kg)	WGHT
52	Age (years)	AGE
53	% Body fat	FAT
54	Forced expiratory volume in 1 second	FEV1
55	Forced vital capacity	FVC
56	Resting heart rate whilst seated (bpm)	HR_RST
57	Average heart rate at 50 watts	HR50
58	Average heart rate at 75 watts	HR75 -
59	Average heart rate at 100 watts	HR100
60	Average heart rate at 125 watts	HR125
61	Average heart rate at 150 watts	HR150
62	Heart rate recovery value over 1 minute	RECOVRY
70	State - Trait Anxiety Inventory Scores - Enrolment trait score	STAI_T
71	STAI - enrolment state score	STAISM1
72	STAI - second morning state score	STAISM2
73	STAI - third morning state score	STAISM3
74	STAI - fourth morning state score	STAISM4
75	STAI - fifth morning state score	STAISM5
76	STAI - pre-HUET state score	STAISH
77	STAI - pre-Abandonment state score	STAISA
78	STAI - pre-fire exercise state score	STAISF
79	STAI - pre TEMPSC abandonment state score	STAIST
80	Internal versus external locus of control score	LOC
81	Interest and preference test total score	I&PTT
82	Interest and preference test, thrill and adventure seeking score.	I&PTAS
83	Interest and preference test, experience seeking score.	I&PES
84	Interest and preference test, disinhibition score.	I&PDIS

85	Interest and preference test, boredom susceptibility score.	I&PBS
90	Urinary cortisol against creatinine enrolment score (nmol/L/µmol/L)	RUFCE
91	Urinary cortisol against creatinine second morning (nmol/L/µmol/L)	RUFC2
92	Urinary cortisol against creatinine third morning (nmol/L/µmol/L)	RUFC3
93	Urinary cortisol against creatinine fourth morning (nmol/L/µmol/L)	RUFC4
94	Urinary cortisol against creatinine fifth morning (nmol/L/µmol/L)	RUFC5
95	Absolute urinary cortisol at enrolment (nmol/L).	AUFCE
96	Absolute urinary cortisol second morning (nmol/L).	AUFC2
97	Absolute urinary cortisol third morning (nmol/L).	AUFC3
98	Absolute urinary cortisol fourth morning (nmol/L).	AUFC4
99	Absolute urinary cortisol fifth morning (nmol/L).	AUFC5
100	Salivarycortisol at enrolment(nmol/L).	SCE
101	Salivary cortisol before HUET(nmol/L).	SCHB
102	Salivary cortisol after HUET(nmol/L).	SCHA
103	Salivary cortisol before abandonment(nmol/L).	SCAB
104	Salivary cortisol after abandonment(nmol/L).	SCAA
105	Salivary cortisol before smoke BA exercise(nmol/L).	SCFB
106	Salivary cortisol after smoke BA exercise(nmol/L).	SCFA
107	Salivary cortisol before TEMPSC abandonment(nmol/L).	SCTB
108	Salivary cortisol after TEMPSC abandonment(nmol/L).	SCTA
109	Salivary cortisol before exercise test(nmol/L).	SCXB
110	Salivary cortisol after exercise test(nmol/L).	SCXA
116	Self measured heart rate value on second morning.	HRM2
117	Self measured heart rate value on third morning.	HRM3
118	Self measured heart rate value on fourth morning.	HRM4
119	Self measured heart rate value on fifth morning.	HRM5
120	Heart rate average over 5 minutes during HUET brief.	HRAHBRF
121	Heart rate average over 1 minute steady state prior to entering water for HUET.	HRAH1
122	Heart rate average during surface impact and partial submersion exercises - combined.	HRAH2C
123	Heart rate average during slow and rapid capsizes - combined.	HRAH3C
124	Heart rate average during refresher HUET exercises.	HRAH2R
125	Percentage of time HR above 150bpm during 1st combined HUET exercises	PHRMH2C
126	Percentage of time HR between 120 and 150bpm during 1st combined HUET exercises.	PHREQH2C
127	Percentage of time HR below 120bpm during 1st combined HUET exercises.	PHRLSH2C
128	Percentage of time HR above 150bpm during 2nd combined HUET exercises.	PHRMH3C
129	Percentage of time HR between 120 and 150bpm during 2nd combined HUET exercises.	PHREQH3C
130	Percentage of time HR below 120bpm during 2nd combined HUET exercise.	PHRLSH3C
131	Percentage of time HR above 150bpm during refresher HUET exercises.	PHRMH2R

132	Percentage of time HR between 120 and 150bpm during refresher HUET exercises.	PHREQH2R
133	Percentage of time HR below 120bpm during refresher HUET exercises.	PHRLSH2R
134	Heart rate average post HUET.	HRA_HPST
135	Heart rate average for 1 minute steady statepre-abandonment.	HRAA1
136	Heart rate average during abandonment.	HRAA2
137	Heart rate average for 1 minute steady state during abandonment debrief.	HRAA3
138	Percentage of time HR above 150bpm during abandonment.	PHRMA2
139	Percentage of time HR between 120 and 150bpm during abandonment.	PHREQA2
140	Percentage of time HR below 120bpm during abandonment.	PHRLSA2
141	Heart rate average for 1 minute steady state during smoke BA exercise brief.	HRAF1
142	Heart rate average during smoke BA exercise.	HRAF2
143	Heart rate average for 1 minute steady statewithin 3 minutes post smoke BA.	HRAF3
144	Percentage of time HR above 150bpm during smoke BA exercise.	PHFMF2
145	Percentage of time HR between 120 and 150bpm during smoke BA exercise.	PHREQF2
146	Percentage of time HR below 120bpm during smoke BA exercise.	PHRLSF2
147	Heart rate average for 1 minute steady state during TEMPSC brief.	HRAT1
148	Heart rate average during 1st TEMPSC abandonment.	HRAT2
149	Heart rate average for 1 minute steady state post 1st TEMPSC abandonment.	HRAT3
150	Percentage of time HR above 150bpm during TEMPSC abandonment.	PHRMT2
151	Percentage of time HR between 120 and 150bpm during TEMPSC abandonment.	PHREQT2
152	Percentage of time HR below 120bpm during TEMPSC abandonment.	PHRLST2
153	Average heart rate whilst at sea.	HRASEA

APPENDIX E - VOLUNTEER INFORMATION & CONSENT FORMS

RGIT LIMITED

VOLUNTEER INFORMATION

Evaluation of Survival Training

This investigation has been designed to measure the physical and psychological effects of the survival training course on its participants. The information gained will help the company to evaluate the effectiveness of the training and as a result, to change procedures where necessary.

The physical reactions of your body will be measured by two means:-

1) **Heart rate** - Your heart rate will be measured by small sensors taped to your chest, with a wrist-watch type monitor.

2) **Cortisol** - Cortisol is a hormone normally found in your body, which can be measured both in saliva and in urine. Each morning you will be asked to give a small urine sample. Saliva will be sampled on the morning of enrolment, as well as prior to and following some of the practical sessions.

Your emotional reaction to the training and your ability to cope will be assessed by various questionnaires which you will be asked to fill in at the start and completion of the course, as well as others prior to and following some of the practical sessions. You will also be given an activity book to be filled in either by yourself or by the experimenter.

In order to assess your physical fitness you will be asked to complete an exercise test. This involves cycling for 6 minutes at a time, at 2 or 3 rates of work. Body fat will be measured by taking a small pinch of skin at several sites.

Throughout the course your training officers will be in charge of all procedures and their instructions will always take priority over these measurements. The results of the tests made on you will be completely confidential and will not be passed on to your training officers or to your company/employer. All results will be stored in such a way that your name cannot be traced.

It is important to emphasise that you may withdraw your consent at any stage and that this will in no way affect the outcome of your survival training course. The experimenter may also stop taking measurements if appropriate.

CONSENT FORM

Name of Volunteer:..

Name of Principal Investigator: ....

Name of Study: Trainee Evaluation

I ....

of ....

being over 16 years freely and voluntarily consent to take part in tests being undertaken in connection with a study of trainees which so far as is known should not carry any unusual risk.

I have read the volunteer information sheet on the above study. The nature and purpose of the tests to be undertaken in connection with this study have been explained to me by: .... I understand fully what is proposed to be done and under whose supervision the tests will be carried out. I have had the opportunity to discuss the details of the tests and to ask questions.

I have agreed to take part in the study as it has been outlined to me, but I understand that I am completely free to withdraw from the study or any part of the study at any time I wish, and that this will not affect the completion of the training course in any way.

I understand that while this procedure is part of a research project which has been approved by the Joint Ethical Committee, the procedure may be of no benefit to me personally but notwithstanding this, I voluntarily accept any risk associated with the procedure which is not directly attributable to negligence on the part of those undertaking the procedure.

Date: ....

Signature: ....

I confirm that I have explained the nature and purpose of the procedure(s) in respect of which consent has been given by the volunteer.

Date: ....

Signature: ....

Signature witnessed by:..

APPENDIX F - FIGURES OF COURSE QUESTIONNAIRE AND STAI RESULTS, NOT CONTAINED WITHIN THE MAIN TEXT

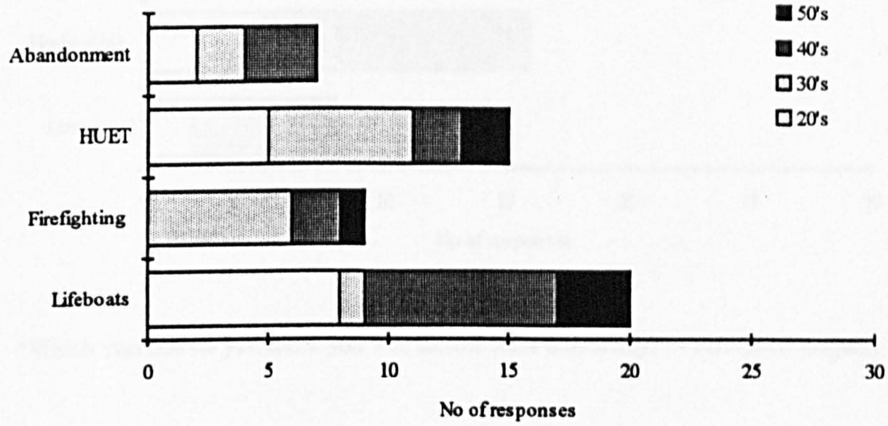

Figure 1a
"Which exercise do you think you will handle most effectively?" - refresher subjects

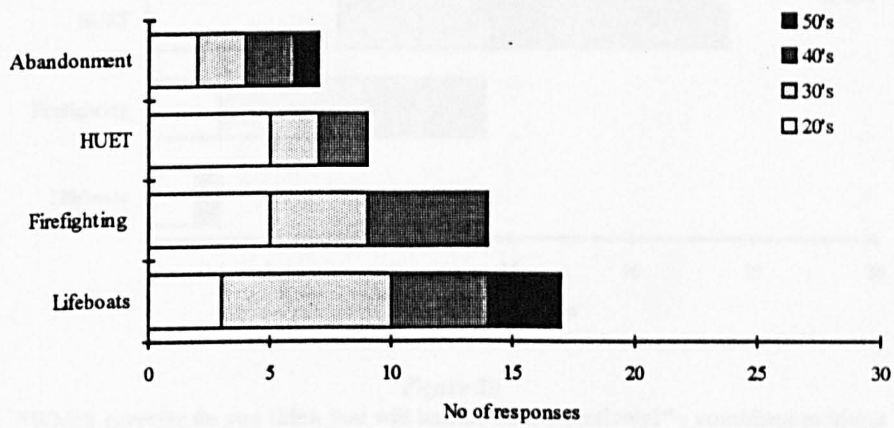

Figure 1b
"Which exercise do you think you will handle most effectively?" - combined subjects

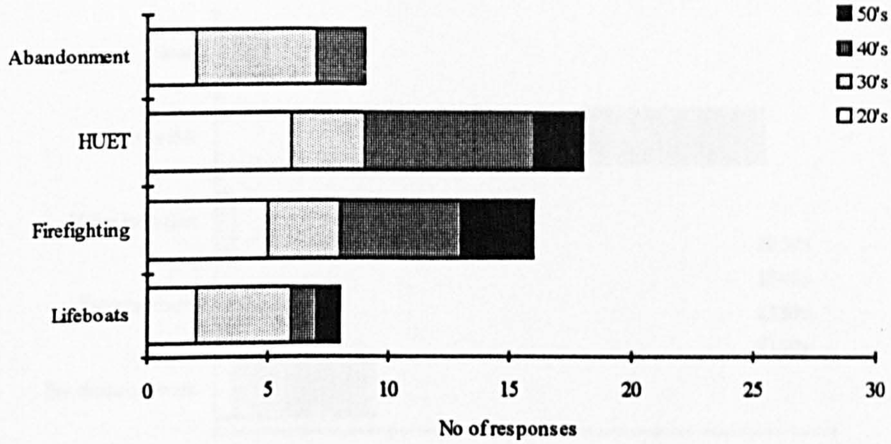

Figure 2a
"Which exercise do you think you will handle least effectively?" - refresher subjects

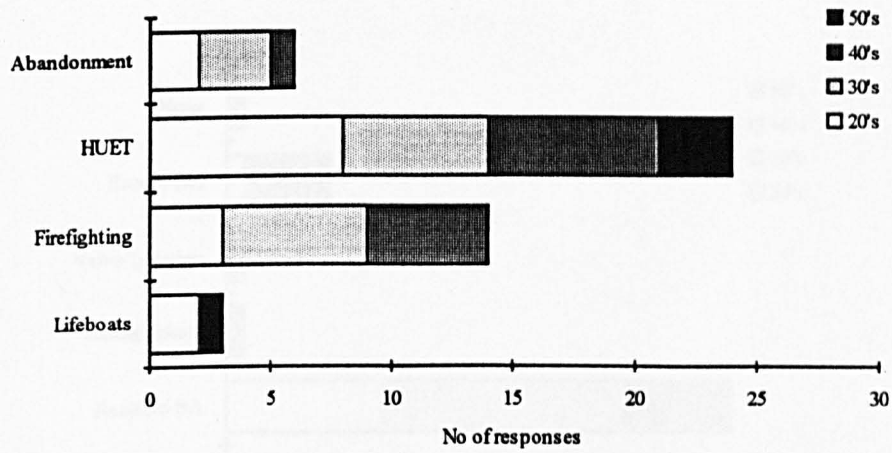

Figure 2b
"Which exercise do you think you will handle least effectively?" - combined subjects

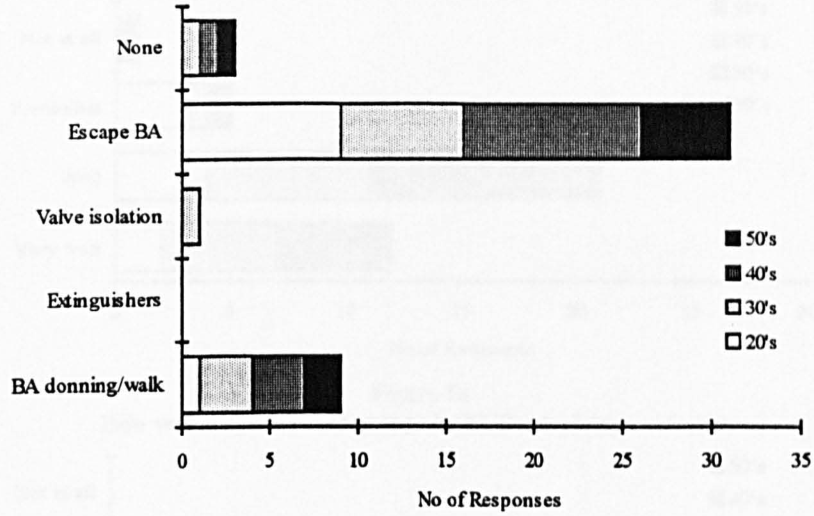

Figure 4a
Most difficult fire training exercise - refresher subjects

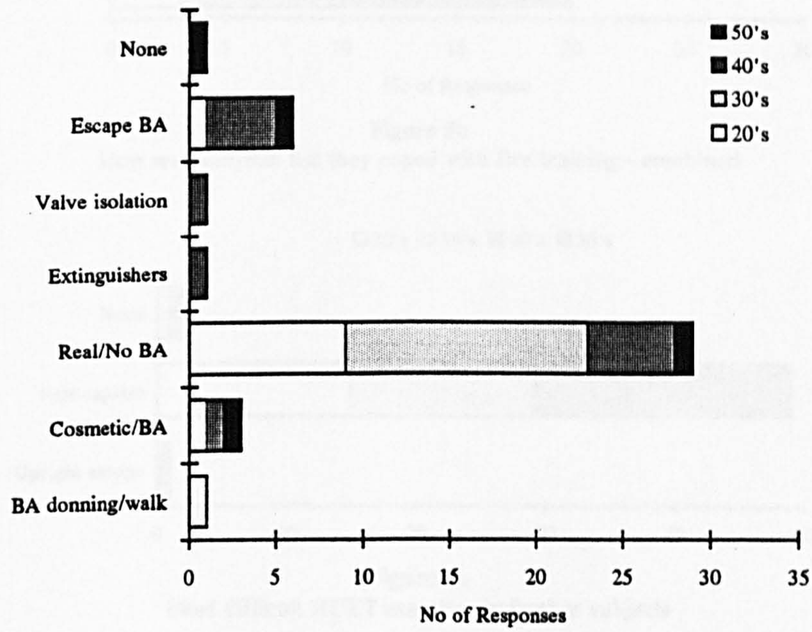

Figure 4b
Most difficult fire training exercise - combined subjects

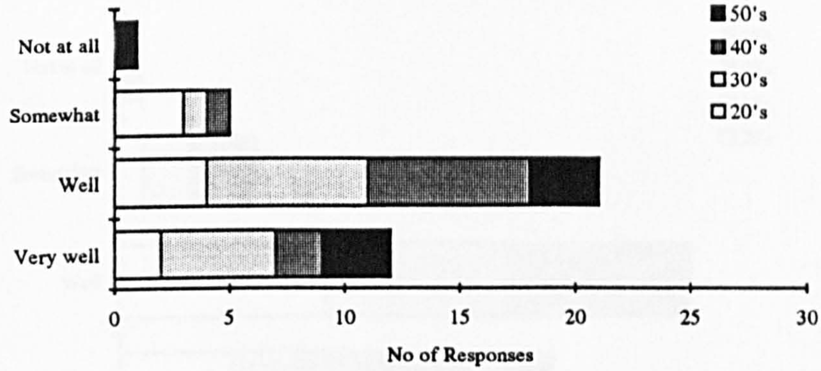

Figure 5a
How well subjects felt they coped with fire training - refresher

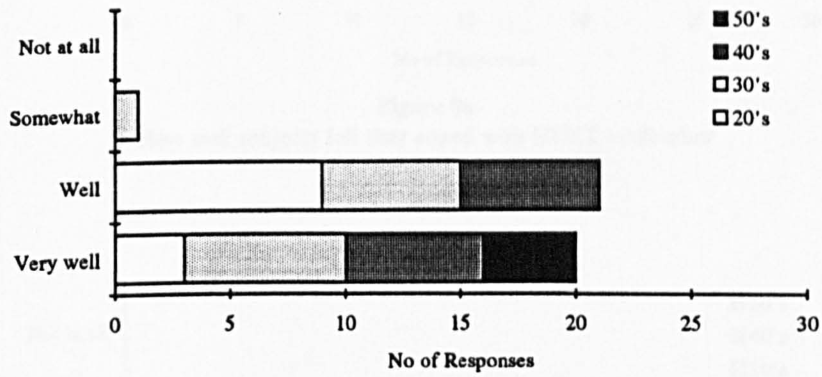

Figure 5b
How well subjects felt they coped with fire training - combined

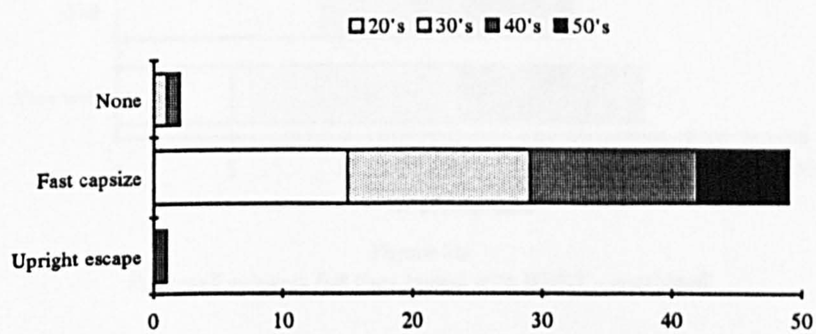

Figure 7a
Most difficult HUET exercise - refresher subjects

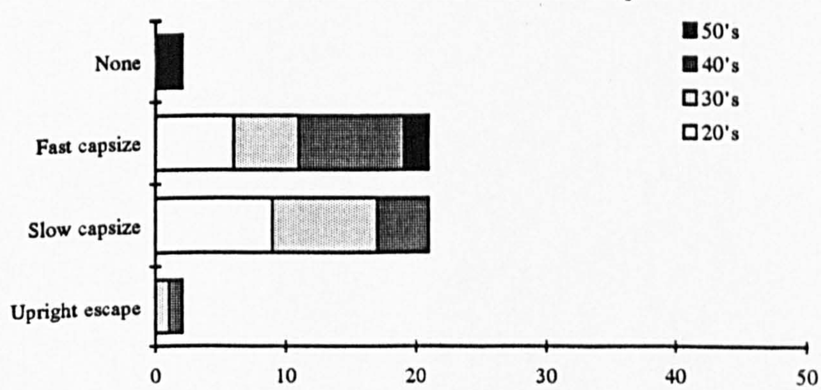

Figure 7b
Most difficult HUET exercise - combined subjects

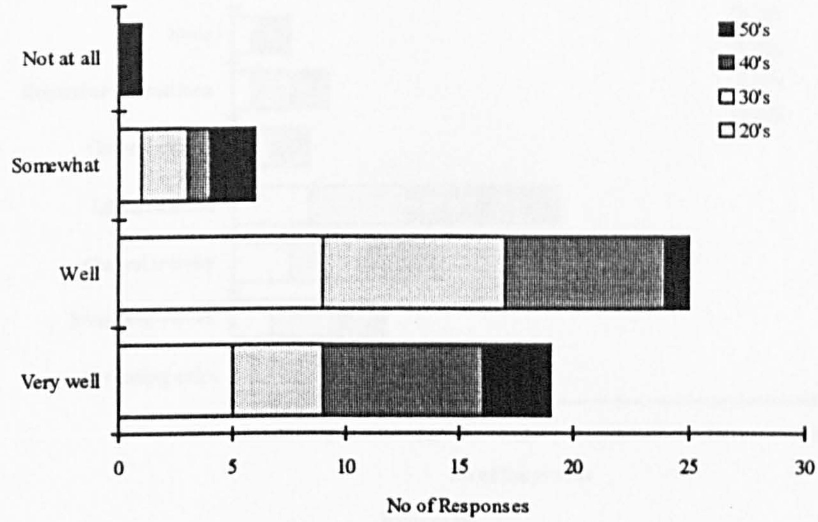

Figure 8a
How well subjects felt they coped with HUET - refresher

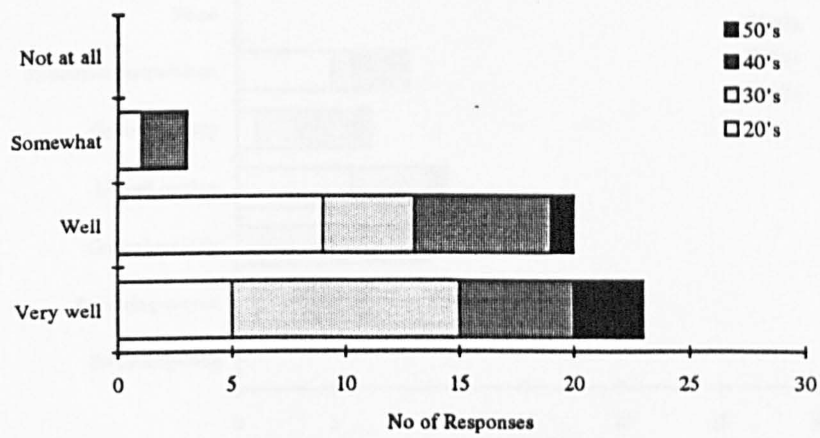

Figure 8b
How well subjects felt they coped with HUET - combined

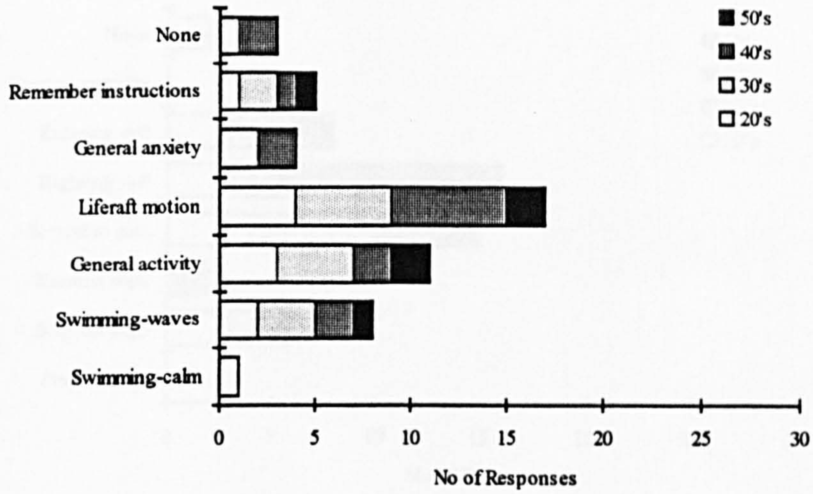

Figure 9a
Aspect of abandonment most difficult to cope with - refresher subjects

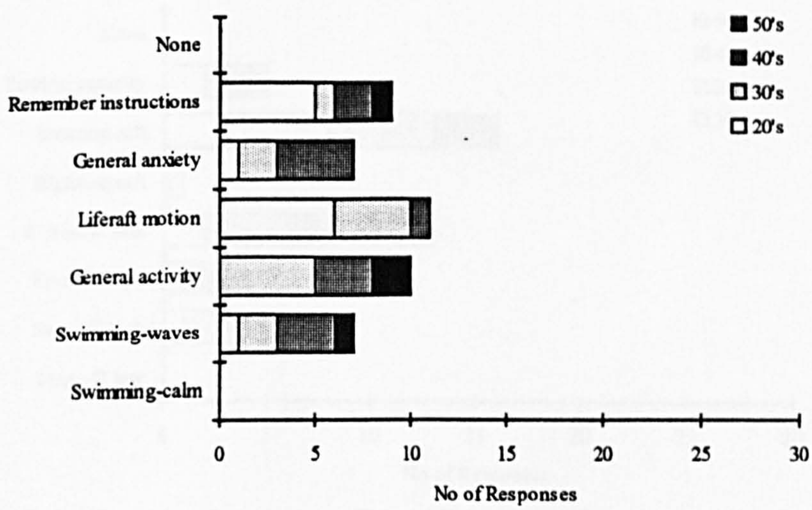

Figure 9b
Aspect of abandonment most difficult to cope with - combined subjects

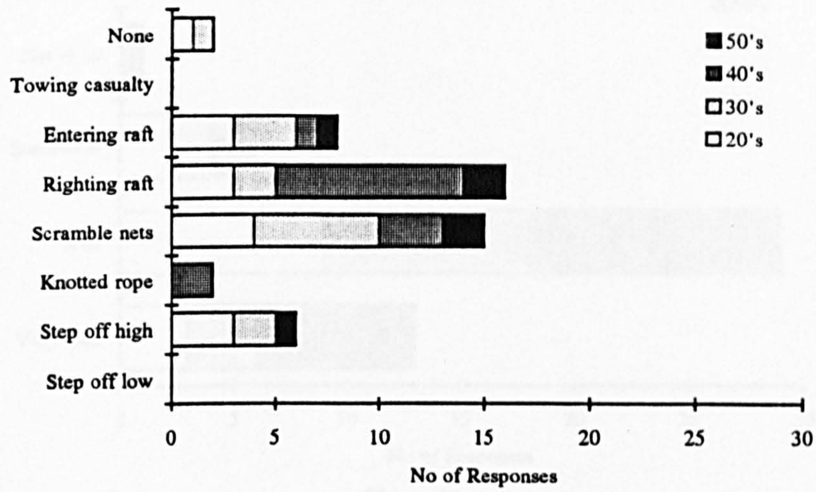

Figure 10a
Most difficult abandonment exercise- refresher subjects

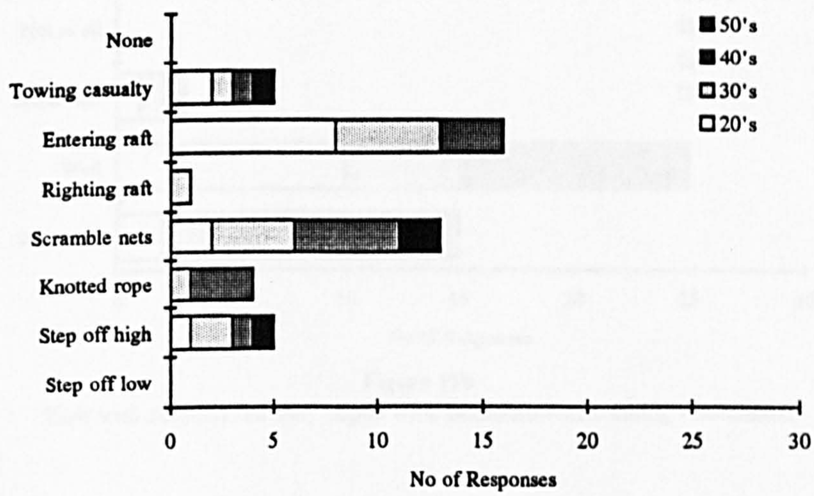

Figure 10b
Most difficult abandonment exercise- combined subjects

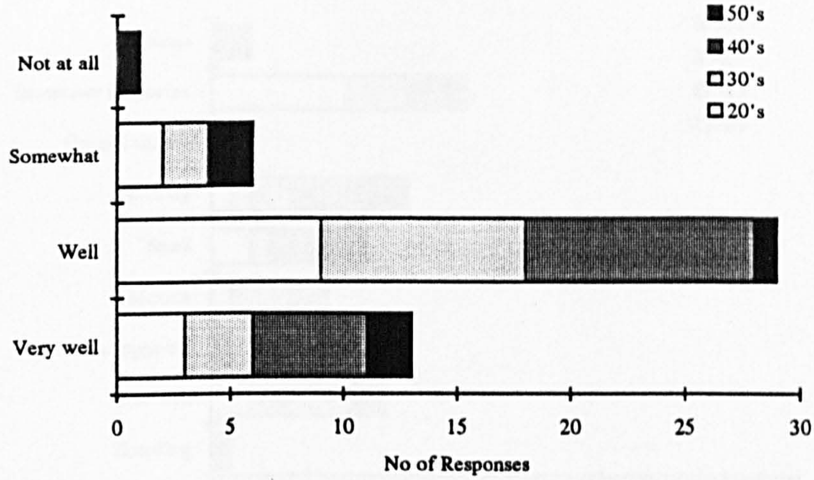

Figure 11a
How well subjects felt they coped with abandonment training - refresher

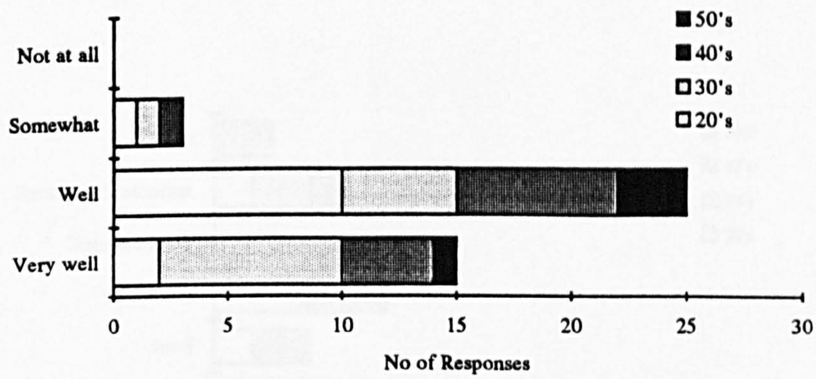

Figure 11b
How well subjects felt they coped with abandonment training - combined

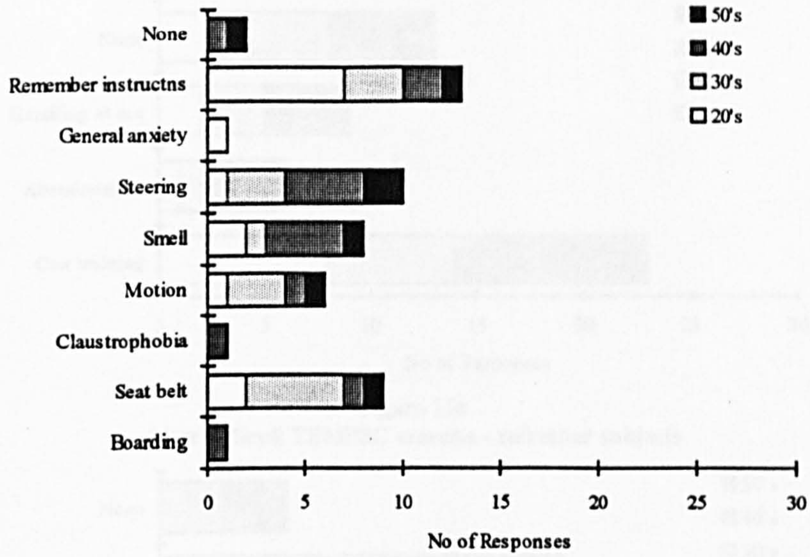

Figure 12a
Aspect of TEMPSC most difficult to cope with - refresher subjects

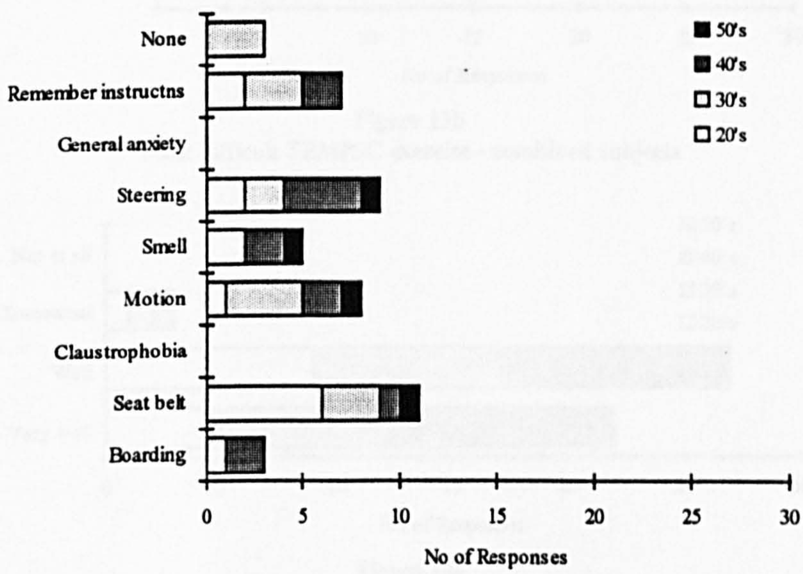

Figure 12b
Aspect of TEMPSC most difficult to cope with - combined subjects

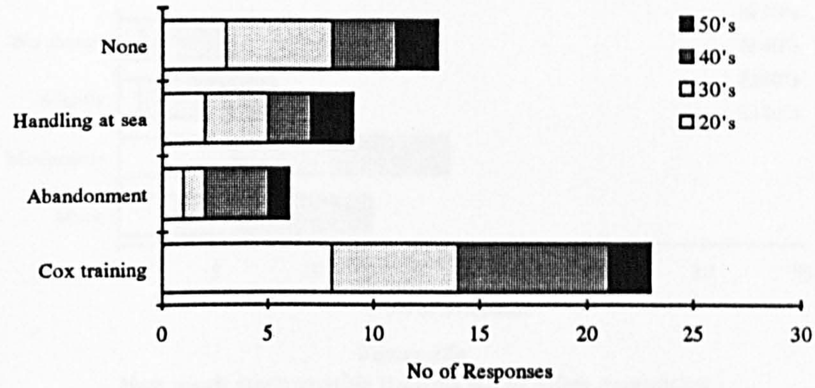

Figure 13a
Most difficult TEMPSC exercise - refresher subjects

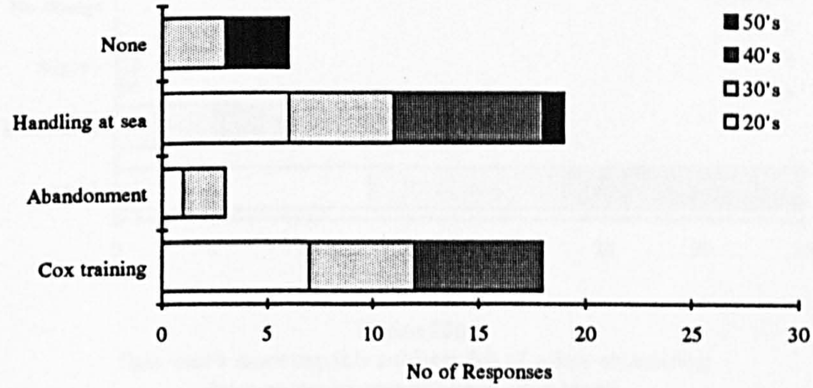

Figure 13b
Most difficult TEMPSC exercise - combined subjects

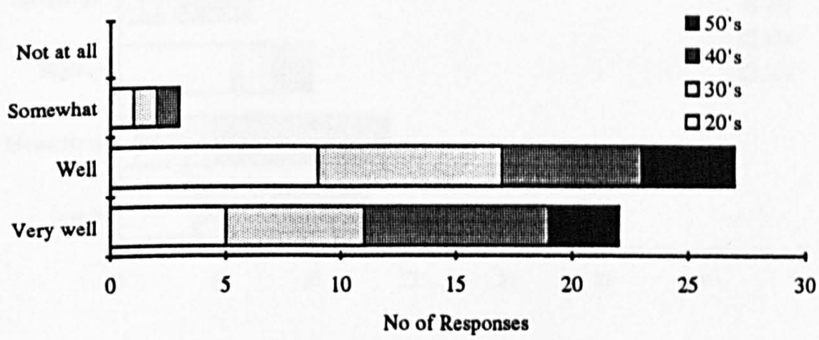

Figure 14a
How well subjects felt they coped with TEMPSC training - refresher

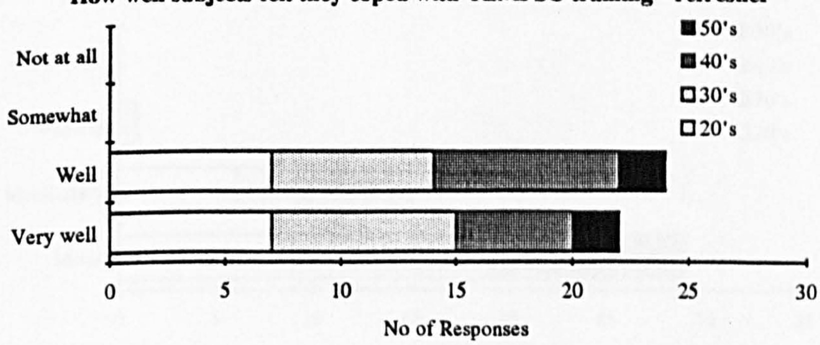

Figure 14b
How well subjects felt they coped with TEMPSC training - combined

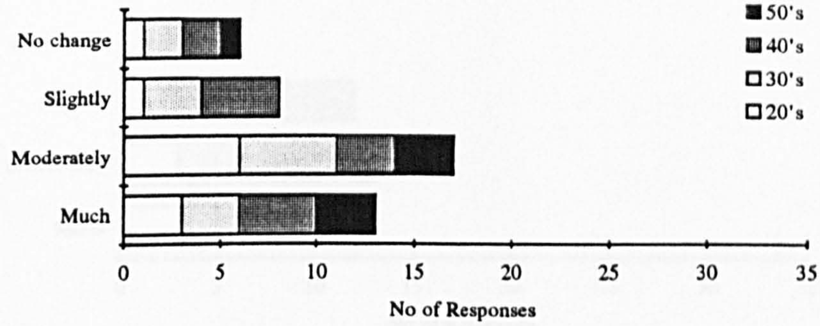

Figure 15a
How much more capable subjects felt of safely evacuating from an emergency offshore - refresher

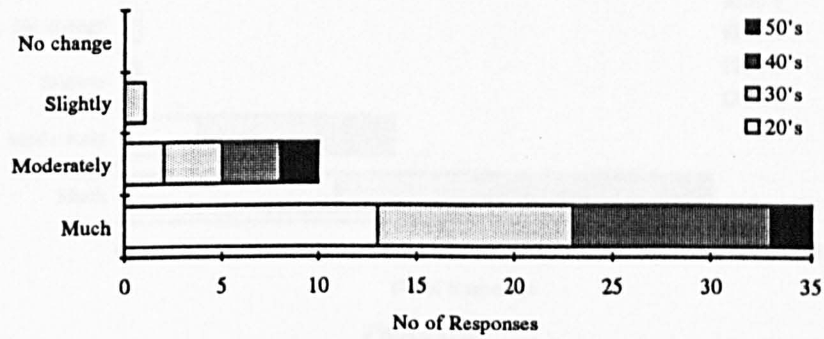

Figure 15b
How much more capable subjects felt of safely evacuating from an emergency offshore - combined

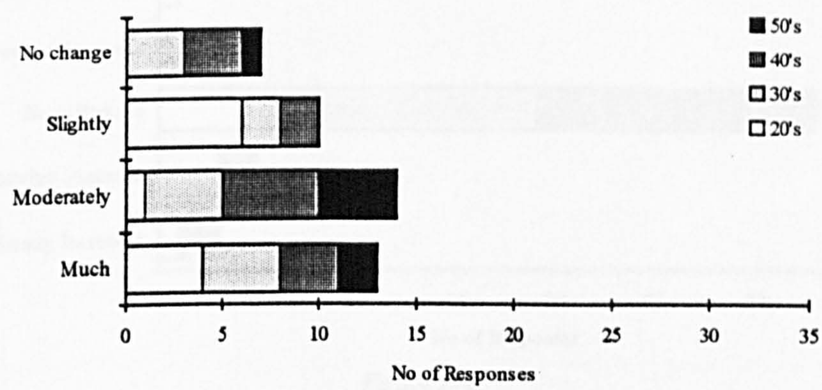

Figure 16a
How much more capable subjects felt of coping with a fire - refresher

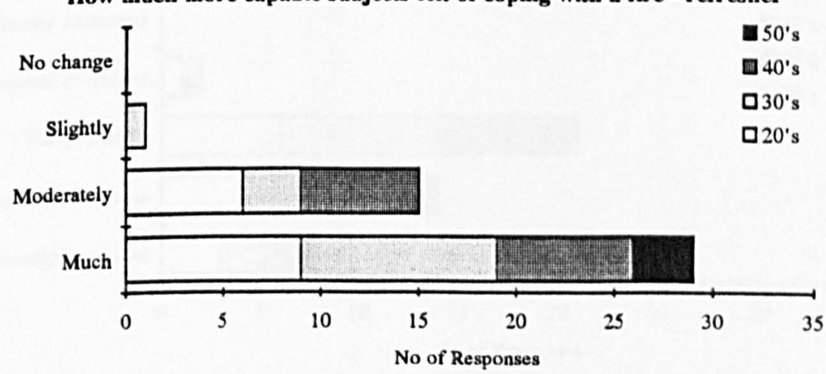

Figure 16b
How much more capable subjects felt of coping with a fire - combined

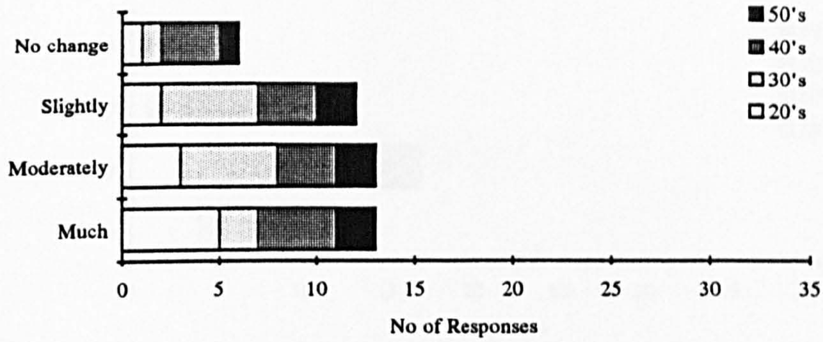

Figure 17a

How much more capable subjects felt of coping with a helicopter ditching - refresher

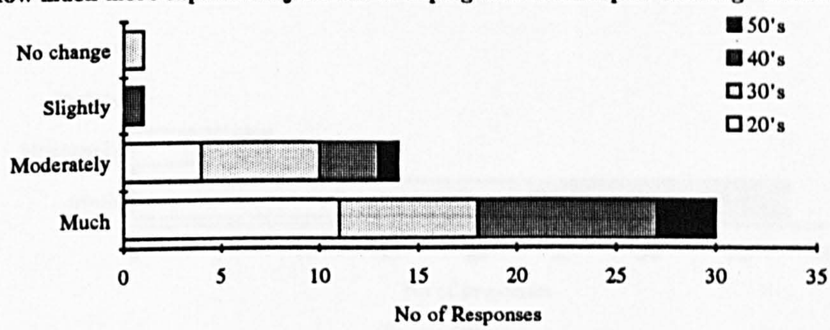

Figure 17b

How much more capable subjects felt of coping with a helicopter ditching - combined

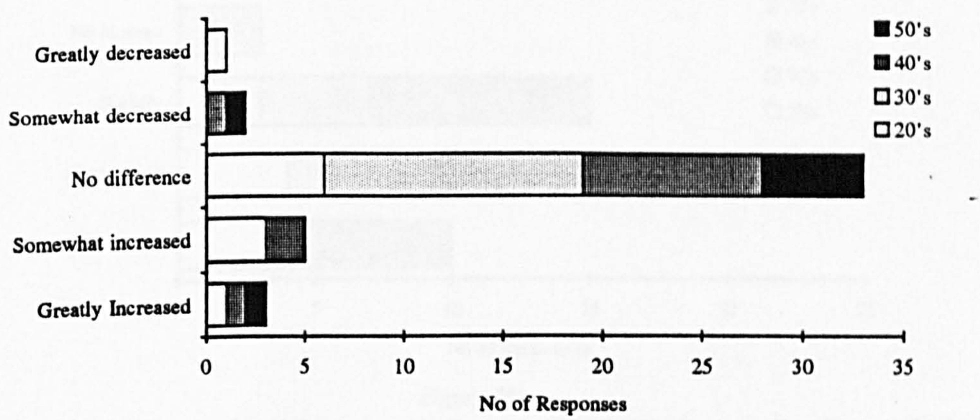

Figure 18a

Whether the training altered subjects' confidence in helicopter transport - refresher

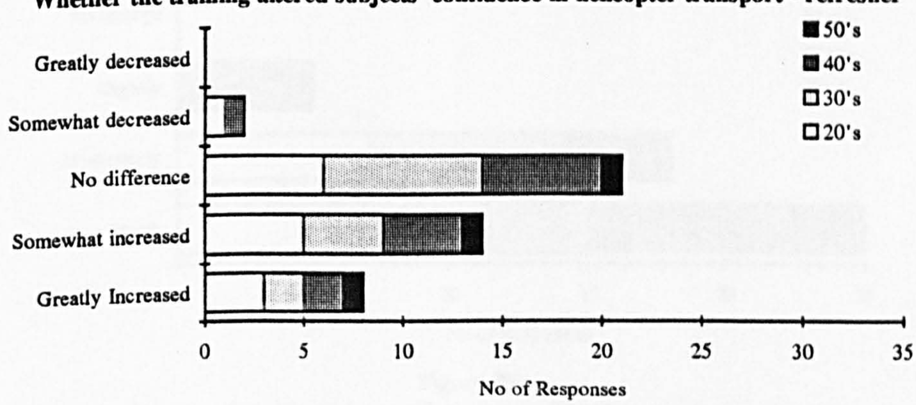

Figure 18b

Whether the training altered subjects' confidence in helicopter transport - combined

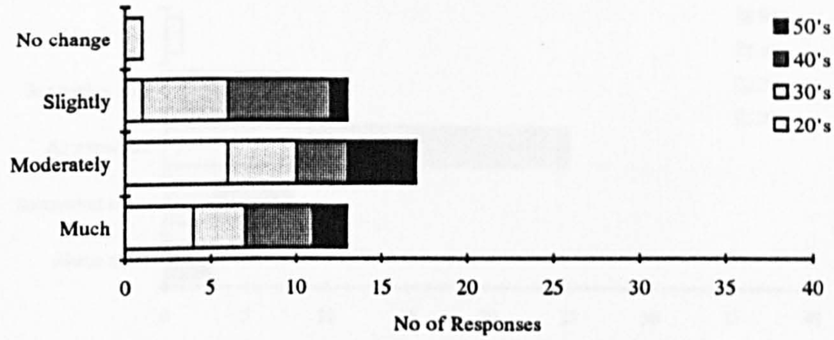

Figure 19a

Whether the course improved subjects' knowledge of survival techniques - refresher

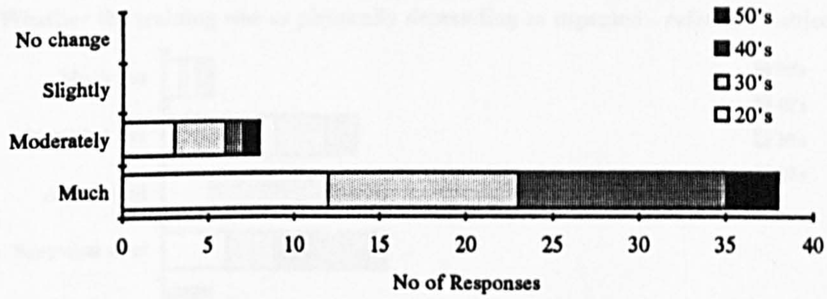

Figure 19b

Whether the course improved subjects' knowledge of survival techniques - combined

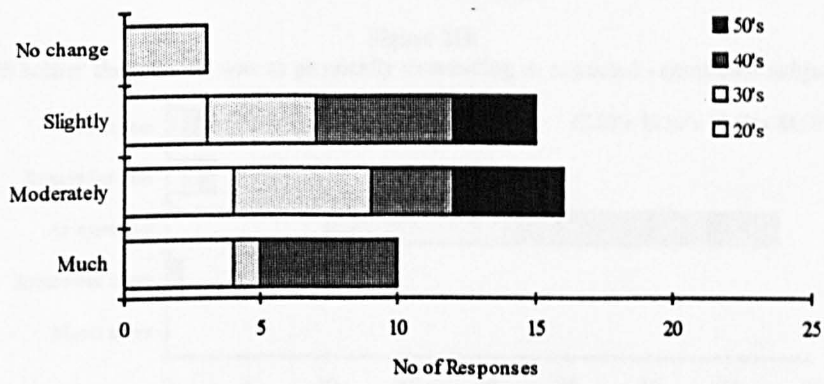

Figure 20a

Whether the training made subjects more able to cope with other emergency situations - refresher

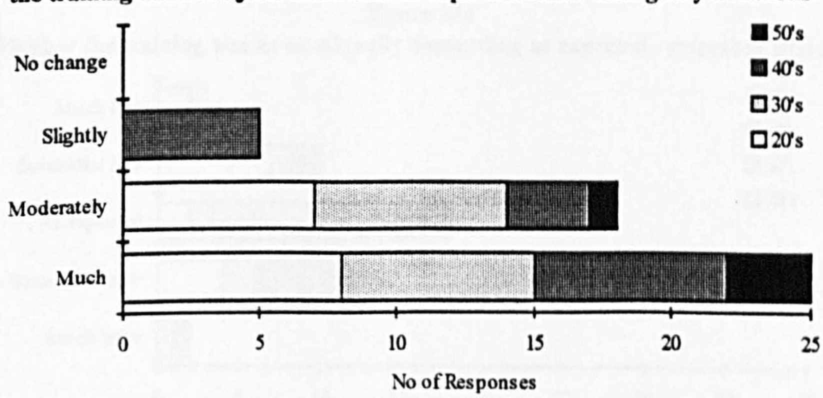

Figure 20b

Whether the training made subjects more able to cope with other emergency situations - combined

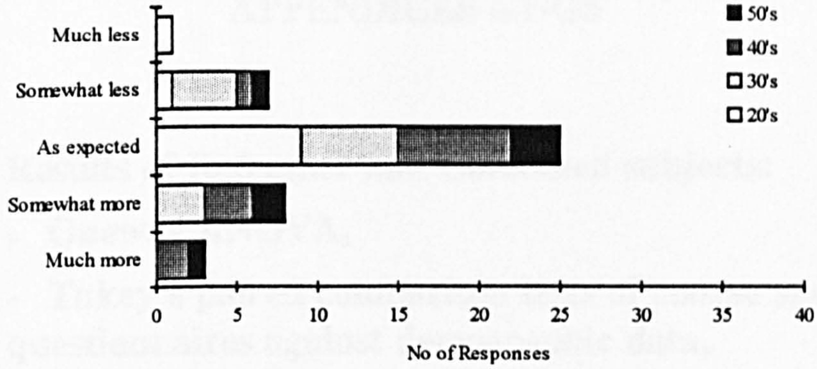

Figure 21a

Whether the training was as physically demanding as expected - refresher subjects

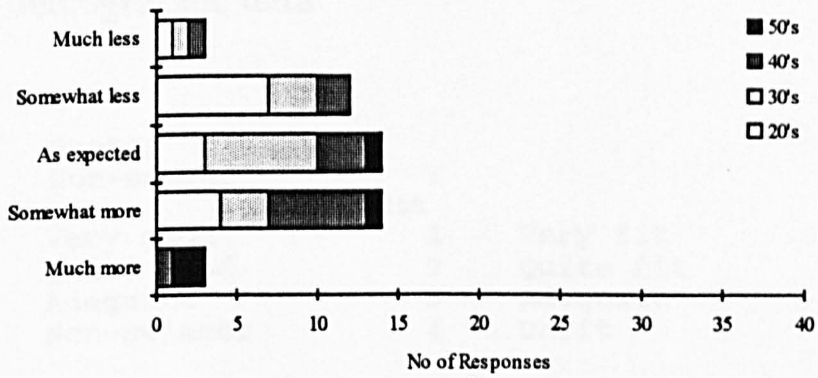

Figure 21b

Whether the training was as physically demanding as expected - combined subjects

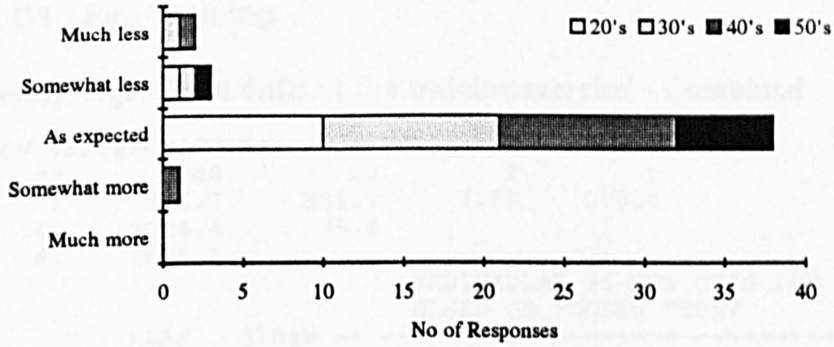

Figure 22a

Whether the training was as emotionally demanding as expected - refresher subjects

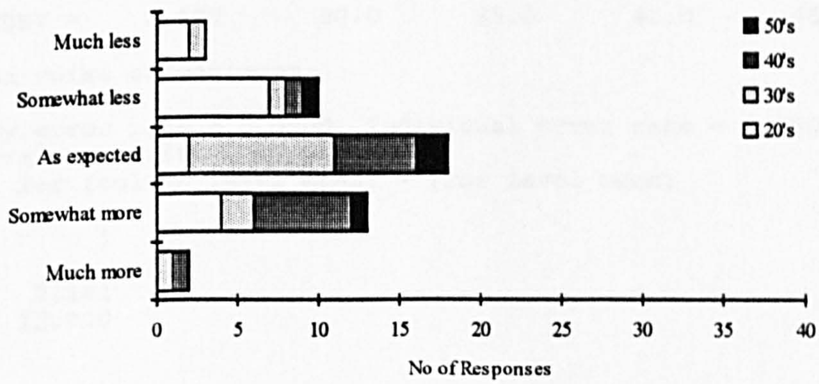

Figure 22b

Whether the training was as emotionally demanding as expected - combined subjects

APPENDICES G1-G5

Results of Refresher and Combined subjects:

- Oneway ANOVA,
- Tukey's paired comparison tests of course specific questionnaires against demographic data,
- GLM of ranked course specific questionnaires against demographic data

KEY

smoke

1	Smoker
2	Non-smoker

Swim

1	Very good
2	Quite good
3	Adequate
4	Non-swimmer

fit

1	Very fit
2	Quite fit
3	Adequate
4	Unfit

Appendix G1 - Fire Training

A - Oneway 'Age' 'Most difficult fire training exercise' - Combined

```
ANALYSIS OF VARIANCE ON Age
SOURCE      DF        SS        MS        F        p
FDIF3        1     581.7     581.7     7.69    0.008
ERROR       40    3024.4      75.6
TOTAL       41    3606.1
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                   BASED ON POOLED STDEV
LEVEL          N    MEAN    STDEV  -+---------+---------+---------+-----
1-Various     13  41.154    9.754                   (---------*---------)
3-SmokenoBA   29  33.103    8.200   (-----*------)
                                   -+---------+---------+---------+-----
POOLED STDEV =     8.695        30.0      35.0      40.0      45.0

Tukey's pairwise comparisons

    Family error rate = 0.0500  Individual error rate = 0.0500
Critical value = 2.86
Intervals for (column level mean) - (row level mean)

                 1

    3      2.181
          13.920
```

B- GLM of 'Satisfaction of coping with fire training' against Age, Smoke & Fit; with covariate Age - Refresher

Factor	Levels	Values			
smoke	2	1	2		
fit	4	1	2	3	4

Source	DF	Seq SS	Adj SS	Adj MS	F	P
AGE	1	0.7540	0.6859	0.6859	2.07	0.159
SMOKE	1	3.3834	2.9850	2.9850	9.01	0.005
FIT	3	1.8269	1.8269	0.6090	1.84	0.158
Error	35	11.5966	11.5966	0.3313		
Total	40	17.5610				

Term	Coeff	Stdev	t-value	P
Constant	2.3414	0.4335	5.40	0.000
AGE	-0.01441	0.01001	-1.44	0.159

<u>Means for Covariates</u>

Covariate	Mean	Stdev
AGE	38.54	9.220

<u>Adjusted Means for FSATIS</u>

fit	Mean	Stdev
1	2.301	0.5840
2	1.517	0.1800
3	1.909	0.1133
4	1.418	0.3472

smoke	Mean	Stdev
1	2.080	0.2061
2	1.492	0.1944

C - GLM of 'Satisfaction of coping with fire training' against Age, Smoke & Fit; with covariate Age - Combined

Factor	Levels	Values			
smoke	2	1	2		
fit	4	1	2	3	4

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Age	1	1.0898	1.0926	1.0926	4.43	0.042
smoke	1	0.3743	0.4107	0.4107	1.67	0.205
fit	3	2.0639	2.0639	0.6880	2.79	0.054
Error	36	8.8767	8.8767	0.2466		
Total	41	12.4048				

Term	Coeff	Stdev	t-value	P
Constant	2.3017	0.3878	5.94	0.000
Age	-0.019752	0.009383	-2.10	0.042

<u>Means for Covariates</u>

Covariate	Mean	Stdev
Age	35.60	9.378

<u>Adjusted Means for fsatis</u>

smoke	Mean	Stdev
1	1.702	0.1482
2	1.495	0.1384
fit		
1	1.314	0.3815
2	1.375	0.1374
3	1.602	0.1117
4	2.104	0.2258

Appendix G2 - HUET

A - Oneway 'FIT' 'Most difficult aspect of HUET to cope with' - Refresher

```
ANALYSIS OF VARIANCE ON FIT
SOURCE       DF        SS          MS         F        p
HCOPE2        3      1.106       0.369      1.02     0.391
ERROR        47     16.933       0.360
TOTAL        50     18.039
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                    BASED ON POOLED STDEV
LEVEL            N    MEAN    STDEV ------+---------+---------+-------
1-Various       15 2.6000   0.6325    (-----*-----)
3-Disorient     24 2.8333   0.6370         (----*----)
6-Genanxiety    10 3.0000   0.0000         (-------*-------)
7-Reminstruct  2 3.0000   1.4142(---------------*---------------)
                                    ------+---------+---------+-------
POOLED STDEV =    0.6002                2.50      3.00      3.50

Tukey's pairwise comparisons
    Family error rate = 0.0500 Individual error rate = 0.0106
Critical value = 3.77
Intervals for (column level mean) - (row level mean)

                 1          3          6
     3    -0.7600
           0.2933

     6    -1.0532    -0.7689
           0.2532     0.4356

     7    -1.6045    -1.3443    -1.2394
           0.8045     1.0110     1.2394
```

B - Oneway 'Age' 'Most difficult aspect of HUET to cope with' - Refresher

```
ANALYSIS OF VARIANCE ON AGE
SOURCE       DF        SS          MS         F        p
HCOPE2        2      502.1       251.0      2.96     0.062
ERROR        48     4075.6        84.9
TOTAL        50     4577.6
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                   BASED ON POOLED STDEV
LEVEL            N    MEAN    STDEV ---+---------+---------+---------+--
1-Various       17 41.941   9.010                  (--------*--------)
3-Disorient     24 36.125   8.729         (------*-------)
6-Genanxiety    10 34.000   10.667(-----------*-----------)
                                   ---+---------+---------+---------+--
POOLED STDEV =     9.215           30.0      35.0      40.0      45.0

Tukey's pairwise comparisons

    Family error rate = 0.0500  Individual error rate = 0.0194
Critical value = 3.42
Intervals for (column level mean) - (row level mean)
                 1          3

     3     -1.248
           12.880

     6     -0.939     -6.262
           16.822     10.512
```

C - Oneway 'Age' 'Most difficult aspect of HUET to cope with' - Combined

```
ANALYSIS OF VARIANCE ON Age
SOURCE       DF        SS          MS          F         p
hcope2        3     722.5       240.8       2.92     0.045
ERROR        42    3459.4        82.4
TOTAL        45    4181.9
                               INDIVIDUAL 95 PCT CI'S FOR MEAN
                               BASED ON POOLED STDEV
LEVEL          N     MEAN   STDEV -------+---------+---------+-------
1-Various      7   29.143 10.730(---------*---------)
3-Disorient   23   33.435  8.696         (-----*----)
6-Genanxiety  10   41.100  8.062                 (--------*-------)
7-Reminstruct  6   38.000 10.198           (---------*----------)
                                  -------+---------+---------+-------
POOLED STDEV =      9.076              28.0      35.0      42.0

Tukey's pairwise comparisons
    Family error rate = 0.0500  Individual error rate = 0.0106
Critical value = 3.78

Intervals for (column level mean) - (row level mean)
                 1         3         6

     3      -14.76
              6.18

     6      -23.91    -16.85
             -0.00      1.52

     7      -22.35    -15.69     -9.43
              4.64      6.55     15.63
```

D - Oneway 'Age' 'Most difficult HUET exercise' - Combined

```
ANALYSIS OF VARIANCE ON Age
SOURCE       DF        SS          MS          F         p
hdif2         2     565.4       282.7       3.36     0.044
ERROR        43    3616.5        84.1
TOTAL        45    4181.9
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                   BASED ON POOLED STDEV
LEVEL          N     MEAN   STDEV +--------+---------+---------+-----
1-Various      4   43.750 9.605         (------------*-------------)
2-Slowcapsize 21   31.857 8.719(-----*----)
3-Fastcapsize 21   36.571 9.537    (-----*-----)
                                 -+---------+---------+---------+-----
POOLED STDEV =     9.171       28.0      35.0      42.0      49.0

Tukey's pairwise comparisons
    Family error rate = 0.0500  Individual error rate = 0.0195
Critical value = 3.43
Intervals for (column level mean) - (row level mean)

                 1         2

     2       -0.24
             24.03

     3       -4.96    -11.58
             19.31      2.15
```

E - Oneway 'Age' 'Altered confidence in helicopter transport' - Refresher

ANALYSIS OF VARIANCE ON AGE

SOURCE	DF	SS	MS	F	p
HALTER	4	735.0	183.7	2.23	0.084
ERROR	39	3219.4	82.5		
TOTAL	43	3954.4			

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                   BASED ON POOLED STDEV
LEVEL            N    MEAN  STDEV -+---------+---------+---------+--
1-Great inc      3  41.000 11.790           (------*------)
2-Somewhat inc   5  30.400  9.737      (----*-----)
3-No dif        33  38.848  8.917                   (-*-)
4-Somewhat dec   2  51.000  4.243                    (--------*--------)
5-Great dec      1  30.000  0.000(-----------*-----------)
                                  --+---------+---------+---------+--
POOLED STDEV =      9.086           15        30        45        60
```

Tukey's pairwise comparisons
    Family error rate = 0.0500 Individual error rate = 0.00678
Critical value = 4.04
Intervals for (column level mean) - (row level mean)

	1	2	3	4
2	-8.35 29.55			
3	-13.50 17.80	-20.90 4.01		
4	-33.69 13.69	-42.32 1.12	-31.05 6.75	
5	-18.97 40.97	-28.03 28.83	-17.50 35.19	-10.79 52.79

F - GLM of 'Satisfaction of coping with HUET' against Age, Smoke, Swim & Fit; with covariate Age - Refresher

Factor	Levels	Values			
SMOKE	2	1	2		
FIT	4	1	2	3	4
SWIM	4	1	2	3	4

Source	DF	Seq SS	Adj SS	Adj MS	F	P
AGE	1	0.4567	0.4395	0.4395	0.90	0.347
SMOKE	1	1.3062	1.2114	1.2114	2.49	0.122
FIT	3	2.4019	2.1072	0.7024	1.45	0.243
SWIM	3	2.0555	2.0555	0.6852	1.41	0.253
Error	42	20.4072	20.4072	0.4859		
Total	50	26.6275				

Term	Coeff	Stdev	t-value	P
Constant	1.5968	0.5063	3.15	0.003
AGE	0.01056	0.01110	0.95	0.347

Means for Covariates

Covariate	Mean	Stdev
AGE	37.47	9.663

Adjusted Means for HSATIS

SMOKE	Mean	Stdev
1	2.167	0.2684
2	1.818	0.2309

FIT	Mean	Stdev
1	2.540	0.7853
2	1.571	0.2589
3	2.080	0.1615
4	1.779	0.3770

SWIM	Mean	Stdev
1	1.611	0.3270
2	1.923	0.3022
3	1.777	0.2556
4	2.658	0.4783

G - GLM of 'Satisfaction of coping with HUET' against Age, Smoke, Swim & Fit; with covariate Age - Combined

Factor	Levels	Values			
smoke	2	1	2		
Swim	4	1	2	3	4
fit	4	1	2	3	4

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Age	1	0.6009	0.9482	0.9482	2.94	0.095
smoke	1	0.2333	0.1580	0.1580	0.49	0.489
Swim	3	1.8770	1.0673	0.3558	1.10	0.361
fit	3	2.6490	2.6490	0.8830	2.74	0.057
Error	37	11.9441	11.9441	0.3228		
Total	45	17.3043				

Term	Coeff	Stdev	t-value	P
Constant	2.2654	0.4312	5.25	0.000
Age	-0.01786	0.01042	-1.71	0.095

<u>Means for Covariates</u>

Covariate	Mean	Stdev
Age	35.04	9.640

<u>Adjusted Means for hsatis</u>

smoke	Mean	Stdev
1	1.578	0.1710
2	1.701	0.1649
Swim		
1	1.594	0.3070
2	1.499	0.2016
3	1.487	0.1690
4	1.978	0.2413
fit		
1	1.201	0.4527
2	1.625	0.1707
3	1.509	0.1461
4	2.222	0.2436

Appendix G3 - Abandonment to Liferaft

A - Oneway 'Age' 'Most difficult aspect of abandon to cope with' - Combined

```
ANALYSIS OF VARIANCE ON Age
SOURCE       DF          SS           MS           F         p
acope2        4      1040.8        260.2        3.68     0.012
ERROR        39      2754.0         70.6
TOTAL        43      3794.8
                                           INDIVIDUAL 95 PCT CI'S FOR MEAN
                                           BASED ON POOLED STDEV
 LEVEL              N     MEAN     STDEV  -------+---------+---------+--------
-
2 -Various          7   39.857     7.819                 (--------*--------)
3 -Gen activity10      40.900     7.637                    (------*-------)
4 -Raft motion 11      28.364     7.941  (-------*------)
5 -Gen anxiety  7      37.429     7.913            (---------*---------)
6 -Rem instruct 9      33.667    10.344       (-------*-------)
                                          -------+---------+---------+--------
-
POOLED STDEV =       8.403                      28.0      35.0      42.0

Tukey's pairwise comparisons
    Family error rate = 0.0500   Individual error rate = 0.00678
Critical value = 4.04
Intervals for (column level mean) - (row level mean)

                  2           3           4           5
     3       -12.87
              10.79
     4        -0.11        2.05
              23.10       23.03
     5       -10.40       -8.36      -20.67
              15.26       15.30        2.54
     6        -5.91       -3.80      -16.09       -8.34
              18.29       18.26        5.49       15.86
```

B - Oneway 'Age' 'Most difficult abandonment exercise' - Combined

```
ANALYSIS OF VARIANCE ON Age
SOURCE       DF          SS           MS           F         p
adif2         2       654.9        327.5        4.28     0.021
ERROR        41      3139.9         76.6
TOTAL        43      3794.8
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                    BASED ON POOLED STDEV
LEVEL            N     MEAN  STDEV  --------+---------+---------+--------
1-Various       15   37.933  9.277                 (--------*--------)
4-Scramblenet 3      39.077  8.139                  (---------*---------)
6-Enterraft     16   30.500  8.718  (--------*--------)
                                    --------+---------+---------+--------
POOLED STDEV =       8.751                30.0      35.0      40.0

Tukey's pairwise comparisons
    Family error rate = 0.0500
Individual error rate = 0.0195   Critical value = 3.44
Intervals for (column level mean) - (row level mean)

                  1           4
     4       -9.210
              6.923
     6       -0.217       0.629
             15.084      16.525
```

C - Oneway 'FIT' 'Most difficult abandonment exercise' - Refresher

```
ANALYSIS OF VARIANCE ON FIT
SOURCE      DF        SS         MS          F        p
ADIF2        3     2.964      0.988       3.09    0.036
ERROR       45    14.383      0.320
TOTAL       48    17.347
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                    BASED ON POOLED STDEV
  LEVEL        N    MEAN    STDEV  --------+---------+---------+-------
1-Various     10  2.9000   0.3162              (--------*---------)
4-Nets        15  3.1333   0.3519                     (------*-------)
5-Rightraft   16  2.6250   0.8062         (------*-------)
6-Enterraft    8  2.5000   0.5345  (---------*----------)
                                   --------+---------+---------+-------
POOLED STDEV =    0.5654                 2.40      2.80      3.20

Tukey's pairwise comparisons
    Family error rate = 0.0500  Individual error rate = 0.0106
Critical value = 3.77
Intervals for (column level mean) - (row level mean)

                 1         4         5
     4    -0.8486
           0.3819
     5    -0.3325   -0.0333
           0.8825    1.0500
     6    -0.3149   -0.0265   -0.5276
           1.1149    1.2931    0.7776
```

D - GLM of 'Satisfaction of coping with abandonment' against Age, Smoke, Swim & Fit; with covariate Age - Refresher

```
Factor      Levels Values
SMOKE          2     1     2
FIT            4     1     2     3     4
SWIM           4     1     2     3     4

Source      DF     Seq SS      Adj SS      Adj MS      F       P
AGE          1     0.2587      0.1592      0.1592    0.38   0.543
SMOKE        1     0.9021      0.8542      0.8542    2.02   0.163
FIT          3     2.4148      1.9150      0.6383    1.51   0.226
SWIM         3     2.0255      2.0255      0.6752    1.60   0.205
Error       40    16.8886     16.8886      0.4222
Total       48    22.4898

Term           Coeff       Stdev     t-value      P
Constant     1.7831      0.4967     3.59       0.001
AGE          0.00668     0.01087    0.61       0.543

Means for Covariates
Covariate         Mean       Stdev
AGE              37.49      9.491

Adjusted Means for ASATIS
SMOKE       Mean       Stdev
    1      2.179      0.2566
    2      1.888      0.2177
FIT                              SWIM
  1        2.578      0.7183       1          1.592      0.2825
  2        1.680      0.2300       2          1.870      0.2925
  3        2.124      0.1509       3          1.974      0.2414
  4        1.752      0.3929       4          2.699      0.4466
```

E - GLM of 'Satisfaction of coping with abandonment' against Age, Smoke, Swim & Fit; with covariate Age - Combined

Factor	Levels	Values			
smoke	2	1	2		
Swim	4	1	2	3	4
fit	4	1	2	3	4

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Age	1	0.5144	0.6713	0.6713	2.35	0.135
smoke	1	1.0678	1.1818	1.1818	4.13	0.050
Swim	3	1.7831	1.1473	0.3824	1.34	0.278
fit	3	1.3502	1.3502	0.4501	1.57	0.213
Error	35	10.0117	10.0117	0.2860		
Total	43	14.7273				

Term	Coeff	Stdev	t-value	P
Constant	2.3904	0.4202	5.69	0.000
Age	-0.01559	0.01018	-1.53	0.135

Means for Covariates

Covariate	Mean	Stdev
Age	35.57	9.394

Adjusted Means for asatis

smoke	Mean	Stdev
1	2.008	0.1623
2	1.664	0.1545

Swim	Mean	Stdev
1	1.672	0.2887
2	1.701	0.1877
3	1.751	0.1647
4	2.218	0.2266

Fit	Mean	Stdev
1	1.599	0.4251
2	1.703	0.1656
3	1.782	0.1401
4	2.259	0.2286

Appendix G4 - TEMPSC Training

A - GLM of 'Satisfaction of coping with TEMPSC' against Age, Smoke, Swim & Fit; with covariate Age - Refresher

Factor	Levels	Values			
SMOKE	2	1	2		
FIT	4	1	2	3	4
SWIM	4	1	2	3	4

Source	DF	Seq SS	Adj SS	Adj MS	F	P
AGE	1	0.2658	0.2032	0.2032	0.52	0.473
SMOKE	1	0.1384	0.1510	0.1510	0.39	0.536
FIT	3	0.3477	0.6176	0.2059	0.53	0.664
SWIM	3	0.6184	0.6184	0.2061	0.53	0.663
Error	43	16.6873	16.6873	0.3881		
Total	51	18.0577				

Term	Coeff	Stdev	t-value	P
Constant	1.9829	0.4523	4.38	0.000
AGE	-0.007179	0.009920	-0.72	0.473

Means for Covariates

Covariate	Mean	Stdev
AGE	37.46	9.568

Adjusted Means for TSATIS

SMOKE	Mean	Stdev
1	1.774	0.2388
2	1.654	0.2051

FIT	Mean	Stdev
1	2.189	0.6876
2	1.421	0.2190
3	1.560	0.1437
4	1.685	0.3329

SWIM	Mean	Stdev
1	1.595	0.2679
2	1.888	0.2654
3	1.853	0.2261
4	1.520	0.4260

B - GLM of 'Satisfaction of coping with TEMPSC' against Age, Smoke, Swim & Fit; with covariate Age - Combined

Factor	Levels	Values			
smoke	2	1	2		
Swim	4	1	2	3	4
fit	4	1	2	3	4

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Age	1	0.0265	0.0340	0.0340	0.15	0.704
smoke	1	1.1635	1.2333	1.2333	5.32	0.027
Swim	3	1.2193	0.8490	0.2830	1.22	0.316
fit	3	0.4901	0.4901	0.1634	0.70	0.555
Error	37	8.5788	8.5788	0.2319		
Total	45	11.4783				

Term	Coeff	Stdev	t-value	P
Constant	1.7867	0.3701	4.83	0.000
Age	-0.003434	0.008961	-0.38	0.704

Means for Covariates

Covariate	Mean	Stdev
Age	35.30	9.440

Adjusted Means for tsatis2

smoke	Mean	Stdev
1	1.838	0.1446
2	1.493	0.1395

Swim	Mean	Stdev
1	1.726	0.2600
2	1.610	0.1686
3	1.449	0.1463
4	1.877	0.2042

Fit	Mean	Stdev
1	1.558	0.3829
2	1.613	0.1460
3	1.580	0.1246
4	1.911	0.2059

Appendix G5 - How demanding the training was perceived to be

A - Oneway 'Age' 'How much more capable of coping with a fire' - Refresher

```
ANALYSIS OF VARIANCE ON AGE
SOURCE      DF        SS         MS         F        p
FCAPBL       3     775.8      258.6      3.25    0.031
ERROR       40    3178.6       79.5
TOTAL       43    3954.4

                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                   BASED ON POOLED STDEV
LEVEL          N    MEAN   STDEV ---+---------+---------+---------+-
1-Much more    3  36.692  10.144         (------*-------)
2-Mod more    14  42.500   9.296                  (------*------)
3-Slightly    10  32.100   7.172  (-------*-------)
4-No change    7  42.286   7.718               (--------*---------)
                                 ---+---------+---------+---------+-
POOLED STDEV =     8.914          28.0      35.0      42.0      49.0
Tukey's pairwise comparisons
    Family error rate = 0.0500 Individual error rate = 0.0106
Critical value = 3.79
Intervals for (column level mean) - (row level mean)

              1          2          3
   2     -15.01
           3.39
   3      -5.46       0.51
          14.64      20.29
   4     -16.79     -10.84     -21.96
           5.61      11.27       1.59
```

B - Oneway 'Age' 'How physically demanding' - Refresher

```
ANALYSIS OF VARIANCE ON AGE
SOURCE      DF        SS         MS         F        p
PHYSCAL      4     647.0      161.8      1.91    0.129
ERROR       39    3307.4       84.8
TOTAL       43    3954.4
                                INDIVIDUAL 95 PCT CI'S FOR MEAN
                                BASED ON POOLED STDEV
LEVEL          N    MEAN   STDEV ------+---------+---------+---------+
1-Much more    3  47.667   5.508                       (------*------)
2-Somewhat     8  42.500   7.521                      (---*----)
3-As expect   25  36.720   9.914                    (-*--)
4-Somewhat     7  37.571   9.053                  (----*----)
5-Much less    1  25.000   0.000 (------------*-----------)
                                 ------+---------+---------+---------+
POOLED STDEV =      9.209              15        30        45        60
```

C - Oneway 'Age' 'How physically demanding' - Combined

```
ANALYSIS OF VARIANCE ON Age
SOURCE      DF        SS         MS         F        p
physcl       4     920.6      230.1      2.89    0.034
ERROR       41    3261.4       79.5
TOTAL       45    4181.9
```

```
                                   INDIVIDUAL 95 PCT CI'S FOR MEAN
                                   BASED ON POOLED STDEV
LEVEL          N   MEAN   STDEV  -------+---------+---------+---------
1-Much more    3 49.333   2.082                  (----------*----------)
2-Somewhat    14 36.071   9.841          (----*----)
3-As expect   14 35.429   9.452          (---*----)
4-Somewhat    12 30.167   7.861    (----*----)
5-Much less    3 33.667   8.737  (----------*---------)
                                 -------+---------+---------+---------
POOLED STDEV =    8.919               30        40        50

Tukey's pairwise comparisons
    Family error rate = 0.0500  Individual error rate = 0.00676
Critical value = 4.03
Intervals for (column level mean) - (row level mean)
               1         2         3         4

    2      -2.91
           29.43
    3      -2.26     -8.96
           30.07     10.25
    4       2.76     -4.09     -4.74
           35.57     15.90     15.26
    5      -5.08    -13.76    -14.41    -19.91
           36.42     18.57     17.93     12.91
```

D - Oneway 'Age' 'How emotionally demanding' - Combined

```
ANALYSIS OF VARIANCE ON Age
SOURCE      DF        SS        MS        F        p
emotion      4     765.1     191.3     2.30    0.075
ERROR       41    3416.8      83.3
TOTAL       45    4181.9
                              INDIVIDUAL 95 PCT CI'S FOR MEAN
                              BASED ON POOLED STDEV
LEVEL         N     MEAN    STDEV  ------+---------+---------+---------
1-Much more  2   42.500   6.364              (----------*----------)
2-Slightly  13   36.615   9.768              (----*---)
3-Asexpect  18   37.556   8.375                (--*---)
4-Slightly  10   29.300  10.133        (---*----)
5-Muchless   3   27.333   7.572  (---------*--------)
                                   ------+---------+---------+---------
POOLED STDEV =    9.129                 24        36        48

Tukey's pairwise comparisons
    Family error rate = 0.0500  Individual error rate = 0.00676
Critical value = 4.03
Intervals for (column level mean) - (row level mean)

               1         2         3         4

    2     -13.87
           25.64

    3     -14.45    -10.41
           24.33      8.53

    4      -6.95     -3.63     -2.00
           33.35     18.26     18.52

    5      -8.58     -7.38     -6.00    -15.16
           38.91     25.94     26.44     19.09
```

APPENDICES G6-G13

Refresher Subjects' STAI Statistical Analysis Output

KEY

Smoke

1	Smoker		
2	Non-smoker		

Swim		**Fit**	
1	Very good	1	Very fit
2	Quite good	2	Quite fit
3	Adequate	3	Adequate
4	Non-swimmer	4	Unfit

G6 - GLM of Score against Event; with covariate Age - Refresher

Factor Levels
Event 6

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Age	1	483.04	434.59	434.59	5.25	0.023
Event	5	4725.85	4725.85	945.17	11.41	0.000
Error	290	24014.83	24014.83	82.81		
Total	296	29223.72				

Term	Coeff	Stdev	t-value	P
Constant	38.157	2.159	17.67	0.000
Age	-0.12797	0.05586	-2.29	0.023

G7 - GLM of Score against Event; with covariates Smoke, Fit & Swim - Refresher

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Smoke	1	1293.32	775.24	775.24	9.90	0.002
Fit	1	603.26	451.46	451.46	5.77	0.017
Swim	1	35.48	62.17	62.17	0.79	0.374
Event	5	4749.89	4749.89	949.98	12.14	0.000
Error	288	22541.77	22541.77	78.27		
Total	296	29223.72				

Term	Coeff	Stdev	t-value	P
Constant	30.843	3.539	8.71	0.000
Smoke	-3.495	1.111	-3.15	0.002
Fit	2.2788	0.9488	2.40	0.017
Swim	0.6190	0.6946	0.89	0.374

G8 - Oneway of 'Trait anxiety score' against 'Smoke' - Refresher

```
SOURCE       DF        SS          MS           F         p
SMOKE         1      275.7       275.7        6.40     0.015
ERROR        48     2067.4        43.1
TOTAL        49     2343.1
                                      INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
 LEVEL        N     MEAN    STDEV  ---+---------+---------+---------+---
1 -Smoker    22   36.409   8.296                 (---------*----------)
2-Non-smkr   28   31.679   4.800  (--------*--------)
                                   ---+---------+---------+---------+---
POOLED STDEV =   6.563              30.0      33.0      36.0      39.0
```

Tukey's pairwise comparisons

Family error rate = 0.0500
Individual error rate = 0.0500
Critical value = 2.84
Intervals for (column level mean) - (row level mean)

```
              1
     2     0.976
           8.485
```

G9 - Repeated Measures ANOVA of STAI by Day against Order and Smoke, with contrasts - Refresher

```
        47 cases accepted.
         0 cases rejected because of out-of-range factor values.
         5 cases rejected because of missing data.
        10 non-empty cells.

Tests of Between-Subjects Effects.
 Tests of Significance for T1 using UNIQUE sums of squares
Source of Variation          SS       DF        MS          F  Sig of F
WITHIN+RESIDUAL         5582.14       40    139.55
REGRESSION                 8.35        1      8.35        .06      .808
SMOKE                    404.53        1    404.53       2.90      .096
ORDER2                   606.69        4    151.67       1.09      .376
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 Estimates for T1 adjusted for 1 covariate
 --- Individual univariate .9500 confidence intervals

 SMOKE
Parameter     Coeff.   Std.Err.    t-Value    Sig.t  Lower-95%CL-Upper
 2        6.22764119   3.65780     1.70257   .09641  -1.16504  13.62033

 ORDER2
Parameter     Coeff.   Std.Err.    t-Value    Sig.t  Lower-95%CL-Upper
 3        7.50513289   7.40552     1.01345   .31694  -7.46198  22.47224
 4       12.3723604    6.51817     1.89813   .06491   -.80136  25.54608
 5        7.89724976   6.85165     1.15261   .25591  -5.95044  21.74494
 6       12.5844100    9.32054     1.35018   .18455  -6.25309  31.42191
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 Regression analysis for WITHIN+RESIDUAL error term
 --- Individual Univariate .9500 confidence intervals

 Dependent variable .. T1
COVARIATE            B          Beta     Std. Err.     t-Value    Sig. of t
TAGE           -.02598      -.03673          .106        -.245         .808
```

COVARIATE	Lower -95%	CL- Upper
TAGE	-.241	.189

- -

EFFECT .. ORDER2 BY DAYS
Multivariate Tests of Significance (S = 2, M = 1/2, N = 19)

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.13580	.74666	8.00	82.00	.650
Hotellings	.15386	.75007	8.00	78.00	.647
Wilks	.86552	.74886	8.00	80.00	.648
Roys	.12531				

Note.. F statistic for WILKS' Lambda is exact.

- -

EFFECT .. SMOKE BY DAYS
Multivariate Tests of Significance (S = 1, M = 0, N = 19)

Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
Pillais	.00944	.19050	2.00	40.00	.827
Hotellings	.00953	.19050	2.00	40.00	.827
Wilks	.99056	.19050	2.00	40.00	.827
Roys	.00944				

Note.. F statistics are exact.

- -

EFFECT .. DAYS
Multivariate Tests of Significance (S = 1, M = 0, N = 19)

Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
Pillais	.33266	9.96963	2.00	40.00	.000
Hotellings	.49848	9.96963	2.00	40.00	.000
Wilks	.66734	9.96963	2.00	40.00	.000
Roys	.33266				

Note.. F statistics are exact.

- -

Tests involving 'DAYS' Within-Subject Effect.
AVERAGED Tests of Significance for STAI using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	1893.23	82	23.09		
DAYS	693.60	2	346.80	15.02	.000
SMOKE BY DAYS	13.43	2	6.72	.29	.748
ORDER2 BY DAYS	84.00	8	10.50	.45	.884

- -

Estimates for T2
--- Individual univariate .9500 confidence intervals

DAYS

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%	CL-Upper
1	4.85544553	1.07525	4.51565	.00005	2.68394	7.02695

SMOKE BY DAYS

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%	CL-Upper
2	1.10061318	1.79277	.61392	.54266	-2.51995	4.72118

ORDER2 BY DAYS

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%	CL-Upper
3	-.52045738	3.63832	-.14305	.88695	-7.86820	6.82728
4	-1.4893728	3.19987	-.46545	.64407	-7.95163	4.97289
5	-1.8466725	3.36501	-.54879	.58613	-8.64244	4.94910
6	-1.3091061	4.49527	-.29122	.77235	-10.38748	7.76927

- -

Estimates for T3
--- Individual univariate .9500 confidence intervals

DAYS

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%	CL-Upper
1	.480821620	.65479	.73431	.46694	-.84156	1.80320

```
 SMOKE BY DAYS
Parameter    Coeff.    Std.Err.      t-Value    Sig.t  Lower-95%CL-Upper
 2      .265011802    1.09174       .24274    .80941   -1.93980  2.46982

 ORDER2 BY DAYS
Parameter    Coeff.    Std.Err.      t-Value    Sig.t  Lower-95%CL-Upper
   3   3.04624674    2.21562      1.37489    .17663   -1.42829  7.52079
   4   3.29015809    1.94862      1.68846    .09892    -.64515  7.22547
   5   1.03230983    2.04918       .50377    .61712   -3.10610  5.17072
   6    .891313023   2.73747       .32560    .74638   -4.63713  6.41975
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

G10 - Cluster Analysis of morning STAI values against Age and Smoke - Refresher

Convergence achieved due to no or small distance change. The maximum distance by which any center has changed is .0000
Current iteration is 3

Minimum distance between intial centers is 59.1354

Iteration Change in Cluster Centers

	1	2
1	18.6872	22.4387
2	.8727	1.7715
3	.0000	.0000

Final Cluster Centers

Cluster	STAI1	STAI2	STAI3	Age	Smoke
1	31.7188	26.1875	24.5313	35.6875	1.5938
2	41.0000	37.6000	36.8667	42.0667	1.4667

*****************************QUICK CLUSTER*********************************

Analysis of Variance

Variable	Cluster MS	DF	Error MS	DF	F	Prob
STAI1	879.7440	1	58.099	45.0	15.1421	.000
STAI2	1330.1633	1	27.521	45.0	48.3315	.000
STAI3	1554.0000	1	23.548	45.0	65.9902	.000
Age	415.5959	1	89.862	45.0	4.6248	.037
Smoke	.1649	1	.254	45.0	.6481	.425

Number of Cases in each Cluster

Cluster	unweighted cases	weighted cases
1	32	32
2	15	15
Missing	5	
Valid cases	47	47

G11 - GLM of Score against Subject and Event; with covariate Sequence - Refresher

Factor	Levels
Subject	52
Event	6

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Sequence	1	25.30	16.05	16.05	0.39	0.532
Subject	51	15262.01	15229.23	298.61	7.29	0.000
Event	5	5059.32	5059.32	1011.86	24.71	0.000
Error	239	9788.55	9788.55	40.96		
Total	296	30135.18				

Term	Coeff	Stdev	t-value	P
Constant	34.332	1.339	25.63	0.000
Sequence	-0.2303	0.3678	-0.63	0.532

G12 - Twoway of Reduced Score against Event & Subject - Refresher

Source	DF	SS	MS
Event	5	3513.8	702.8
Subject	39	11170.9	286.4
Error	195	7580.3	38.9
Total	239	22265.1	

F value MS/ErrMS	F value from tables ($p \leq 0.01$)
18.1 *	9.02
7.4 *	1.51

* denotes significance at the 1% level.

```
                              Individual 95% CI
 Event           Mean      -------+---------+---------+---------+----
1 -Enrolment     33.42                       (----*-----)
2 -Morn2         28.50        (----*-----)
3 -Morn3         27.65     (-----*-----)
4 -Fire          37.17                                  (----*-----)
5 -TEMPSC        31.23                (----*-----)
6 -HUET          37.40                                  (-----*----)
                           -------+---------+---------+---------+----
                                28.00     31.50     35.00     38.50
```

G13 - GLM of Score against Sequence and Event considered simultaneously, and Subject - Refresher

Factor	**Levels**
Subject	52
Seq+10Ev	12

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Subject	51	15579.35	14948.82	293.11	7.61	0.000
Seq+10Ev	11	4789.46	4789.46	435.41	11.30	0.000
Error	234	9018.26	9018.26	38.54		
Total	296	29387.07				

Means for SCORE

Seq+10Ev	**Mean**	**Stdev**	**Seq+10Ev**	**Mean**	**Stdev**
11	34.37	0.8647	52	32.60	1.1257
23	29.63	0.8678	54	31.56	3.4102
35	28.25	0.8997	56	30.24	2.4092
42	37.18	2.5411	62	38.82	2.8045
44	39.44	1.3852	64	38.53	1.3094
46	37.32	1.4200	66	38.63	1.5266

APPENDICES G14-G21

Combined subjects' STAI Statistical Analysis Output

G14 - GLM of Score against Event; with Covariate Age - Combined

Factor Levels
Event 9

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Age	1	17.0	6.8	6.8	0.07	0.787
Event	8	10007.4	10007.4	1250.9	13.39	0.000
Error	383	35771.7	35771.7	93.4		
Total	392	45796.1				

Term	Coeff	Stdev	t-value	P
Constant	35.207	1.885	18.68	0.000
Age	-0.01395	0.05160	-0.27	0.787

G15 - GLM of Score against Event; with covariates Smoke, Fit & Swim - Combined

Factor Levels
Event 9

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Smoke	1	75.1	23.0	23.0	0.32	0.573
Fit	1	6477.1	6038.8	6038.8	83.74	0.000
Swim	1	1582.0	1627.3	1627.3	22.56	0.000
Event	8	10184.9	10184.9	1273.1	17.65	0.000
Error	381	27477.1	27477.1	72.1		
Total	392	45796.1				

Term	Coeff	Stdev	t-value	P
Constant	13.141	2.426	5.42	0.000
Smoke	0.4977	0.8823	0.56	0.573
Fit	5.3247	0.5819	9.15	0.000
Swim	2.4990	0.5261	4.75	0.000

G16 - Repeated Measures ANOVA of STAI by Day against Order and Smoke, with contrasts - Combined

```
      31 cases accepted.
       1 case rejected because of out-of-range factor values.
      15 cases rejected because of missing data.
       9 non-empty cells.
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Tests of Between-Subjects Effects.
Tests of Significance for T1 using UNIQUE sums of squares
Source of Variation        SS        DF        MS          F  Sig of F
WITHIN+RESIDUAL       4773.28        24    198.89
REGRESSION             242.38         1    242.38       1.22      .281
SMOKE                   15.92         1     15.92        .08      .780
ORDER2                1191.34         4    297.83       1.50      .234
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 Estimates for T1 adjusted for 1 covariate
 --- Individual univariate .9500 confidence intervals

 SMOKE
Parameter   Coeff.    Std. Err.   t-Value    Sig.t    Lower-95% CL-Upper
  2     -1.5196228    5.37131     -.28291   .77967   -12.60545  9.56621

 ORDER2
Parameter   Coeff.    Std. Err.   t-Value    Sig.t    Lower-95%CL-Upper
  3     -8.0237345   11.77338     -.68151   .50207   -32.32280 16.27533
  4     -9.9369928    9.36725   -1.06082    .29933   -29.27005  9.39607
  5    -23.596496    10.61006   -2.22397    .03582   -45.49459 -1.69840
  6    -11.311150    11.54493    -.97975    .33698   -35.13871 12.51641
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 Regression analysis for WITHIN+RESIDUAL error term
 --- Individual Univariate .9500 confidence intervals
 Dependent variable .. T1
COVARIATE      B       Beta         Std. Err.    t-Value      Sig. of t
TAGE     -.14807  -.22418          .134         -1.104       .281

 COVARIATE    Lower -95%  CL- Upper
 TAGE              -.425       .129
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 EFFECT .. ORDER2 BY DAYS
 Multivariate Tests of Significance (S = 4, M = -1/2, N = 10 )
Test Name          Value   Approx. F Hypoth. DF   Error DF  Sig. of F
Pillais           .61766    1.14134      16.00     100.00       .329
Hotellings        .82758    1.06034      16.00      82.00       .406
Wilks             .49106    1.11153      16.00      67.85       .363
Roys              .31365
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 EFFECT .. SMOKE BY DAYS
 Multivariate Tests of Significance (S = 1, M = 1 , N = 10 )
Test Name          Value    Exact F Hypoth. DF   Error DF  Sig. of F
Pillais           .03483     .19850       4.00      22.00       .936
Hotellings        .03609     .19850       4.00      22.00       .936
Wilks             .96517     .19850       4.00      22.00       .936
Roys              .03483
 Note.. F statistics are exact.
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 EFFECT .. DAYS
 Multivariate Tests of Significance (S = 1, M = 1 , N = 10 )
Test Name          Value    Exact F Hypoth. DF   Error DF  Sig. of F
Pillais           .49827    5.46200       4.00      22.00       .003
Hotellings        .99309    5.46200       4.00      22.00       .003
Wilks             .50173    5.46200       4.00      22.00       .003
Roys              .49827
 Note.. F statistics are exact.
```

Tests involving 'DAYS' Within-Subject Effect.
AVERAGED Tests of Significance for STAI using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	2294.70	100	22.95		
DAYS	1198.03	4	299.51	13.05	.000
SMOKE BY DAYS	24.82	4	6.20	.27	.896
ORDER2 BY DAYS	247.81	16	15.49	.67	.812

Estimates for T2
--- Individual univariate .9500 confidence intervals

DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL-Upper
1	6.96156763	1.52989	4.55038	.00012	3.81071	10.11243

SMOKE BY DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
2	-1.5394468	2.71335	-.56736	.57553	-7.12770	4.04881

ORDER2 BY DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
3	.602018302	5.62290	.10707	.91559	-10.97855	12.18259
4	4.01116194	4.74471	.84540	.40591	-5.76075	13.78307
5	3.70155253	5.32936	.69456	.49374	-7.27447	14.67758
6	3.50890667	5.62290	.62404	.53826	-8.07166	15.08948

Estimates for T3
--- Individual univariate .9500 confidence intervals

DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
1	2.46783931	.95126	2.59429	.01563	.50869	4.42699

SMOKE BY DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
2	-.86047396	1.68712	-.51003	.61451	-4.33515	2.61421

ORDER2 BY DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
3	-1.5183202	3.49622	-.43428	.66781	-8.71892	5.68228
4	-1.8119916	2.95018	-.61420	.54463	-7.88799	4.26401
5	-2.6002968	3.31370	-.78471	.44000	-9.42500	4.22440
6	-2.6730207	3.49622	-.76455	.45170	-9.87362	4.52757

Estimates for T4
--- Individual univariate .9500 confidence intervals

DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
1	-.59427605	.68310	-.86996	.39260	-2.00115	.81260

SMOKE BY DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
2	.531900417	1.21153	.43903	.66441	-1.96329	3.02709

ORDER2 BY DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
3	6.57220866	2.51066	2.61773	.01481	1.40142	11.74300
4	2.30189228	2.11854	1.08655	.28760	-2.06132	6.66511
5	3.62477376	2.37959	1.52328	.14024	-1.27609	8.52563
6	1.57116710	2.51066	.62580	.53712	-3.59963	6.74196

Estimates for T5
--- Individual univariate .9500 confidence intervals

DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
1	-.16084413	.70473	-.22824	.82132	-1.61226	1.29057

SMOKE BY DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
2	.431743083	1.24988	.34543	.73266	-2.14244	3.00593

ORDER2 BY DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%	CL- Upper
3	2.20007663	2.59014	.84941	.40372	-3.13441	7.53456
4	3.58811364	2.18561	1.64170	.11317	-.91323	8.08946
5	.440128644	2.45492	.17928	.85916	-4.61588	5.49614
6	4.85172706	2.59014	1.87315	.07279	-.48276	10.18622

G17 - STAI - Effect of Order by Day - Values extracted from Repeated Measures Analysis - Combined

STAI MORNING SCORES

EFFECT OF ORDER BY DAY

HAFT	AHFT	FTHA	TAHF	THAF	
2	4	7	9	10	
1.270666	0.867333	-1.58266	1.177333	-1.73266	3.6E-15
-0.506	-1.126	2.174	-1.066	0.524	-7.1E-15
-0.60933	-0.87933	-2.66266	0.630666	3.520666	-1.1E-14
0.937333	2.467333	-0.64933	-1.62266	-1.13266	-3.6E-15
-1.09266	-1.32933	2.720666	0.880666	-1.17933	-1.1E-14
1.1E-14	-3.6E-15	-1.4E-14	-1.1E-14	-1.1E-14	

Total HUET	TEMPSC	Aband	Fire1	Fire2
0.65	-5.64	5.536666	-5.82666	5.28

error s.d. = 4.396513

ORDER	EFFECT	DAY	EFFECT
2	0.982666	1	6.382666
4	-1.09733	2	0.626
7	5.769333	3	-2.87066
9	-5.65733	4	-2.21733
10	0.002666	5	-1.92066

G18 - Principal Components Analysis of morning STAI scores - Combined

Analysis number 1 Listwise deletion of cases wtih missing values.

Initial Statistics

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
STAI1	1.00000	*	1	3.70897	74.2	74.2
STAI2	1.00000	*	2	.57810	11.6	85.7
STAI3	1.00000	*	3	.29923	6.0	91.7
STAI4	1.00000	*	4	.24484	4.9	96.6
STAI5	1.00000	*	5	.16887	3.4	100.0

PC extracted 1 factor

Factor Matrix

	Factor 1
STAI1	.77797
STAI2	.91998
STAI3	.87711
STAI4	.88323
STAI5	.84140

Final Statistics

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
STAI1	.60523	*	1	3.70897	74.2	74.2
STAI2	.84637	*				
STAI3	.76933	*				
STAI4	.78009	*				
STAI5	.70796	*				

G19 - Cluster Analysis of morning STAI factor versus Age - Combined

Convergence achieved due to no or small distance change. The maximum distance by which any center has changed is .0000
Current iteration is 3

Minimum distance between intial centers is 16.0321

Iteration Change in Cluster Centers

Iteration	1	2	3
1	4.1603	2.5271	.9755
2	.6400	.6898	.2043
3	.0000	.0000	.0000

Final Cluster Centers

Cluster	Age	Morning STAI factor
1	48.3750	-.4869
2	23.9000	.1938
3	37.9286	.1398

Number of Cases in each Cluster

Cluster	unweighted cases	weighted cases
1	8	8
2	10	10
3	14	14
Missing	15	
Valid cases	32	32

G20 - GLM of Score against Subject and Event; with covariate Sequence - Combined

Factor	Levels
EventNo	9
Subject	47

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Seq	1	1664.92	612.08	612.08	17.34	0.000
Event	8	8953.01	9627.44	1203.43	34.10	0.000
Subject	46	23284.38	23284.38	506.18	14.34	0.000
Error	337	11893.82	11893.82	35.29		
Total	392	45796.14				

Term	Coeff	Stdev	t-value	P
Constant	38.720	1.003	38.59	0.000
Seq	-0.7960	0.1911	-4.16	0.000

G21 - GLM of Score against Sequence and Event considered simultaneously, and Subject - Combined

Factor	Levels
Subject	47
Seq+10Ev	26

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Subject	46	22646.60	21905.84	476.21	13.72	0.000
Seq+10Ev	25	12004.01	12004.01	480.16	13.83	0.000
Error	321	11145.53	11145.53	34.72		
Total	392	45796.14				

Term	Coeff	Stdev	t-value	P
Constant	37.4739	0.6184	60.90	0.000

Means for Score

Seq+10Ev	Mean	Stdev
11	38.15	0.8595
22	35.55	3.7785
23	30.52	1.0073
34	28.67	2.3141
35	28.81	1.0238
46	31.94	1.0799
47	28.01	1.7039
58	28.29	0.9423
62	43.37	1.3566
64	40.43	1.8958
65	44.78	3.2158
66	41.47	2.3853
67	37.88	3.7785

Seq+10Ev	Mean	Stdev
69	47.57	6.3166
72	42.72	3.1251
74	38.39	1.2822
76	38.83	2.4057
77	45.54	2.8767
79	31.88	3.7785
83	45.68	2.4785
85	49.57	6.3166
87	41.67	1.3213
89	38.87	1.7039
92	36.85	1.6397
95	28.21	3.7785
99	30.70	1.1823

APPENDICES G22-G25

Oneway ANOVA of Refresher and Combined subjects' STAI and course evaluation responses

Appendix G22 - HUET / Abandonment

A - Oneway of pre HUET STAI vs 'Most difficult aspect of HUET to cope with' - Refresher

```
ANALYSIS OF VARIANCE ON SAIHUET
SOURCE       DF          SS          MS          F          p
HCOPE2        3         896         299       2.77      0.053
ERROR        45        4858         108
TOTAL        48        5754
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                  BASED ON POOLED STDEV
LEVEL        N    MEAN   STDEV   ------+---------+---------+------
The rest    14   35.57    7.79        (------*------)
Disorient   23   36.39   11.52           (----*-----)
Gen anx     10   46.70    9.33                     (-------*--------)
Reminstrct   2   39.50   19.09  (----------------*-----------------)
                                 ------+---------+---------+------
POOLED STDEV =    10.39               32.0      40.0      48.0

Tukey's pairwise comparisons

    Family error rate = 0.0500
Individual error rate = 0.0106
Critical value = 3.77
Intervals for (column level mean) - (row level mean)

                1          3          6
     3     -10.21
             8.57
     6     -22.60     -20.80
             0.34       0.18
     7     -24.87     -23.53     -14.25
            17.01      17.31      28.65
```

B - Oneway of pre HUET STAI vs 'How much more capable of coping with a helicopter ditching' - Refresher

```
ANALYSIS OF VARIANCE ON SAIHUET
SOURCE       DF          SS          MS          F          p
HDCAPBL       3      1030.9       343.6       3.73      0.019
ERROR        38      3497.5        92.0
TOTAL        41      4528.4
                                       INDIVIDUAL 95 PCT CI'S FOR MEAN
                                       BASED ON POOLED STDEV
LEVEL       N    MEAN    STDEV   ------+---------+---------+---------
Much       12   35.417   9.558      (------*------)
Moderate   13   32.000   8.583   (------*------)
Slightly   11   39.636   7.839           (-------*------)
Nochange    6   47.000  14.100                  (---------*---------)
                                 ------+---------+---------+---------
POOLED STDEV =     9.594              32.0      40.0      48.0
```

```
Tukey's pairwise comparisons
    Family error rate = 0.0500
Individual error rate = 0.0106
Critical value = 3.80

Intervals for (column level mean) - (row level mean)

                1          2          3
     2      -6.90
            13.74
     3     -14.98     -18.20
             6.54       2.92
     4     -24.47     -27.72     -20.45
             1.31      -2.28       5.72
```

C - Oneway of pre HUET STAI vs 'Whether the training has altered trainees' confidence in helicopter transport' - Refresher

```
ANALYSIS OF VARIANCE ON SAIHUET
SOURCE      DF        SS         MS         F        p
HALTER       4     885.5      221.4      2.25    0.082
ERROR       37    3642.9       98.5
TOTAL       41    4528.4
                                INDIVIDUAL 95 PCT CI'S FOR MEAN
                                BASED ON POOLED STDEV
LEVEL        N    MEAN    STDEV  -+---------+---------+---------+-----
Great ↑      3  31.333    9.866   (-----*----)
Somewhat↑    5  33.800   10.756     (----*---)
No dif      31  37.226    9.080          (-*)
Somewhat↓    2  39.000   22.627     (-------*------)
Great↓       1  64.000    0.000              (---------*---------)
                                 -+---------+---------+---------+-----
POOLED STDEV =    9.923          20        40        60        80

Tukey's pairwise comparisons

    Family error rate = 0.0500
Individual error rate = 0.00680
Critical value = 4.05

Intervals for (column level mean) - (row level mean)

                1          2          3          4
     2     -23.22
            18.29
     3     -23.07     -17.12
            11.29      10.27
     4     -33.61     -28.97     -22.51
            18.27      18.57      18.96
     5     -65.48     -61.33     -55.64     -59.80
             0.15       0.93       2.10       9.80
```

D - Oneway of pre HUET STAI vs 'How satisfied trainees were with the way they coped with the HUET training' - Combined

```
ANALYSIS OF VARIANCE ON STAIHUET
SOURCE       DF        SS         MS         F        p
hsatis        2    1913.4      956.7      9.73    0.000
ERROR        43    4227.5       98.3
TOTAL        45    6140.9
                                      INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL        N    MEAN    STDEV   -+---------+---------+---------+-----
Very well   23  39.000    9.095   (--*---)
Well        20  43.600   10.615       (--*---)
Somewhat     3  65.667   11.547                     (---------*--------)
                                  -+---------+---------+---------+-----
POOLED STDEV =     9.915           36        48        60        72

Tukey's pairwise comparisons
    Family error rate = 0.0500
Individual error rate = 0.0195
Critical value = 3.43
Intervals for (column level mean) - (row level mean)
                1          2
     2     -11.95
             2.75
     3     -41.43     -36.96
           -11.90      -7.18
```

E - Oneway of pre abandonment training STAI vs 'How satisfied trainees were with the way they coped with the abandonment training' - Combined

```
ANALYSIS OF VARIANCE ON STAIAbnd
SOURCE       DF        SS         MS         F        p
asatis        2       949        474      4.35    0.020
ERROR        39      4258        109
TOTAL        41      5207
                                      INDIVIDUAL 95 PCT CI'S FOR MEAN
                                      BASED ON POOLED STDEV
LEVEL        N    MEAN    STDEV   ---+---------+---------+---------+-
Very well   15   32.93     7.54   (-----*----)
Well        25   42.88    11.81             (---*---)
Somewhat     2   42.50    10.61    (-------------*-------------)
                                  ---+---------+---------+---------+-
POOLED STDEV =     10.45             30        40        50        60

Tukey's pairwise comparisons
    Family error rate = 0.0500
Individual error rate = 0.0195
Critical value = 3.45

Intervals for (column level mean) - (row level mean)

                1          2
     2     -18.27
            -1.62
     3     -28.76     -18.35
             9.62      19.11
```

Appendix G23 - Fire training

A - Oneway of pre fire training STAI vs 'How satisfied trainees were with the way they coped with the fire training' - Refresher

```
ANALYSIS OF VARIANCE ON SAIFIRE
SOURCE      DF        SS        MS        F        p
FSATIS       2       778       389     3.14    0.055
ERROR       38      4713       124
TOTAL       40      5491
                                    INDIVIDUAL 95 PCT CI'S FOR MEAN
                                    BASED ON POOLED STDEV
LEVEL      N    MEAN    STDEV   --+---------+---------+---------+----
Very well 15   34.40    10.32    (----*-----)
Well      21   37.86    12.06        (----*----)
Somewhat   5   48.80     8.81              (---------*---------)
                                --+---------+---------+---------+----
POOLED STDEV =     11.14          30        40        50        60

Tukey's pairwise comparisons
    Family error rate = 0.0500
Individual error rate = 0.0195
Critical value = 3.45
Intervals for (column level mean) - (row level mean)

              1          2
    2    -12.64
           5.73
    3    -28.43     -24.46
          -0.37       2.58
```

B - Oneway of pre fire training STAI vs 'How satisfied trainees were with the way they coped with the fire training' - Combined

```
ANALYSIS OF VARIANCE ON STAIFire
SOURCE      DF        SS        MS        F        p
fsatis       2     767.6     383.8     4.24    0.022
ERROR       37    3347.7      90.5
TOTAL       39    4115.4
                                 INDIVIDUAL 95 PCT CI'S FOR MEAN
                                 BASED ON POOLED STDEV
LEVEL      N    MEAN    STDEV   --------+---------+---------+--------
Very well 20   37.400  11.133                (--*---)
Well      19   45.947   7.427                       (--*---)
Somewhat   1   34.000   0.000    (--------------*--------------)
                                --------+---------+---------+--------
POOLED STDEV =     9.512                24        36        48

Tukey's pairwise comparisons
    Family error rate = 0.0500
Individual error rate = 0.0195
Critical value = 3.45
Intervals for (column level mean) - (row level mean)

              1          2
    2    -15.98
          -1.11
    3    -20.38     -11.86
          27.18      35.76
```

Appendix G24 - TEMPSC

A - Oneway of pre TEMPSC abandonment STAI vs 'How satisfied trainees were with the way they coped with the TEMPSC' - Refresher

```
ANALYSIS OF VARIANCE ON SAIBOAT
SOURCE       DF        SS         MS        F        p
TSATIS2       2     407.3      203.7     3.69    0.033
ERROR        42    2316.6       55.2
TOTAL        44    2723.9
                                      INDIVIDUAL 95 PCT CI'S FOR MEAN
                                  BASED ON POOLED STDEV
LEVEL        N    MEAN    STDEV   -----+---------+---------+---------+-
Very well   18  28.056    7.712   (----*----)
Well        24  32.042    6.792         (----*---)
Somewhat     3  39.667   11.060            (------------*-----------)
                                  -----+---------+---------+---------+-
POOLED STDEV =     7.427              28.0      35.0      42.0      49.0

Tukey's pairwise comparisons
   Family error rate = 0.0500
Individual error rate = 0.0195
Critical value = 3.44
Intervals for (column level mean) - (row level mean)
                  1         2
     2        -9.62
               1.65
     3       -22.88    -18.69
              -0.35      3.44
```

B - Oneway of pre TEMPSC abandonment STAI vs 'How satisfied trainees were with the way they coped with the TEMPSC' - Combined

```
ANALYSIS OF VARIANCE ON STAITEMP
SOURCE       DF        SS         MS        F        p
tsatis2       1     372.4      372.4     7.03    0.011
ERROR        42    2223.2       52.9
TOTAL        43    2595.5
                                  INDIVIDUAL 95 PCT CI'S FOR MEAN
                                  BASED ON POOLED STDEV
LEVEL        N    MEAN    STDEV   ---+---------+---------+---------+--
Very well   22  29.773    7.050   (--------*--------)
Well        22  35.591    7.494                  (--------*--------)
                                  ---+---------+---------+---------+--
POOLED STDEV =     7.276         28.0      31.5      35.0      38.5

Tukey's pairwise comparisons
   Family error rate = 0.0500
Individual error rate = 0.0500
Critical value = 2.85
Intervals for (column level mean) - (row level mean)

                  1
     2      -10.239
             -1.397
```

Appendix G25 - Correlations among Personality Questionnaires

Refresher subjects

	AGE	LOC	I&PTT	I&PTAS	I&PES	I&PDIS
LOC	-0.302					
I&PTT	-0.208	0.058				
I&PTAS	-0.008	-0.183	0.693			
I&PES	-0.095	-0.184	0.797	0.502		
I&PDIS	-0.467	0.307	0.690	0.171	0.468	
I&PBS	-0.022	0.226	0.652	0.210	0.330	0.339

Combined subjects

	AGE	LOC	I&PTOT	I&PTAS	I&PES	I&PDIS
LOC	-0.361					
I&PTOT	-0.252	0.103				
I&PTAS	-0.146	-0.090	0.711			
I&PES	-0.118	0.160	0.730	0.360		
I&PDIS	-0.328	0.183	0.817	0.383	0.498	
I&PBS	-0.165	0.115	0.719	0.250	0.375	0.546

KEY
LOC - Locus of control
I&PTot - Interest & Preference test (SSS) - Total
I&PTAS - Interest & Preference test - Thrill & Aventure Seeking
I&PES - Interest & Preference test - Experience Seeking
I&PDis - Interest & Preference test - Disinhibition
I&PBS - Interest & Preference test - Boredom susceptibility

APPENDIX H - FIGURES FROM HEART RATE AND CORTISOL RESULTS, NOT CONTAINED WITHIN THE TEXT

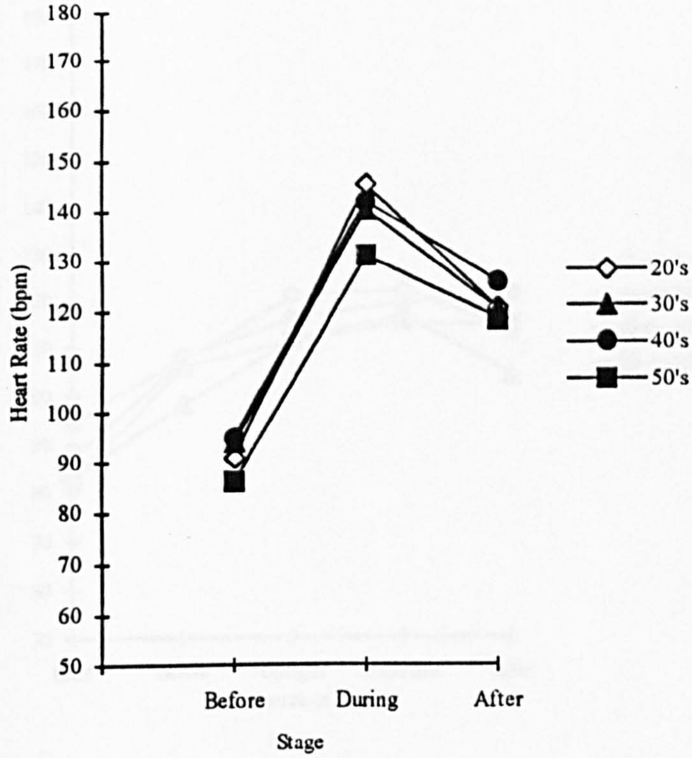

Figure 30a
Combined subjects' heart rate means during the fire exercise - self-rescue from the smokehouse, using BA

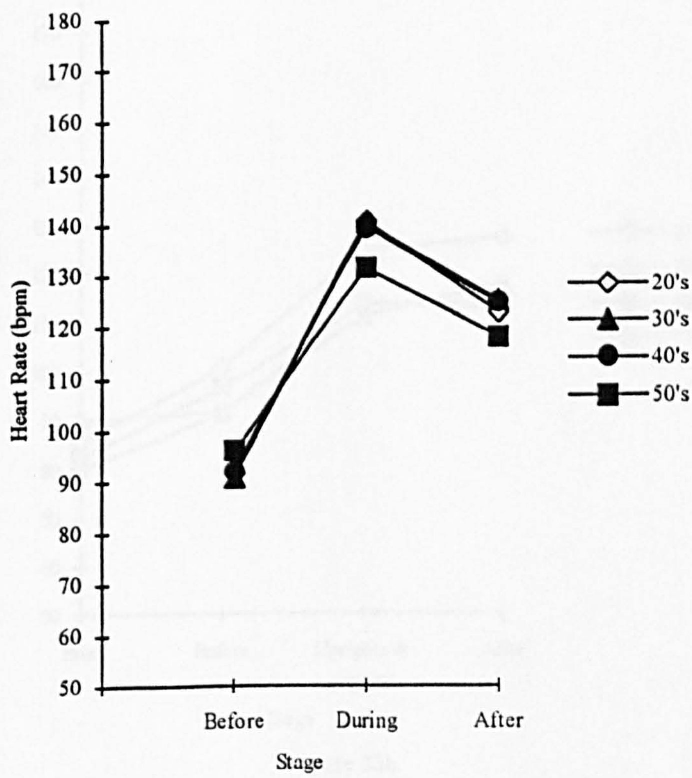

Figure 30b
Refresher subjects' heart rate means during the fire exercise - self-rescue from the smokehouse, using BA

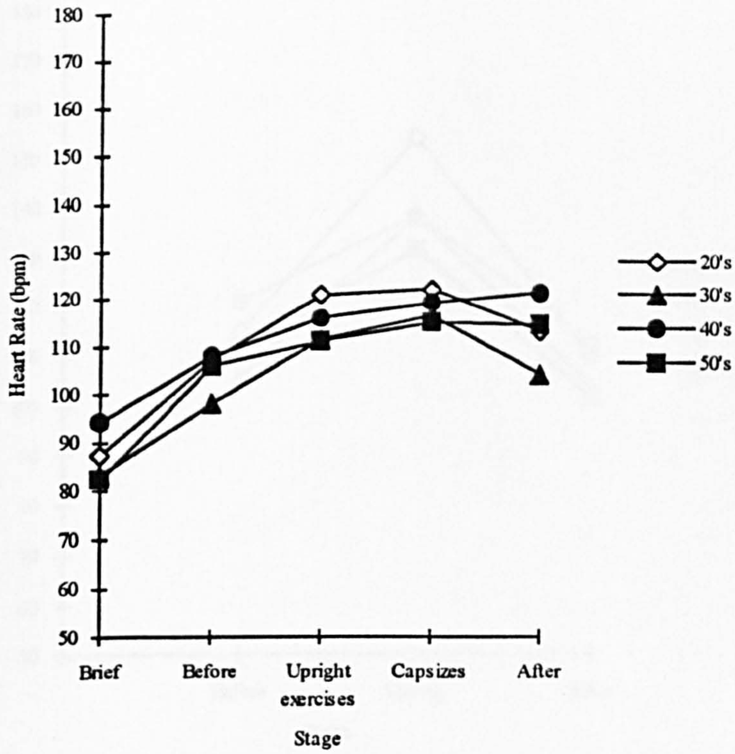

Figure 33a
Combined subjects' heart rate means during the HUET

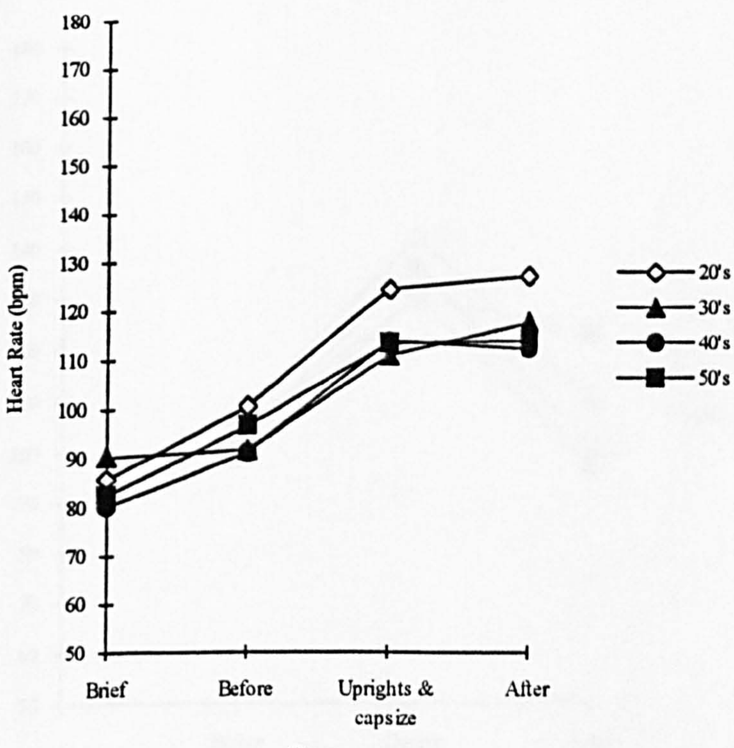

Figure 33b
Refresher subjects' heart rate means during the HUET

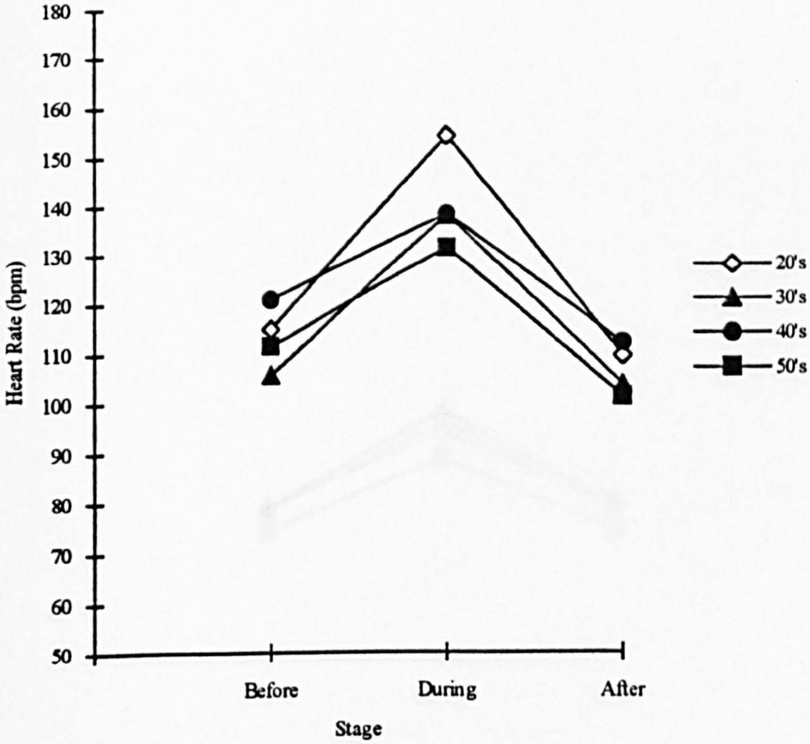

Figure 35a
Combined subjects' heart rate means during the abandonment exercise

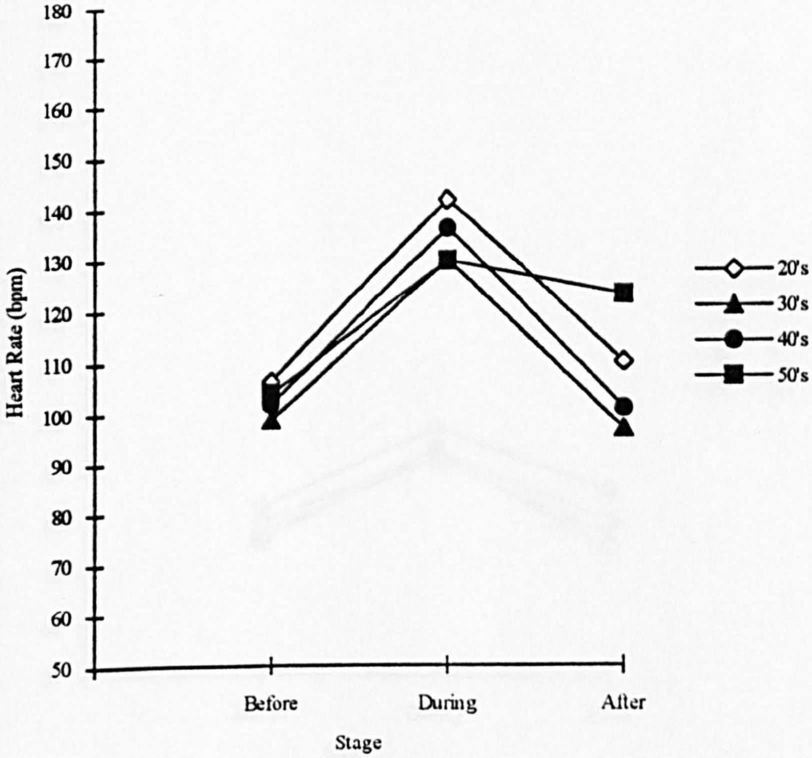

Figure 35b
Refresher subjects' heart rate means during the abandonment exercise

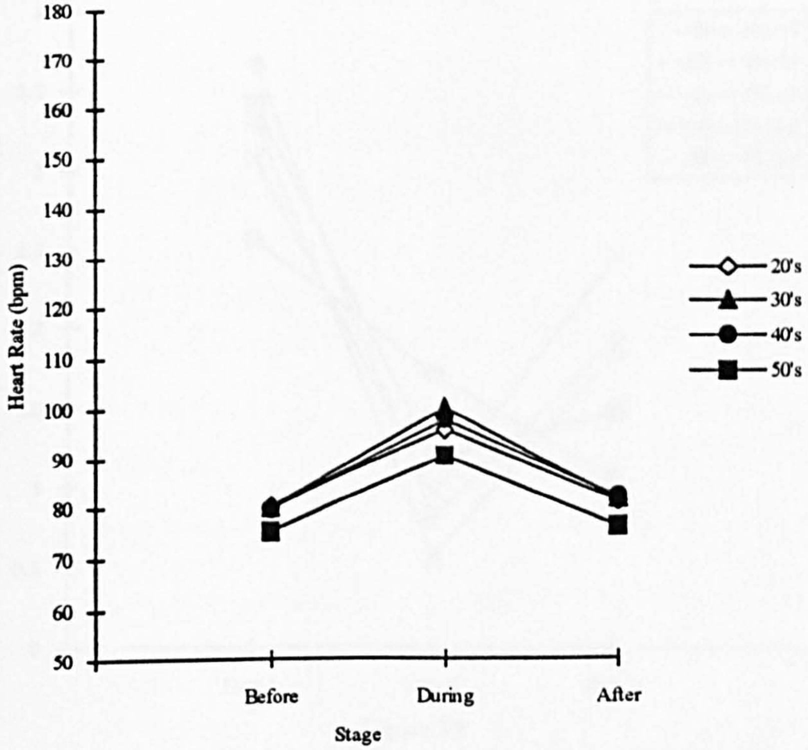

Figure 37a
Combined subjects' heart rate means during the TEMPSC abandonment

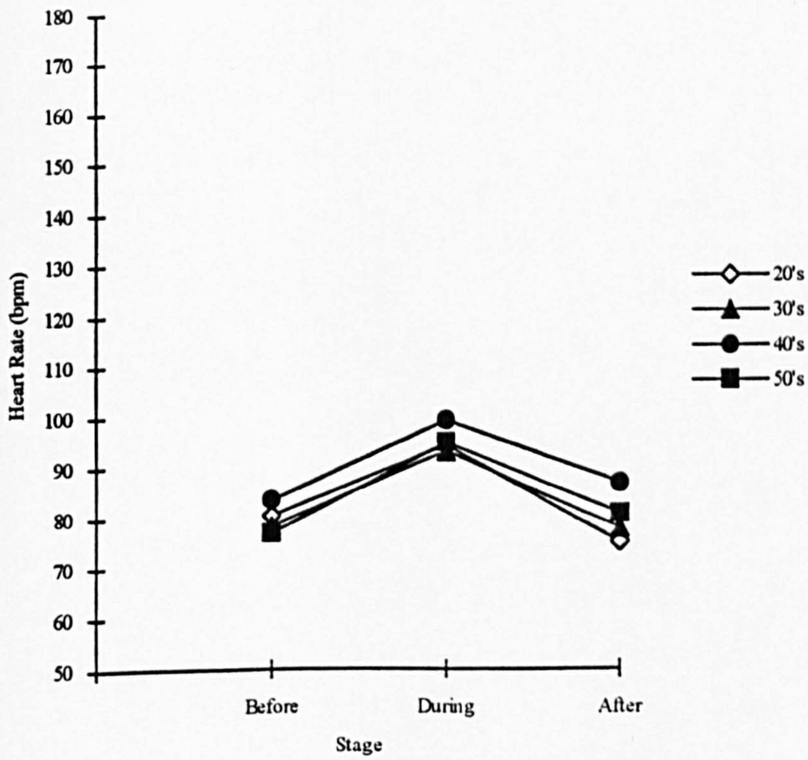

Figure 37b
Refresher subjects' heart rate means during the TEMPSC abandonment

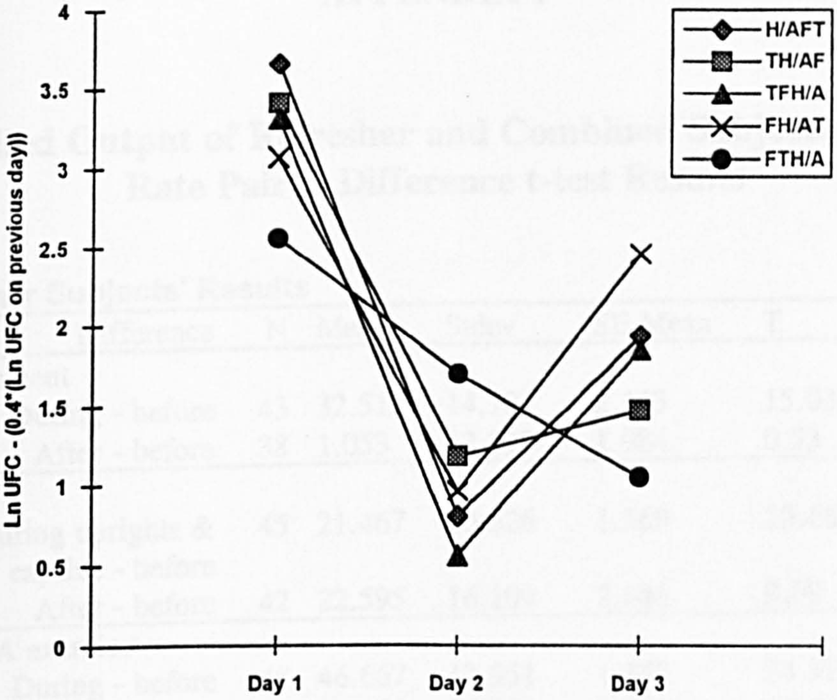

Figure 39

Refresher subjects' UFC data divided according to Order groups - demonstrating the difference in pattern of the group who completed the TEMPSC training on day 2

APPENDIX I

Detailed Output of Refresher and Combined Subjects' Heart Rate Paired Difference t-test Results

Refresher Subjects' Results

Difference	N	Mean	Stdev	SE Mean	T	P Value
Abandonment						
During - before	43	32.512	14.181	2.163	15.03	0.0000
After - before	38	1.053	12.232	1.984	0.53	0.60
HUET						
During uprights & capsize - before	45	21.467	10.526	1.569	13.68	0.0000
After - before	42	22.595	16.109	2.486	9.09	0.0000
Fire - BA exercise						
During - before	48	46.667	12.951	1.869	24.97	0.0000
After - before	48	30.958	14.293	2.063	15.01	0.0000
TEMPSC abandon						
During - before	45	15.778	7.914	1.180	13.37	0.0000
After - before	44	-0.591	7.969	1.201	-0.49	0.63

Combined Subjects' Results

Difference:	N	Mean	St Dev	SE Mean	T	P Value
Abandonment						
During - before	38	28.842	15.954	2.588	11.14	0.0000
After - before	38	-5.658	12.486	2.026	-2.79	0.0082
HUET						
During uprights - before	42	11.381	10.104	1.559	7.30	0.0000
During capsizes - before	42	15.048	12.591	1.943	7.75	0.0000
After - before	38	-7.079	17.073	2.770	-2.56	0.015
Fire - BA exercise						
During - before	34	47.559	12.837	2.202	21.60	0.0000
After - before	34	27.059	10.795	1.851	14.62	0.0000
TEMPSC abandon						
During - before	39	17.744	9.768	1.564	11.34	0.0000
After - before	39	1.231	8.508	1.362	0.90	0.37

Alternative 0.
Test Of Mu = 0.000 Vs Mu N.E. 0.000

APPENDICES J1 - J13

Detailed Output of Statistical Analyses on Cortisol Data

J1 - GLM of UFC (t_1,i,j) = Smoke + Fit + Swim + Age + C - Combined

Factor	Levels	Values			
SMOKE	2	1	2		
Fit	4	1	2	3	4
SWIM	4	1	2	3	4

Source	DF	Seq SS	Adj SS	Adj MS	F	P
SMOKE	1	0.3	9.1	9.1	0.02	0.894
Fit	3	2454.2	3405.2	1135.1	2.25	0.099
SWIM	3	2463.2	2680.6	893.5	1.77	0.170
AGE	1	291.0	291.0	291.0	0.58	0.452
Error	37	18665.4	18665.4	504.5		
Total	45	23874.1				

Term	Coeff	Stdev	t-value	P
Constant	16.50	17.29	0.95	0.346
AGE	0.3189	0.4199	0.76	0.452

Covariate	Mean	Stdev
AGE	34.89	9.599

Adjusted Means for RUFCE

SMOKE	Mean	Stdev
1	28.10	6.798
2	27.15	6.572

Fit	Mean	Stdev	SWIM	Mean	Stdev
1	24.35	17.999	1	16.66	12.143
2	43.18	6.674	2	22.09	7.951
3	30.47	5.853	3	38.06	6.733
4	12.51	9.654	4	33.71	9.556

J2 - GLM of UFC (t_1,i,j) = Smoke + Fit + Swim + Age + C - Refresher

Factor	Levels	Values			
SMOKE	2	1	2		
FIT	4	1	2	3	4
SWIM	4	1	2	3	4

Source	DF	Seq SS	Adj SS	Adj MS	F	P
SMOKE	1	2018.0	309.5	309.5	1.03	0.317
FIT	3	981.3	1240.7	413.6	1.37	0.265
SWIM	3	1888.4	1884.2	628.1	2.08	0.117
AGE	1	16.3	16.3	16.3	0.05	0.817
Error	41	12356.0	12356.0	301.4		
Total	49	17259.9				

Term	Coeff	Stdev	t-value	P
Constant	30.61	13.14	2.33	0.025
AGE	0.0666	0.2864	0.23	0.817

<u>Means for Covariates</u>

Covariate	Mean	Stdev
AGE	37.78	9.597

<u>Adjusted Means for RUFCE</u>

SMOKE	Mean	Stdev
1	36.00	6.895
2	30.26	5.705

FIT	Mean	Stdev	SWIM	Mean	Stdev
1	21.89	19.288	1	48.93	7.487
2	26.79	6.428	2	26.24	7.405
3	35.58	4.032	3	29.27	6.511
4	48.26	9.271	4	28.07	12.010

J3 - MANOVA of STAI, UFC & SFC on Day 1 against Order, Smoke & Age - Combined

41 cases accepted.
5 cases rejected because of out-of-range factor values.
1 case rejected because of missing data.
9 non-empty cells.

1 design will be processed.

- -

	ORDER2
THAF	1
HAFT	2
FTHA	3
AHFT	4
TAHF	5

- -

Order of Variables for Analysis

Variates
SAL1 - Saliva free cortisol on day 1
STAI1 - State anxiety on day 1
UM1 - Urinary free cortisol on day 1
Covariates
AGE

3 Dependent Variables
1 Covariate

- -

Adjusted WITHIN+RESIDUAL Correlations with Std. Devs. on Diagonal

	SAL1	STAI1	UM1
SAL1	6.622		
STAI1	-.146	10.847	
UM1	.075	-.106	25.810

- -

EFFECT .. WITHIN+RESIDUAL Regression
Multivariate Tests of Significance (S = 1, M = 1/2, N = 15)

Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
Pillais	.07628	.88090	3.00	32.00	.461
Hotellings	.08258	.88090	3.00	32.00	.461
Wilks	.92372	.88090	3.00	32.00	.461
Roys	.07628				

Note.. F statistics are exact.

- -

EFFECT .. WITHIN+RESIDUAL Regression (Cont.)
Univariate F-tests with (1,34) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F
SAL1	120.60603	1490.89694	120.60603	43.84991	2.75043
STAI1	1.60282	4000.53615	1.60282	117.66283	.01362
UM1	5.33094	22648.60356	5.33094	666.13540	.00800

Variable	Sig. of F
SAL1	.106
STAI1	.908
UM1	.929

- -

Regression analysis for WITHIN+RESIDUAL error term
--- Individual Univariate .9500 confidence intervals
Dependent variable .. SAL1

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t
AGE	-.19727	-.29817	.119	-1.658	.106

COVARIATE	Lower -95%	CL- Upper
AGE	-.439	.044

Dependent variable .. STAI1

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t
AGE	.02274	.02092	.195	.117	.908

COVARIATE	Lower -95%	CL- Upper
AGE	-.373	.419

Dependent variable .. UM1

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t
AGE	.04147	.01691	.464	.089	.929

COVARIATE	Lower -95%	CL- Upper
AGE	-.901	.984

- -

EFFECT .. SMOKE
Multivariate Tests of Significance (S = 1, M = 1/2, N = 15)

Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
Pillais	.02333	.25478	3.00	32.00	.857
Hotellings	.02389	.25478	3.00	32.00	.857
Wilks	.97667	.25478	3.00	32.00	.857
Roys	.02333				

Note.. F statistics are exact.

- -

EFFECT .. SMOKE (Cont.)
Univariate F-tests with (1,34) D. F.

Variable	Hypoth.SS	Error SS	Hypoth. MS	Error MS	F	Sig.of F
SAL1	6.88526	1490.89694	6.88526	43.84991	.15702	.694
STAI1	56.07930	4000.53615	56.07930	117.66283	.47661	.495
UM1	39.55811	22648.6036	39.55811	666.13540	.05938	.809

- -

```
EFFECT .. ORDER2
Multivariate Tests of Significance (S = 3, M = 0, N = 15 )
Test Name        Value   Approx. F Hypoth. DF   Error DF  Sig. of F
Pillais         .12456    .36821      12.00     102.00       .972
Hotellings      .13659    .34905      12.00      92.00       .977
Wilks           .87778    .35756      12.00      84.96       .974
Roys            .10245
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

EFFECT .. ORDER2 (Cont.)
Univariate F-tests with (4,34) D. F.

Variable  Hypoth.SS   Error SS   Hypoth.MS   ErrorMS      F    Sig.of F
SAL1      23.95752   1490.89694   5.98938   43.84991  .13659    .968
STAI1     99.99801   4000.53615  99.99950  117.66283  .84988    .504
UM1       78.30975   22648.6036  69.57744  666.13540  .10445    .980
- - - - - - - - - - - - - - - - - - - - - - -
```

J4 - MANOVA of STAI, UFC & SFC on Day 1 against Smoke, Fit, Swim & Age - Refresher

```
      33 cases accepted.
       0 cases rejected because of out-of-range factor values.
      19 cases rejected because of missing data.
      13 non-empty cells.
       1 design will be processed.
- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Order of Variables for Analysis
  Variates      Covariates
SALE- Saliva free cortisol on day 1
STAI1 - State anxiety on day 1
UCORT1   - Urinary free cortisol on day 1
Covariates
AGE

   3 Dependent Variables
   1 Covariate
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

Adjusted WITHIN+RESIDUAL Correlations with Std. Devs. on Diagonal
                STAI1       SALE      UCORT1
STAI1           8.368
SALE             .087      6.310
UCORT1           .065       .287     17.904
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

EFFECT .. WITHIN+RESIDUAL Regression
Multivariate Tests of Significance (S = 1, M = 1/2, N = 10 )
Test Name       Value    Exact F Hypoth. DF   Error DF  Sig. of F
Pillais        .10092    .82313      3.00      22.00       .495
Hotellings     .11225    .82313      3.00      22.00       .495
Wilks          .89908    .82313      3.00      22.00       .495
Roys           .10092
Note.. F statistics are exact.
- - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

EFFECT .. WITHIN+RESIDUAL Regression (Cont.)
Univariate F-tests with (1,24) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F
STAI1	66.35973	1680.38406	66.35973	70.01600	.94778
SALE	76.13281	955.54726	76.13281	39.81447	1.91219
UCORT1	15.33868	7693.09730	15.33868	320.54572	.04785

Variable	Sig. of F
STAI1	.340
SALE	.179
UCORT1	.829

Regression analysis for WITHIN+RESIDUAL error term
--- Individual Univariate .9500 confidence intervals

- -

Dependent variable .. STAI1

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t
AGE	-.17212	-.21892	.177	-.974	.340

COVARIATE	Lower -95%	CL- Upper
AGE	-.537	.193

Dependent variable .. SALE

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t
AGE	-.18436	-.26458	.133	-1.383	.179

COVARIATE	Lower -95%	CL- Upper
AGE	-.460	.091

Dependent variable .. UCORT1

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t
AGE	-.08275	-.03958	.378	-.219	.829

COVARIATE	Lower -95%	CL- Upper
AGE	-.863	.698

- -

EFFECT .. SWIM
Multivariate Tests of Significance (S = 3, M = -1/2, N = 10)

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.32930	.98639	9.00	72.00	.459
Hotellings	.39986	.91819	9.00	62.00	.516
Wilks	.69617	.95722	9.00	53.69	.485
Roys	.20572				

- -

EFFECT .. SWIM (Cont.)
Univariate F-tests with (3,24) D. F.

Variable	Hypoth.SS	ErrorSS	Hypoth.MS	ErrorMS	F	Sig.ofF
STAI1	44.43728	1680.38406	14.81243	70.01600	.21156	.887
SALE	231.80433	955.54726	77.26811	39.81447	1.94070	.150
UCORT1	1096.84287	7693.09730	365.61429	320.54572	1.14060	.353

- -

EFFECT .. FIT
Multivariate Tests of Significance (S = 3, M = -1/2, N = 10)

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.14530	.40720	9.00	72.00	.927
Hotellings	.15601	.35824	9.00	62.00	.950
Wilks	.86027	.38061	9.00	53.69	.939
Roys	.08588				

EFFECT .. FIT (Cont.)
Univariate F-tests with (3,24) D. F.

Variable	Hypoth.SS	ErrorSS	Hypoth.MS	ErrorMS	F	Sig.ofF
STAI1	74.15267	1680.38406	24.71756	70.01600	.35303	.787
SALE	43.11088	955.54726	14.37029	39.81447	.36093	.782
UCORT1	324.72344	7693.09730	108.24115	320.54572	.33768	.798

EFFECT .. SMOKE
Multivariate Tests of Significance (S = 1, M = 1/2, N = 10)

Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
Pillais	.37764	4.44973	3.00	22.00	.014
Hotellings	.60678	4.44973	3.00	22.00	.014
Wilks	.62236	4.44973	3.00	22.00	.014
Roys	.37764				

Note.. F statistics are exact.

EFFECT .. SMOKE (Cont.)
Univariate F-tests with (1,24) D. F.

Variable	Hypoth.SS	ErrorSS	Hypoth.MS	ErrorMS	F	Sig.ofF
STAI1	78.22690	1680.38406	78.22690	70.01600	1.11727	.301
SALE	432.78990	955.54726	432.78990	39.81447	10.87017	.003
UCORT1	2268.08871	7693.09730	2268.08871	320.54572	7.07571	.014

Estimates for STAI1 adjusted for 1 covariate
--- Individual univariate .9500 confidence intervals

SMOKE

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%CL	-Upper
2	3.85616036	3.64818	1.05701	.30103	-3.67330	11.38562

FIT

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%CL	-Upper
3	-8.3930856	12.44587	-.67437	.50652	-34.08010	17.29393
4	1.51568888	7.18780	.21087	.83477	-13.31920	16.35058
5	.174716208	6.96378	.02509	.98019	-14.19783	14.54726

SWIM

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%CL	-Upper
6	-8.0139869	10.91321	-.73434	.46986	-30.53775	14.50978
7	-5.3706843	10.00270	-.53692	.59626	-26.01524	15.27387
8	-6.4345889	9.49074	-.67799	.50427	-26.02250	13.15333

Estimates for SALE adjusted for 1 covariate
--- Individual univariate .9500 confidence intervals

SMOKE

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%CL	-Upper
2	9.07017348	2.75104	3.29699	.00303	3.39230	14.74805

FIT

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%CL-	Upper
3	7.99510107	9.38528	.85188	.40270	-11.37516	27.36536
4	5.34941930	5.42023	.98694	.33352	-5.83738	16.53622
5	4.48614262	5.25130	.85429	.40139	-6.35202	15.32430

SWIM

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%CL-	Upper
6	-17.074335	8.22952	-2.07477	.04890	-34.05923	-.08944
7	-12.026418	7.54291	-1.59440	.12393	-27.59422	3.54139
8	-15.128813	7.15685	-2.11389	.04511	-29.89982	-.35781

- -

Estimates for UCORT1 adjusted for 1 covariate
--- Individual univariate .9500 confidence intervals

SMOKE

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%CL-	Upper
2	20.7638103	7.80588	2.66002	.01370	4.65326	36.87436

FIT

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%CL-	Upper
3	-5.4511150	26.63003	-.20470	.83953	-60.41280	49.51057
4	-8.5665112	15.37950	-.55701	.58268	-40.30824	23.17522
5	-.78213191	14.90019	-.05249	.95857	-31.53460	29.97034

SWIM

Parameter	Coeff.	Std.Err.	t-Value	Sig.t	Lower-95%CL-	Upper
6	-8.8722756	23.35065	-.37996	.70732	-57.06565	39.32110
7	-23.982602	21.40246	-1.12055	.27357	-68.15510	20.18990
8	-23.164294	20.30702	-1.14070	.26525	-65.07592	18.74734

- -

J5 - Repeated Measures ANOVA of Log UFC(t,i,j) = D(t) + O(j) + Age + C - Combined

35 cases accepted.
0 cases rejected because of out-of-range factor values.
12 cases rejected because of missing data.
5 non-empty cells.
1 design will be processed.

- -

Tests of Between-Subjects Effects.
Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	28.67	29	.99		
REGRESSION	2.22	1	2.22	2.25	.145
ORDER2	4.41	4	1.10	1.12	.368

- -

Regression analysis for WITHIN+RESIDUAL error term
--- Individual Univariate .9500 confidence intervals
Dependent variable .. T1

COVARIATE	B	Beta	Std. Err.	t-Value	Sig. of t
TAGE	.01308	.29505	.009	1.499	.145

COVARIATE	Lower -95%	CL- Upper
TAGE	-.005	.031

- -

EFFECT .. ORDER2 BY DAYS
Multivariate Tests of Significance (S = 4, M = -1/2, N = 12 1/2)

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.42294	.88679	16.00	120.00	.586
Hotellings	.51300	.81759	16.00	102.00	.663
Wilks	.62850	.85297	16.00	83.12	.623
Roys	.23572				

- -

EFFECT .. DAYS
Multivariate Tests of Significance (S = 1, M = 1 , N = 12 1/2)

Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
Pillais	.86902	44.78365	4.00	27.00	.000
Hotellings	6.63461	44.78365	4.00	27.00	.000
Wilks	.13098	44.78365	4.00	27.00	.000
Roys	.86902				

Note.. F statistics are exact.

- -

Tests involving 'DAYS' Within-Subject Effect.
AVERAGED Tests of Significance for MEAS.1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	47.09	120	.39		
DAYS	46.87	4	11.72	29.86	.000
ORDER2 BY DAYS	5.35	16	.33	.85	.625

- -

J6 - Repeated Measures ANOVA of UFC(t,i,j) = D(t) + O(j) + smoke + C - with contrasts - Refresher

47 cases accepted.
0 cases rejected because of out-of-range factor values.
5 cases rejected because of missing data.
10 non-empty cells.
1 design will be processed.

- -

	ORDER2
HAFT	1
THAF	2
TFHA	3
FTHA	4
FHAT	5

- -

Tests of Between-Subjects Effects.
Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	21203.67	41	517.16		
SMOKE	414.73	1	414.73	.80	.376
ORDER2	2447.74	4	611.94	1.18	.332

- -

Estimates for T1
--- Individual univariate .9500 confidence intervals

SMOKE

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower -95%CL-	Upper
2	3.10871	3.47146	.89551	.37574	-3.90205	10.1

ORDER2

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower -95%CL-	Upper
3	17.10581	8.38059	2.04112	.04771	.1809	34.0
4	-.75421	5.82101	-.12957	.89754	-12.510	11.0
5	-2.87860	6.41074	-.44903	.65578	-15.825	10.0
6	-1.62321	11.13833	-.14573	.88485	-24.118	20.8

- -

EFFECT .. ORDER2 BY DAYS
Multivariate Tests of Significance (S = 2, M = 1/2, N = 19)

Test Name	Value	Approx.F	Hypoth.DF	Error DF	Sig. of F
Pillais	.25622	1.59604	8.00	82.00	.168
Hotellings	.30481	1.48593	8.00	78.00	.176
Wilks	.75659	1.49664	8.00	80.00	.172
Roys	.18819				

Note.. F statistics for WILKS' Lambda is exact.

- -

EFFECT .. ORDER2 BY DAYS (Cont.)
Univariate F-tests with (4,41) D. F.

Variable	Hypoth.SS	Error SS	Hypoth.MS	Error MS	F	Sig.ofF
T2	1299.9968	6453.0557	324.9992	157.3916	2.065	.100
T3	831.1431	10501.0677	207.7858	256.1236	.811	>.100

- -

EFFECT .. SMOKE BY DAYS
Multivariate Tests of Significance (S = 1, M = 0, N = 19)

Test Name	Value	Exact.F	Hypoth.DF	Error DF	Sig. of F
Pillais	.14683	3.44195	2.00	40.00	.042
Hotellings	.17210	3.44195	2.00	40.00	.042
Wilks	.85317	3.44195	2.00	40.00	.042
Roys	.14683				

Note.. F statistics are exact.

- -

EFFECT .. SMOKE BY DAYS (Cont.)
Univariate F-tests with (1,41) D. F.

Variable	Hypoth.SS	ErrorSS	Hypoth.MS	Error MS	F	Sig.ofF
T2	931.4388	6453.0557	931.4388	157.3916	5.9180	<.050
T3	692.62917	10501.0677	692.6292	256.1236	2.7043	>.100

- -

EFFECT .. DAYS
Multivariate Tests of Significance (S = 1, M = 0, N = 19)

Test Name	Value	Exact F	Hypoth.DF	Error DF	Sig. of F
Pillais	.22089	5.67022	2.00	40.00	.007
Hotellings	.28351	5.67022	2.00	40.00	.007
Wilks	.77911	5.67022	2.00	40.00	.007
Roys	.22089				

Note.. F statistics are exact.

- -

EFFECT .. DAYS (Cont.)
Univariate F-tests with (1,41) D. F.

Variable	Hypoth.SS	ErrorSS	Hypoth.MS	ErrorMS	F	Sig.ofF
T2	791.4716	6453.0557	791.4716	157.3916	5.029	<.050
T3	2382.07811	10501.0677	2382.0781	256.1236	9.300	<.010

- -

Tests involving 'DAYS' Within-Subject Effect.

AVERAGED Tests of Significance for UCORT using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	16954.12	82	206.76		
DAYS	3173.55	2	1586.77	7.67	.001
SMOKE BY DAYS	1634.07	2	812.03	3.93	.024
ORDER2 BY DAYS	2131.14	8	266.39	1.29	.261

- -

Estimates for T2
--- Individual univariate .9500 confidence intervals

DAYS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%CL-Upper	
1	-5.282709	2.3558	-2.2425	.03040	-10.04	-.8

SMOKE BY DAYS

Parameter	Coeff.	Std. Err	t-Value	Sig.t	Lower-95%CL-Upper	
2	-4.658823	1.9151	-2.4327	.01944	-8.53	-.7

ORDER2 BY DAYS

Parameter	Coeff.	Std. Err	t-Value	Sig.t	Lower-95%CL-Upper	
3	-3.046672	4.6233	-.6590	.51359	-12.38	6.2
4	-7.955441	3.2113	-2.4774	.01745	-14.44	-1.4
5	-3.824971	3.5366	-1.0815	.28578	-10.97	3.3
6	12.916768	6.1446	2.1021	.04173	.51	25.3

- -

Estimates for T3
--- Individual univariate .9500 confidence intervals

DAYS

Parameter	Coeff.	Std. Err	t-Value	Sig.t	Lower-95%CL-Upper	
1	9.164674	3.00513	3.0497	.00400	3.0957	15.2

SMOKE BY DAYS

Parameter	Coeff.	Std. Err	t-Value	Sig.t	Lower-95%CL-Upper	
2	4.017440	2.44300	1.64447	.10773	-.9163	8.9

ORDER2 BY DAYS

Parameter	Coeff.	Std. Err	t-Value	Sig.t	Lower-95%CL-Upper	
3	-.987368	5.89775	-.16741	.86787	-12.8981	10.3
4	-1.327448	4.09647	-.32405	.74755	-9.6004	6.2
5	6.512604	4.51148	1.44356	.15646	-2.5985	15.2
6	3.539920	7.83847	.45161	.65393	-12.2902	19.1

- -

J7 - Repeated Measures ANOVA of Log UFC(t,i,j) = E(j) + O(j) - with contrasts - Combined

35 cases accepted.
0 cases rejected because of out-of-range factor values.
12 cases rejected because of missing data.
5 non-empty cells.
1 design will be processed.

- -

	ORDER2
THAF	1
HAFT	2
FTHA	3
AHFT	4
TAHF	5

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	1231.44	30	1041.05		
ORDER2	1666.11	4	416.53	.40	.807

- -

Estimates For T1

Individual univariate .9500 confidence intervals

ORDER2

Parameter	Coeff	Std Err	t-Value	Sig t	Lower 95%CL	Upper
2	-10.93	19.538	-.5595	.58	-50.83	28.9
3	.09187	15.210	.0013	.99	-31.04	31.0
4	-15.31	22.815	-.6713	.51	-61.92	31.2
5	-18.86	22.815	-.8269	.41	-65.46	27.7

- -

EFFECT .. ORDER2 BY EVENT

Multivariate Tests of Significance (S = 4, M = -1/2, N = 12 1/2)

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	1.24437	3.38682	16.00	120.00	.000
Hotellings	2.68680	4.28209	16.00	102.00	.000
Wilks	.17573	3.98366	16.00	83.12	.000
Roys	.65834				

- -

EFFECT .. EVENT

Multivariate Tests of Significance (S = 1, M = 1 , N = 12 1/2)

Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
Pillais	.16633	1.34672	4.00	27.00	.278
Hotellings	.19951	1.34672	4.00	27.00	.278
Wilks	.83367	1.34672	4.00	27.00	.278
Roys	.16633				

Note.. F statistics are exact.

- -

Tests involving 'EVENT Within-Subject Effect.

Averaged Tests of Significance for MEAS.1 using unique sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	19157.48	120	159.65		
EVENT	923.96	4	230.99	1.45	.223
ORDER2 BY EVENT	11949.51	16	746.84	4.68	.000

- -

Estimates For T2

Individual univariate .9500 confidence intervals

EVENT

Parameter	Coeff	Std Err	t-Value	Sig t	Lower 95%CL	Upper
1	.929	2.819	.0329	.974	-5.66	5.8

ORDER2 by EVENT

Parameter	Coeff	Std Err	t-Value	Sig t	Lower 95%CL	Upper
2	5.61	8.180	.6864	.50	-11.09	22.3
3	-11.37	6.368	-1.786	.08	-24.38	1.6
4	-.023	9.552	-.0025	.99	-19.53	19.4
5	16.85	9.552	1.7643	.09	-2.66	36.3

- -

Estimates For T3

Individual univariate .9500 confidence intervals

EVENT

Parameter	Coeff	Std Err	t-Value	Sig t	Lower 95%CL	Upper
1	.888	3.138	.2832	.779	-5.52	7.2

ORDER2 by EVENT

Parameter	Coeff	Std Err	t-Value	Sig t	Lower 95%CL	Upper
2	-4.417	9.105	-.4851	.63	-23.01	14.1
3	-6.326	7.088	-.8924	.38	-20.80	8.1
4	14.411	10.63	1.3554	.19	-7.30	36.1
5	-9.431	10.63	-.8869	.38	-31.14	12.2

- -

Estimates For T4
Individual univariate .9500 confidence intervals
EVENT

Parameter	Coeff	Std Err	t-Value	Sig t	Lower 95%CL	Upper
1	-.095	1.816	-.052	.959	-3.804	3.6

ORDER2 by EVENT

Parameter	Coeff	Std Err	t-Value	Sig t	Lower 95%CL	Upper
2	-11.34	5.269	-2.152	.04	-22.10	-.5
3	-16.21	4.102	-3.952	.00	-24.59	-7.8
4	-11.17	6.153	-1.816	.08	-23.74	1.3
5	-12.56	6.153	-2.041	.05	-25.12	.0

- -

Estimates For T5
Individual univariate .9500 confidence intervals
EVENT

Parameter	Coeff	Std Err	t-Value	Sig t	Lower 95%CL	Upper
1	6.280	2.592	2.422	.022	.986	11.5

ORDER2 by EVENT

Parameter	Coeff	Std Err	t-Value	Sig t	Lower 95%CL	Upper
2	11.83	7.521	1.573	.13	-3.53	27.1
3	-23.87	5.855	-4.076	.00	-35.83	-11.9
4	-24.41	8.783	-2.779	.01	-42.35	-6.4
5	-13.62	8.783	-1.550	.13	-31.56	4.3

J8 - Values extracted from Repeated Measures Analysis of Log_e UFC(t,i,j) = D(t) + O(j) + C - Combined

Day	HAFT (2)	AHFT (4)	FTHA (7)	TAHF (9)	THAF (10)	
1	-0.03880	0.026921	0.016683	-0.06411	0.059313	0
2	0.025103	-0.05470	0.141936	-0.06076	-0.05156	0
3	0.087688	-0.04726	-0.15171	-0.00839	0.119691	-2.2E-16
4	-0.00103	0.090211	0.059512	-0.05996	-0.08872	-3.3E-16
5	-0.07295	-0.01516	-0.06641	0.193249	-0.03871	-4.4E-16
	-3.3E-16	-4.4E-16	-2.2E-16	-2.2E-16	0	0

TOTALS for EVENTS

HUET	TEMPSC	Aband	Fire1	Fire2
-0.09396	-0.24463	0.044533	-0.09158	0.385648

error s.d.= 0.271115

ORDER EFFECTS		DAY EFFECTS	
2	0.031009	1	0.310246
4	-0.07014	2	-0.13744
7	-0.03743	3	-0.06826
9	0.111749	4	-0.04522
10	-0.03517	5	-0.05931

J9 - GLM of $UFC(t_{2-5},i,j) = \beta UFC(t-1,i,j) + E(j_t) + C$ - Combined

Factor	Levels	Values				
EVNT2-5	5	1	2	3	4	5

Source	DF	Seq SS	Adj SS	Adj MS	F	P
UFCE-4	1	7973.5	8706.7	8706.7	49.98	0.000
EVENT2-5	4	1104.8	1104.8	276.2	1.59	0.181
Error	165	28745.7	28745.7	174.2		
Total	170	37824.0				

Term	Coeff	Stdev	t-value	P
Constant	7.993	1.535	5.21	0.000
UFCE-4	0.37686	0.05331	7.07	0.000
EVNT2-5				
1	-2.796	2.517	-1.11	0.268
2	-2.852	1.934	-1.47	0.142
3	1.903	1.912	0.99	0.321
4	0.065	2.181	0.03	0.976

Means for Covariates

Covariate	Mean	Stdev
UFCE-4	21.27	19.68

Adjusted Means for UFC2-5

EVNT2-5		Mean	Stdev
HUET	1	13.21	2.952
Abandon	2	13.16	2.060
Fire(day2)	3	17.91	2.063
TEMPSC	4	16.07	2.462
Fire(day1)	5	19.69	2.158

J10 - GLM of Log $UFC(t_{2-5},i-\mu_i,j) - (0.4*UFC(t-1,i-\mu_i,j)) = D(t-1) + E(j_{t-1}) + C$ - Combined

Factor	Levels	Values				
EVNT2-5	5	1	2	3	4	5
DAY2-5	4	2	3	4	5	

Source	DF	Seq SS	Adj SS	Adj MS	F	P
EVNT2-5	4	0.65144	0.31532	0.07883	1.03	0.392
DAY2-5	3	0.99576	0.99576	0.33192	4.35	0.006
Error	136	10.36668	10.36668	0.07623		
Total	143	12.01389				

Means for 0.4Lq-Av

EVNT2-5	Mean	Stdev	DAY2-5	Mean	Stdev
1	-0.1366	0.06805	2	-0.2774	0.05910
2	-0.0627	0.05974	3	-0.0042	0.05325
3	-0.0381	0.05236	4	-0.1010	0.05456
4	-0.1942	0.07321	5	-0.0268	0.05999
5	-0.0802	0.05682			

J11 - GLM of Log UFC(t,i,j) = D(t) + C - Refresher

Factor	Levels	Values		
MORN	3	1	2	3

Source	DF	Seq SS	Adj SS	Adj MS	F	P
DAY	2	22.290	22.290	11.145	16.31	0.000
Error	148	101.111	101.111	0.683		
Total	150	123.401				

Means for LogUFCs

DAY	Mean	Stdev
1	3.288	0.1169
2	2.386	0.1146
3	2.613	0.1181

J12 - Repeated Measures ANOVA of UFC(t,i,j) = E(j) + O(j) + Smoke + C - with contrasts - Refresher

```
      47 cases accepted.
       0 cases rejected because of out-of-range factor values.
       5 cases rejected because of missing data.
      10 non-empty cells.
       1 design will be processed.
- - - - - - - - - - - - - - - - - - - - - - - - - - - -
      ORDER2
 HAFT - 1    THAF - 2    TFHA - 3    FTHA - 4    FHAT - 5
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	21203.67	41	517.16		
ORDER2	2447.74	4	611.94	1.18	.332
SMOKE	414.73	1	414.73	.80	.376

Estimates for T1

--- Individual univariate .9500 confidence intervals

ORDER2

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower -95%CL-	Upper
2	10.2265793	17.60815	.58079	.56456	-25.33380	45.78696
3	11.0955805	12.47521	.88941	.37897	-14.09861	36.28977
4	8.97119483	13.08477	.68562	.49681	-17.45403	35.39642
5	28.9556119	14.69079	1.97101	.05550	-.71303	58.62425

SMOKE

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower -95%CL-	Upper
6	6.21743200	6.94293	.89551	.37574	-7.80409	20.23896

EFFECT .. SMOKE BY EVENTS

Multivariate Tests of Significance (S = 1, M = 0, N = 19)

Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
Pillais	.10228	2.27867	2.00	40.00	.116
Hotellings	.11393	2.27867	2.00	40.00	.116
Wilks	.89772	2.27867	2.00	40.00	.116
Roys	.10228				

Note.. F statistics are exact.

EFFECT .. SMOKE BY EVENTS (Cont.)
Univariate F-tests with (1,41) D. F.

Variable	Hypoth.SS	Error SS	Hypoth.MS	Error MS	F	Sig.ofF
T2	106.70146	9891.99859	106.70146	241.26826	.44225	.510
T3	796.33412	7783.15716	796.33412	189.83310	4.19492	.047

EFFECT .. ORDER2 BY EVENTS
Multivariate Tests of Significance (S = 2, M = 1/2, N = 19)

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.30407	1.83773	8.00	82.00	.082
Hotellings	.36187	1.76413	8.00	78.00	.097
Wilks	.71805	1.80113	8.00	80.00	.089
Roys	.18369				

Note.. F statistic for WILKS' Lambda is exact.

EFFECT .. ORDER2 BY EVENTS (Cont.)
Univariate F-tests with (4,41) D. F.

Variable	Hypoth.SS	ErrorSS	Hypoth.MS	Error MS	F	Sig.ofF
T2	1393.50574	9891.99859	348.37643	241.26826	1.44394	.237
T3	1723.50251	7783.15716	430.87563	189.83310	2.26976	.078

EFFECT .. EVENTS
Multivariate Tests of Significance (S = 1, M = 0, N = 19)

Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
Pillais	.22269	5.72972	2.00	40.00	.006
Hotellings	.28649	5.72972	2.00	40.00	.006
Wilks	.77731	5.72972	2.00	40.00	.006
Roys	.22269				

Note.. F statistics are exact.

EFFECT .. EVENTS (Cont.)
Univariate F-tests with (1,41) D. F.

Variable	Hypoth.SS	ErrorSS	Hypoth.MS	ErrorMS	F	Sig.ofF
T2	103.37492	9891.99859	103.37492	241.26826	.42846	.516
T3	2137.86665	7783.15716	2137.86665	189.83310	11.26182	.002

Tests involving 'EVENTS' Within-Subject Effect.
AVERAGED Tests of Significance for UCORT using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	17675.16	82	215.55		
EVENTS	2241.24	2	1120.62	5.20	.007
ORDER2 BY EVENTS	3117.01	8	389.63	1.81	.087
SMOKE BY EVENTS	903.04	2	451.52	2.09	.130

Estimates for T2
--- Individual univariate .9500 confidence intervals
EVENTS

Parameter	Coeff.	Std. Err.	t-Value	Sig.t	Lower-95%CL-Upper	
1	-1.9091789	2.91668	-.65457	.51640	-7.79954	3.98118

ORDER2 BY EVENTS

Parameter	Coeff.	Std. Err	t-Value	Sig.t	Lower-95%CL-Upper	
2	9.39271808	12.02681	.78098	.43930	-14.89591	33.68134
3	-.90439365	8.52088	-.10614	.91599	-18.11266	16.30387
4	-9.2166449	8.93722	-1.03127	.30846	-27.26573	8.83244
5	-10.090417	10.03417	-1.00561	.32050	-30.35484	10.17400

SMOKE BY EVENTS

Parameter	Coeff.	Std. Err	t-Value	Sig.t	Lower-95%CL-Upper	
6	-3.1536554	4.74219	-.66502	.50976	-12.73071	6.42340

- -

Estimates for T3
--- Individual univariate .9500 confidence intervals

EVENTS

Parameter	Coeff.	Std. Err	t-Value	Sig.t	Lower-95%CL-Upper	
1	8.68219084	2.58717	3.35586	.00171	3.45729	13.90709

ORDER2 BY EVENTS

Parameter	Coeff.	Std. Err	t-Value	Sig.t	Lower-95%CL-Upper	
2	8.11675926	10.66808	.76085	.45110	-13.42786	29.66138
3	12.1268768	7.55823	1.60446	.11629	-3.13728	27.39104
4	13.2384633	7.92754	1.66993	.10255	-2.77153	29.24845
5	-3.7491957	8.90056	-.42123	.67579	-21.72425	14.22585

SMOKE BY EVENTS

Parameter	Coeff.	Std. Err	t-Value	Sig.t	Lower-95%CL-Upper	
6	8.61542512	4.20644	2.04815	.04699	.12034	17.11051

- -

J13 - GLM of Log UFC (t_{2-3},i,j) - (0.4*Log UFC(t-1,i,j)) = D(t-1) + E(j_{t-1}) + C - Refresher

Factor	Levels	Values		
EVNT2-3	3	1	3	4
Mrn2&3	2	2	3	

Source	DF	Seq SS	Adj SS	Adj MS	F	P
EVNT2-3	2	1.3084	1.0145	0.5073	3.96	0.022
Mrn2&3	1	1.5825	1.5825	1.5825	12.35	0.001
Error	95	12.1731	12.1731	0.1281		
Total	98	15.0640				

Means for 0.4Logs

Event on day2-3	Mean	Stdev
HUET/Aband	0.6231	0.05475
Fire	0.4890	0.05460
TEMPSC	0.7936	0.10027
Day 2&3		
2	0.5071	0.05755
3	0.7633	0.05364

APPENDICES K1-K11

Printouts of Correlations, Principal Components Analyses (PCA), and Cluster Analyses conducted on Refresher and Combined subjects' data

Appendix K1 - Correlations among STAI, UFC and SC data from day 1

Refresher subjects

- - Correlation Coefficients - -

	LOGUFCE	SCE	UFCE	STAISM1
LOGUFCE	1.0000	.3654	.9258	.0861
	(47)	(33)	(47)	(46)
	P= .	P= .037	P= .000	P= .569
SCE	.3654	1.0000	.4883	.2333
	(33)	(35)	(33)	(34)
	P= .037	P= .	P= .004	P= .184
UFCE	.9258	.4883	1.0000	.0115
	(47)	(33)	(47)	(46)
	P= .000	P= .004	P= .	P= .939
STAISM1	.0861	.2333	.0115	1.0000
	(46)	(34)	(46)	(51)
	P= .569	P= .184	P= .939	P= .

(Coefficient / (Cases) / 2-tailed Significance)
" . " is printed if a coefficient cannot be computed

SPEARMAN CORRELATION COEFFICIENTS

SCE	.3454		
	N(33)		
	Sig .049		
UFCE	1.0000	.3454	
	N(47)	N(33)	
	Sig .000	Sig .049	
STAISM1	.0055	.2142	.0055
	N(46)	N(34)	N(46)
	Sig .971	Sig .224	Sig .971
	LOGUFCE	SCE	UFCE

(Coefficient / (Cases) / 2-tailed Significance)
" . " is printed if a coefficient cannot be computed

Combined subjects

Variable		Cases	Mean	Std Dev
SAL1	= Salivary cortisol on day 1	40	10.0300	5.7054
STAI1	= State anxiety on day 1	47	38.1489	10.6301
UM1	= Urinary cortisol on day 1	46	33.9109	23.0334
LUM1	= Log of urinary cortisol on day 1	46	3.3415	.6192

- - Correlation Coefficients - -

	SC1	STAI1	UFC1	LUFC1
SC1	1.0000	.1088	.1326	.2334
	(40)	(40)	(40)	(40)
	P= .	P= .504	P= .415	P= .147
STAI1	.1088	1.0000	-.0494	.0151
	(40)	(47)	(46)	(46)
	P= .504	P= .	P= .745	P= .921
UFC1	.1326	-.0494	1.0000	.8828
	(40)	(46)	(46)	(46)
	P= .415	P= .745	P= .	P= .000
LUFC1	.2334	.0151	.8828	1.0000
	(40)	(46)	(46)	(46)
	P= .147	P= .921	P= .000	P= .

(Coefficient / (Cases) / 2-tailed Significance)
" . " is printed if a coefficient cannot be computed

- - - SPEARMAN CORRELATION COEFFICIENTS - - -

STAI1	.1025		
	N(40)		
	Sig .529		
UFC1	.2175	.0571	
	N(40)	N(46)	
	Sig .178	Sig .706	
LUFC1	.2175	.0571	1.0000
	N(40)	N(46)	N(46)
	Sig .178	Sig .706	Sig .000
	SC1	STAI1	UFC1

(Coefficient / (Cases) / 2-tailed Significance)
" . " is printed if a coefficient cannot be computed

Appendix K2 - PCA on data from Sensation Seeking Scales, STAI, UFC, Course Questionnaires and HR - Refresher

Sensation Seeking Scales (SSS)

---- F A C T O R   A N A L Y S I S -----------

Analysis number 1 Listwise deletion of cases with missing values
Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality*		Factor	Eigenvalue	Pct of Var	Cum Pct
I_PBS	1.00000	*	1	2.02913	50.7	50.7
I_PDIS	1.00000	*	2	.88619	22.2	72.9
I_PES	1.00000	*	3	.69065	17.3	90.1
I_PTAS	1.00000	*	4	.39403	9.9	100.0

PC extracted 1 factors.

Factor Matrix:

	Factor 1
I_PBS	.63413
I_PDIS	.69985
I_PES	.84102
I_PTAS	.65568

Final Statistics:

Variable	Communality*		Factor	Eigenvalue	Pct of Var	Cum Pct
I_PBS	.40212	*	1	2.02913	50.7	50.7
I_PDIS	.48978	*				
I_PES	.70731	*				
I_PTAS	.42992	*				

STAI

---- F A C T O R   A N A L Y S I S -----------

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality*		Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
STAI_T	1.00000	*	1	4.40836	63.0	63.0
STAISF	1.00000	*	2	.68969	9.9	72.8
STAISH	1.00000	*	3	.62508	8.9	81.8
STAISM1	1.00000	*	4	.52395	7.5	89.2
STAISM2	1.00000	*	5	.27657	4.0	93.2
STAISM3	1.00000	*	6	.26667	3.8	97.0
STAIST	1.00000	*	7	.20968	3.0	100.0

PC extracted 1 factors.

Factor Matrix:

	Factor 1
STAI_T	.76420
STAISF	.77488
STAISH	.84421
STAISM1	.71350
STAISM2	.88797
STAISM3	.83679
STAIST	.71653

Final Statistics:

Variable	Communality*		Factor	Eigenvalue	Pct of Var	Cum Pct
STAI_T	.58401	*	1	4.40836	63.0	63.0
STAISF	.60044	*				
STAISH	.71270	*				
STAISM1	.50908	*				
STAISM2	.78850	*				
STAISM3	.70022	*				
STAIST	.51342	*				

1 PC EXACT factor scores will be saved.

UFC

---- F A C T O R   A N A L Y S I S -----------

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
RUFC2	1.00000	*	1	1.72454	57.5	57.5
RUFC3	1.00000	*	2	.96054	32.0	89.5
RUFCE	1.00000	*	3	.31493	10.5	100.0

PC extracted 1 factors.

Factor Matrix:

	Factor 1
RUFC2	.58151
RUFC3	.91539
RUFCE	.74057

Final Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
RUFC2	.33815	*	1	1.72454	57.5	57.5
RUFC3	.83794	*				
RUFCE	.54844	*				

1 PC EXACT factor scores will be saved.

Course Questionnaires

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
A_COPE	1.00000	*	1	2.64988	22.1	22.1
A_DIF	1.00000	*	2	1.93211	16.1	38.2
A_SATIS	1.00000	*	3	1.52357	12.7	50.9
F_CAPBL	1.00000	*	4	1.27181	10.6	61.5
F_COPE	1.00000	*	5	1.11275	9.3	70.8
F_DIF	1.00000	*	6	.81485	6.8	77.5
H_COPE	1.00000	*	7	.73845	6.2	83.7
H_DIF	1.00000	*	8	.62942	5.2	88.9
H_SATIS	1.00000	*	9	.51059	4.3	93.2
T_COPE	1.00000	*	10	.43965	3.7	96.9
T_DIF	1.00000	*	11	.31762	2.6	99.5
T_SATIS	1.00000	*	12	.05928	.5	100.0

PC extracted 5 factors.

Factor Matrix:

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
A_COPE	.64017	.23900	.18178	-.15758	-.05849
A_DIF	.48149	-.32959	.01026	.53362	.19077
A_SATIS	-.74749	.40404	.17400	.35605	-.11771
F_CAPBL	.07161	.66826	-.07347	.25401	-.24042
F_COPE	.29936	-.24827	.26484	.44423	-.53041
F_DIF	.11586	.46386	.42715	-.01544	.55672
H_COPE	.47045	.57311	.13855	-.33854	.04691
H_DIF	.58002	.30467	-.01797	.55941	.09960
H_SATIS	-.80096	.42368	.14780	.20072	-.01659
T_COPE	.24180	.09873	.72813	-.13665	-.26286
T_DIF	.20555	.34031	-.63914	.17930	.22658
T_SATIS	-.20330	-.39166	.47129	.23387	.52648

Final Statistics:

Variable	Communality*		Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
A_COPE	.52824	*	1	2.64988	22.1	22.1
A_DIF	.66171	*	2	1.93211	16.1	38.2
A_SATIS	.89289	*	3	1.52357	12.7	50.9
F_CAPBL	.57942	*	4	1.27181	10.6	61.5
F_COPE	.70006	*	5	1.11275	9.3	70.8
F_DIF	.72122	*				
H_COPE	.68579	*				
H_DIF	.75244	*				
H_SATIS	.88345	*				
T_COPE	.68616	*				
T_DIF	.65005	*				
T_SATIS	.74872	*				

FAC1_5	REGR factor score	1 for analysis	1
FAC2_5	REGR factor score	2 for analysis	1
FAC3_5	REGR factor score	3 for analysis	1
FAC4_5	REGR factor score	4 for analysis	1
FAC5_5	REGR factor score	5 for analysis	1

HR

------------ F A C T O R   A N A L Y S I S -----

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality*		Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
HRAA1	1.00000	*	1	6.19814	56.3	56.3
HRAA2	1.00000	*	2	1.40687	12.8	69.1
HRAF1	1.00000	*	3	1.01818	9.3	78.4
HRAF2	1.00000	*	4	.78803	7.2	85.6
HRAF3	1.00000	*	5	.57875	5.3	90.8
HRAH1	1.00000	*	6	.36648	3.3	94.1
HRAH2R	1.00000	*	7	.21502	2.0	96.1
HRAHBRF	1.00000	*	8	.18455	1.7	97.8
HRAT1	1.00000	*	9	.10405	.9	98.7
HRAT2	1.00000	*	10	.09106	.8	99.6
HRAT3	1.00000	*	11	.04888	.4	100.0

PC extracted 3 factors.

Factor Matrix:

	Factor 1	Factor 2	Factor 3
HRAA1	.70375	-.00136	.21017
HRAA2	.58966	.06565	.69000
HRAF1	.82783	-.26763	-.19546
HRAF2	.76971	-.40700	.10864
HRAF3	.65650	-.54283	.16879
HRAH1	.76663	.54009	-.06127
HRAH2R	.57683	.59207	.34534
HRAHBRF	.68623	.42478	-.43847
HRAT1	.90986	.06169	-.11664
HRAT2	.84471	-.13312	-.11618
HRAT3	.84479	-.16254	-.27755

Final Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
HRAA1	.53944	*	1	6.19814	56.3	56.3
HRAA2	.82811	*	2	1.40687	12.8	69.1
HRAF1	.79513	*	3	1.01818	9.3	78.4
HRAF2	.76991	*				
HRAF3	.75414	*				
HRAH1	.88318	*				
HRAH2R	.80254	*				
HRAHBRF	.84360	*				
HRAT1	.84526	*				
HRAT2	.74476	*				
HRAT3	.81712	*				

Appendix K3 - Cluster Analysis on all parameters except SC - Refresher

Convergence achieved due to no or small distance change.

Number of Cases in each Cluster.

Cluster	unweighted cases	weighted cases
1	3.0	3.0
2	4.0	4.0
Missing	45	
Valid cases	7.0	7.0

Appendix K4 - Cluster Analysis on all HR, except post abandonment and post HUET, and UFC data - Refresher

Convergence achieved due to no or small distance change.
The maximum distance by which any center has changed is 3.7538
Current iteration is 2

Minimum distance between initial centers is 203.4082

Iteration	Change in Cluster Centers 1	2
1	100.6286	83.9729
2	7.3861	7.1009

Final Cluster Centers.

Cluster	HRAA1	HRAA2	HRAF1	HRAF2
1	98.6667	133.5833	81.6667	125.8333
2	114.5833	144.0833	106.1667	156.2500

Cluster	HRAF3	HRAH1	HRAH2R	HRAHBRF
1	112.9167	88.0000	113.9167	77.5833
2	137.2500	106.2500	124.1667	88.6667

Cluster	HRAT1	HRAT2	HRAT3	RUFC2
1	69.5833	86.5000	67.5833	20.2500
2	88.2500	101.7500	86.9167	12.3667

Cluster	RUFC3	RUFCE
1	16.0917	21.3833
2	20.0083	41.7167

- -

Analysis of Variance.

Variable	Cluster MS	DF	Error MS	DF	F	Prob
HRAA1	1520.0417	1	236.981	22.0	6.4142	.019
HRAA2	661.5000	1	166.447	22.0	3.9742	.059
HRAF1	3601.5000	1	109.378	22.0	32.9269	.000
HRAF2	5551.0417	1	157.905	22.0	35.1542	.000
HRAF3	3552.6667	1	306.962	22.0	11.5736	.003
HRAH1	1998.3750	1	223.011	22.0	8.9609	.007
HRAH2R	630.3750	1	214.026	22.0	2.9453	.100
HRAHBRF	737.0417	1	78.162	22.0	9.4296	.006
HRAT1	2090.6667	1	163.416	22.0	12.7935	.002
HRAT2	1395.3750	1	93.965	22.0	14.8498	.001
HRAT3	2242.6667	1	185.447	22.0	12.0933	.002
RUFC2	372.8817	1	442.587	22.0	.8425	.369
RUFC3	92.0417	1	300.949	22.0	.3058	.586
RUFCE	2480.6667	1	195.993	22.0	12.6569	.002

- -

Number of Cases in each Cluster.

Cluster	unweighted cases	weighted cases
1	12.0	12.0
2	12.0	12.0
Missing	28	
Valid cases	24.0	24.0

Appendix K5 - Cluster Analysis on all HR, except post abandonment and post HUET, and day 1 UFC data - Refresher

Convergence achieved due to no or small distance change.
The maximum distance by which any center has changed is 2.8000
Current iteration is 2

Minimum distance between initial centers is 173.7764

Iteration	Change in Cluster Centers 1	2
1	69.7334	58.5909
2	4.4654	3.1813

Final Cluster Centers.

Cluster	HRAA1	HRAA2	HRAF1	HRAF2
1	115.5455	146.8182	108.4545	157.7273
2	99.8824	134.5882	84.4706	130.2941

Cluster	HRAF3	HRAH1	HRAH2R	HRAHBRF
1	143.0909	105.0909	125.8182	86.7273
2	113.8824	90.3529	113.0588	79.7647

Cluster	HRAT1	HRAT2	HRAT3	RUFCE
1	89.0000	102.7273	87.9091	40.3000
2	72.3529	88.5882	71.3529	23.3353

- -

Analysis of Variance.

Variable	Cluster MS	DF	Error MS	DF	F	Prob
HRAA1	1638.4723	18	209.480	26.0	7.8216	.010
HRAA2	998.9246	18	133.067	26.0	7.5069	.011
HRAF1	3841.7160	18	107.729	26.0	35.6608	.000
HRAF2	5026.1459	18	170.142	26.0	29.5408	.000
HRAF3	5697.7548	18	210.872	26.0	27.0200	.000
HRAH1	1450.6371	18	221.645	26.0	6.5448	.017
HRAH2R	1087.2796	18	171.329	26.0	6.3461	.018
HRAHBRF	323.7594	18	99.355	26.0	3.2586	.083
HRAT1	1850.7962	18	159.533	26.0	11.6013	.002
HRAT2	1335.1291	18	89.780	26.0	14.8710	.001
HRAT3	1830.6371	18	190.953	26.0	9.5868	.005
RUFCE	1922.1012	18	231.456	26.0	8.3044	.008

Number of Cases in each Cluster.

Cluster	unweighted cases	weighted cases
1	11.0	11.0
2	17.0	17.0
Missing	24	
Valid cases	28.0	28.0

Appendix K6 - Cluster Analysis on all HR, except post abandonment and post HUET, and STAI data - Refresher

Convergence achieved due to no or small distance change.
Current iteration is 2

Final Cluster Centers.

Cluster	HRA_HPST	HRAA1	HRAA2	HRAF1
1	114.2308	101.6154	132.8462	84.0769
2	124.9000	116.8000	146.7000	107.3000

Cluster	HRAF2	HRAF3	HRAH1	HRAH2R
1	130.4615	113.8462	89.5385	111.2308
2	160.4000	146.3000	101.7000	120.9000

Cluster	HRAHBRF	HRAT1	HRAT2	HRAT3
1	78.3846	71.6154	86.6923	70.6154
2	85.0000	86.4000	102.7000	88.2000

Cluster	STAI_T	STAISF	STAISH	STAISM1
1	31.6154	34.3846	34.5385	32.6923
2	35.9000	43.5000	40.5000	35.4000

Cluster	STAISM2	STAISM3	STAIST
1	28.0000	27.5385	29.2308
2	28.3000	28.7000	32.6000

Analysis of Variance.

Variable	Cluster MS	DF	Error MS	DF	F	Prob
HRA_HPST	643.4010	1	194.628	21.0	3.3058	.083
HRAA1	1303.2361	1	188.508	21.0	6.9134	.016
HRAA2	1084.8164	1	155.894	21.0	6.9586	.015
HRAF1	3048.2813	1	116.239	21.0	26.2242	.000
HRAF2	5066.1084	1	136.553	21.0	37.0997	.000
HRAF3	5953.1642	1	211.037	21.0	28.2090	.000
HRAH1	835.9736	1	211.015	21.0	3.9617	.060
HRAH2R	528.4445	1	175.390	21.0	3.0130	.097
HRAHBRF	247.3579	1	90.337	21.0	2.7382	.113
HRAT1	1235.4796	1	181.403	21.0	6.8107	.016
HRAT2	1448.3482	1	91.470	21.0	15.8341	.001
HRAT3	1747.7579	1	189.937	21.0	9.2018	.006
STAI_T	103.7622	1	39.998	21.0	2.5941	.122
STAISF	469.6405	1	91.027	21.0	5.1593	.034
STAISH	200.8779	1	92.939	21.0	2.1614	.156
STAISM1	41.4395	1	58.341	21.0	.7103	.409
STAISM2	.5087	1	42.100	21.0	.0121	.914
STAISM3	7.6258	1	44.825	21.0	.1701	.684
STAIST	64.1619	1	51.081	21.0	1.2561	.275

Number of Cases in each Cluster.

Cluster	unweighted cases	weighted cases
1	13.0	13.0
2	10.0	10.0
Missing	29	
Valid cases	23.0	23.0

Appendix K7 - Cluster Analysis on HR, SSS, STAI, CourseQ and UFC factor values - Refresher

Convergence achieved due to no or small distance change.
The maximum distance by which any center has changed is .0000
Current iteration is 2
Minimum distance between initial centers is 5.8622

Iteration	Change in Cluster Centers 1	2
1	1.9307	2.1382
2	.0000	.0000

Final Cluster Centers.

Cluster	HRFAC	SSSFAC	STAIFAC	CourseQFAC
1	-.1122	.2653	.5544	-.3136
2	-.0914	-.2966	-.9828	1.5827

Cluster	UFCsFAC
1	-.2188
2	-.2849

Analysis of Variance.

Variable	Cluster MS	DF	Error MS	DF	F	Prob
HRFAC	.0014	1	.999	13.0	.0014	.970
SSSFAC	1.0527	1	.872	13.0	1.2063	.292
STAIFAC	7.8771	1	.244	13.0	32.1740	.000
CourseQFAC	11.9858	1	.742	13.0	16.1485	.001
UFCsFAC	.0145	1	.497	13.0	.0292	.867

Number of Cases in each Cluster.

Cluster	unweighted cases	weighted cases
1	10.0	10.0
2	5.0	5.0
Missing	37	
Valid cases	15.0	15.0

Appendix K8 - Cluster Analysis on SSS, STAI and CourseQ factor values - Refresher

Convergence achieved due to no or small distance change.
The maximum distance by which any center has changed is .1004

Minimum distance between initial centers is 5.8179

Final Cluster Centers.

Cluster	SSSFAC	STAIFAC	CourseQFAC
1	.3670	.7898	-.4781
2	-.6104	-.8642	.8432

Analysis of Variance.

Variable	Cluster MS	DF	Error MS	DF	F	Prob
SSSFAC	6.3694	1	.597	25.0	10.6688	.003
STAIFAC	18.2375	1	.492	25.0	37.0427	.000
CourseQFAC	11.6375	1	.808	25.0	14.4018	.001

Number of Cases in each Cluster.

Cluster	unweighted cases	weighted cases
1	15.0	15.0
2	12.0	12.0
Missing	25	
Valid cases	27.0	27.0

Appendix K9 - PCA on data from Sensation Seeking Scales, STAI, UFC, and HR - Combined

Sensation Seeking Scales (SSS)

```
--- F A C T O R   A N A L Y S I S -----------
Analysis number 1  Pairwise deletion of cases with missing values
Extraction 1 for analysis  1, Principal Components Analysis (PC)
PC    extracted   1 factors.

Factor Matrix:
                 Factor  1
I_PBS              .73707
I_PDIS             .83743
I_PES              .75553
I_PTAS             .63654

Final Statistics:
Variable  Communality  *  Factor  Eigenvalue  Pct of Var  Cum Pct
                       *
I_PBS          .54327  *     1     2.22057       55.5       55.5
I_PDIS         .70129  *
I_PES          .57082  *
I_PTAS         .40519  *
  1 PC   EXACT  factor scores will be saved.
```

STAI

```
-- F A C T O R   A N A L Y S I S -----------
Analysis number 1  Pairwise deletion of cases with missing values
Extraction 1 for analysis  1, Principal Components Analysis (PC)
PC    extracted   1 factors.

Factor Matrix:
                 Factor  1
STAISM1            .85603
STAISM2            .89391
STAISM3            .90351
STAISM4            .89780
STAISM5            .74578

Final Statistics:
Variable  Communality  *  Factor  Eigenvalue  Pct of Var  Cum Pct
                       *
STAISM1        .73280  *   1       3.71043       74.2      74.2
STAISM2        .79907  *
STAISM3        .81632  *
STAISM4        .80605  *
STAISM5        .55619  *
  1 PC   EXACT  factor scores will be saved.
```

UFC

```
--- F A C T O R   A N A L Y S I S -----------
Analysis number 1  Pairwise deletion of cases with missing values
Extraction  1 for analysis  1, Principal Components Analysis (PC)
PC    extracted   1 factors.

Factor Matrix:
                 Factor  1
RUFC2              .74423
RUFC3              .75475
RUFC4              .90912
RUFC5              .70937
RUFCE              .78071
```

```
Final Statistics:
Variable  Communality  *  Factor  Eigenvalue  Pct of Var  Cum Pct
                       *
RUFC2          .55388  *     1     3.06275       61.3       61.3
RUFC3          .56965  *
RUFC4          .82650  *
RUFC5          .50320  *
RUFCE          .60950  *
  1 PC  EXACT  factor scores will be saved.
```

HR

```
---- F A C T O R   A N A L Y S I S -----------
Analysis number 1  Pairwise deletion of cases with missing values
Extraction 1 for analysis  1, Principal Components Analysis (PC)
PC    extracted   2 factors.

Factor Matrix:
              Factor  1    Factor  2
HRAA1           .79515      -.33075
HRAA3           .79012      -.20843
HRAT1           .65364       .65817
HRAT2           .65296       .53976
HRAT3           .65622       .59517
HRAH1           .73675      -.50698
HRAH2C          .82347      -.39043
HRAH3C          .80747      -.14999
HRAHBRF         .78288       .09019

Final Statistics:
Variable  Communality  *  Factor  Eigenvalue  Pct of Var  Cum Pct
                       *
HRAA1          .74165  *     1     5.02660    55.9          55.9
HRAA3          .66773  *     2     1.67170    18.6          74.4
HRAT1          .86043  *
HRAT2          .71770  *
HRAT3          .78486  *
HRAH1          .79983  *
HRAH2C         .83054  *
HRAH3C         .67451  *
HRAHBRF        .62104  *
  2 PC  EXACT  factor scores will be saved.

Number of valid observations (listwise) =        24.00
                                                     Valid
Variable      Mean     Std Dev   Minimum   Maximum      N
HEARTFAC      -.12         .92  -1.96706   1.30799     24

  Label - A1,A3,H1,H2C,H3C,HBRF
```

Appendix K10 - Cluster Analysis on HR, SSS, STAI, and UFC factor values - Combined

Convergence achieved due to no or small distance change.
The maximum distance by which any center has changed is .0000
Current iteration is 2
Minimum distance between initial centers is 2.0826

Iteration	Change in Cluster Centers 1	2	3
1	.6682	.5718	.4442
2	.0000	.0000	.0000

Final Cluster Centers.

Cluster	STAIFAC	UFCFAC	SSSFAC	HRFAC
1	.0084	-.2502	.3187	-.3599
2	.2174	-.8361	1.6494	-.9593
3	.6179	.0301	-.9980	.7853

Analysis of Variance.

Variable	Cluster MS	DF	Error MS	DF	F	Prob
STAIFAC	.5196	2	.326	10.0	1.5926	.251
UFCFAC	.5690	2	.052	10.0	10.8864	.003
SSSFAC	5.9162	2	.198	10.0	29.8514	.000
HRFAC	3.0564	2	.229	10.0	13.3281	.002

Number of Cases in each Cluster.

Cluster	unweighted cases	weighted cases
1	5.0	5.0
2	2.0	2.0
3	6.0	6.0
Missing	34	
Valid cases	13.0	13.0

Appendix K11 - Cluster Analysis on HR, SSS, and UFC factor values - Combined

Convergence achieved due to no or small distance change.
The maximum distance by which any center has changed is .0000
Current iteration is 2

Minimum distance between initial centers is 4.3488

Iteration	Change in Cluster Centers 1	2
1	1.2773	1.3868
2	.0000	.0000

Final Cluster Centers.

Cluster	UFCFAC	SSSFAC	HRFAC
1	-.0848	-1.0847	.4905
2	-.4979	.8382	-.6423

Analysis of Variance.

Variable	Cluster MS	DF	Error MS	DF	F	Prob
UFCFAC	.6144	1	.097	13.0	6.3097	.026
SSSFAC	13.3109	1	.456	13.0	29.1737	.000
HRFAC	4.6199	1	.302	13.0	15.2533	.002

Number of Cases in each Cluster.

Cluster	unweighted cases	weighted cases
1	9.0	9.0
2	6.0	6.0
Missing	32	
Valid cases	15.0	15.0

Appendix K12 - Correlation coefficients among HR, SSS, STAI and UFC factor values - Combined

- - Correlation Coefficients - -

	HRFAC	SSSFAC	STAIFAC	UFCFAC
HRFAC	1.0000	-.4828	.5102	.6887
	(23)	(23)	(15)	(15)
	P= .	P= .020	P= .052	P= .005
SSSFAC		1.0000	-.1971	.0945
		(43)	(30)	(29)
		P= .	P= .296	P= .626
STAIFAC			1.0000	.2026
			(32)	(27)
			P= .	P= .311
UFCFAC				1.0000
				(32)
				P= .

(Coefficient / (Cases) / 2-tailed Significance)

" . " is printed if a coefficient cannot be computed

APPENDIX L - Data

Refresher Subjects

Subject number	MPLOY	OFSHORE	LASTVYY	FIRSTV YY	WKS	TRNING	ORDER	SMOKE
61	1	1	91	79	26	1	2	2
62	1	1	91	88	6	1	2	2
63	1	1	91	77	23	1	2	2
64	1	1	91	80	21	1	2	2
65	1	1	91	76	26	1	2	2
66	1	1	91	80	20	1	2	1
67	1	1	91	87	27	1	10	1
68	1	2				1	10	1
69	2	1	89	88	10	1	10	2
70	1	1	91	88	28	1	10	1
71	1	1	92	81	20	1	12	2
72	1	1	92	79	26	1	12	1
73	1	1	92	80	26	1	12	1
74	1	1	92	88	20	1	10	1
75	2	1	92	83	30	1	10	1
76	1	1	92	74	40	1	10	1
77	1	1	92	85	30	1	10	2
78	1	1	91	83	25	1	10	2
79	1	1	90	90	2	1	10	2
80	1	1	92	80	26	1	10	2
81	1	1	92	72	30	1	10	2
82	1	1	91	73	10	1	10	2
83	1	1	92	87	18	1	12	1
84	1	1	92	77	20	1	12	1
85	1	1	92	83	24	1	12	1
86	1	1	92	80	26	1	12	1
87	1	1	92	88	27	1	12	1
88	1	1	92	89	27	1	12	1
89	2	1	83	79	26	1	10	2
90	1	1	90	82	26	1	10	2
91	1	1	92	74	20	1	6	1
92	1	1	92	77	26	1		1
93	1	1	92	85	12	1	6	2
94	1	1	92	77	23	1	6	1
95	1	1	92	81	12	1	10	1
96	1	1	92	89	26	1	10	2
97	1	1	92	85	26	1	10	1
98	1	1	92	79	26	1	10	2
99	1	1	92	82	20	1	10	1
100	1	1	92	89	26	1	2	2
101	1	1	92	73	26	1	2	2
102	1	1	92	89	26	1	2	1
103	1	1	92	82	26	1	12	2
104	1	1	92	88	4	1	12	1
105	1	1	92	82	26	1	12	2
106	1	1	92	75	30	1	10	2
107	1	1	92	90	5	1	12	2
108	1	1	92	83	6	1	12	2
109	1	1	92	82	20	1	12	2
110	1	1	92	81	26	1	7	1
111	1	1	92	89	27	1	7	2
112	1	1	92	89	30	1	7	2
113	1	1	92	89	26	1	10	2
114	2	1	92	88	26	1	7	2

Subject number	CIGS	SPORT	FREQ	REASON	FIT	SWIM	H_EXP	A_EXP
61		1	7	2	1	1	1	1
62		1	1	2	3	2	1	1
63		1		2	2	2	1	1
64		2		2	3	3	1	2
65		2		2	1	1	1	1
66	15	2		2	4	2	2	1
67	15	2		2	3	1	1	1
68	15	2		1	3	2	1	1
69		2		1	4	4	1	1
70	15	1	2	3	3	3	1	1
71		2		2	3	3	1	1
72	15	2		2	3	1	1	1
73	5	2		2	3	4	1	1
74	15	1	3	3	3	1	1	1
75	15	2		1	3	3	1	1
76	20	2		2	3	1	1	1
77		2		2	3	3	1	1
78		2		2	3	3	1	1
79		2		1	3	3	1	1
80		2		2	3	3	1	1
81		1	3	2	2	1	1	2
82		1	7	2	2	3	2	1
83	10	1	2	2	2	3	1	1
84	20	2		2	3	3	1	1
85	10	2		2	2	3	1	1
86	30	2		2	3	3	1	1
87	30	2		2	3	3	1	1
88	25	2		2	4	2	1	1
89		2		1	3	2	2	1
90		2		1	3	3	1	1
91		2		2	3	3	1	1
92	20	2		2	3	3	1	1
93		1	8	2	2	3	1	1
94	20	2		2	4	3	1	1
95	30	2		2	3	3	1	1
96		1	5	2	3	3	1	1
97	5	1	4	2	3	3	1	1
98		2		2	3	3	1	1
99	20	2		2	3	3	1	1
100		1	2	2	3	3	1	1
101		1	2	2	2	2	1	1
102	20	2		2	3	1	1	1
103		1	2	2	3	4	1	1
104	4	2		3	3	2	1	1
105		1	4	2	2	3	1	1
106		2		2	2	2	1	1
107		1	2	2	3	3	1	1
108		1	2	2	2	3	1	1
109		1	1	2	3	3	1	1
110	20	1	3	2	2	3	1	1
111		1	1	2	3	3	1	1
112		1	2	2	2	2	2	2
113		1	6	2	3	3	1	1
114		2		1	3	3	1	1

Subject number	F_EXP	L_EXP	MEFCT	LEFCT	ACHIEVE	F_COPE	F_DIF	F_SATIS
61	1	1	3	4	2	2	3	2
62	1	1	3	1	1	2	3	1
63	1	1	2	3	1	1	1	1
64	1	1	1	2	2	3	6	2
65	1	1	3	1	2			
66	1	1	4	3	2	1	3	2
67	1	1	3	2	2			
68	1	1	3	2	2			
69	1	1	1	3	1			
70	1	1	1	4	1			
71	1	1	2	1	2	3	2	1
72	1	1	3	2	3	1	6	3
73	1	1	2	1	3	1	6	2
74	1	1	3	1	4	4	3	
75	1	1	1	2	3	1	3	2
76	1	1	4	2	1	3	2	3
77	1	1	1	3	3			
78	1	1	2	3	1			
79	1	1	4	3	3			
80	1	1	3	1	3	1	5	2
81	1	1	3	4	4	1	3	1
82	1	1	1	3	2	4	3	2
83	1	1	3	2	2	10	7	1
84	1	1	4	1	2	4	1	2
85	1	1	1	3	2	9	6	3
86	1	1	2	1	1	4	6	2
87	1	1	2	4	2	6	1	2
88	1	1	2	4	2	1	1	1
89	1	1	1	2	2	4	6	2
90	1	1	1	2	2	2	6	2
91	1	1	2	3	3	1	6	2
92	1	1	3	2	3			
93	1	1	2	3	2	4	1	1
94	1	1	1		1	5	1	2
95	1	1	1	2	2	3	6	2
96	1	1	1	3	2	4	6	
97	1	1		1	2	4	6	2
98	1	1	1	3	2	1	6	1
99	1	1	3	4	2	6	2	2
100	1	1	1	3	1			1
101	1	1	1	4	1	10	7	1
102	1	1	1	3	2	9	3	2
103	1	1	1	3	2	1	6	
104	1	1	3	2	3	4	6	3
105	1	1	3	4	2	8	1	1
106	2	1	3	3	2	2	6	
107	1	1	1	4	2	1	6	3
108	1	1	4	2	2	1	6	1
109	1	1	1	3	2	4	1	1
110	1	1	3	2	2	4	6	1
111	1	1	4	3	3	1	6	2
112	2	2	4	2	2	9	6	2
113	1	1	1	2	2	1	1	2
114	1	1	3	2	3	1	6	1

Subject number	H_COPE	H_DIF	H_SATIS	A_COPE	A_DIF	A_SATIS	T_COPE	T_DIF
61	3	3	2	4	5	2	8	1
62	6	3	2	3	4	2	8	3
63	5	3	1	4	6	1	6	3
64	2	3	3	3	4	3	2	4
65								
66	3	3	2	6	4	2	4	1
67	4	3	2	4	4	2	5	4
68	3	3	1	7	8	1	8	1
69	7	1	2	5	5	2	2	2
70	6	3	1	5	2	2	4	1
71	3	3	2	2	6	2	2	4
72	5	3	2	4	4	2	2	2
73	3	3	2	3	5	2	6	3
74	3	3	2	3	4	2	8	1
75	2	3	3	2	2	3	8	1
76	6	3	2	5	3	2	5	4
77		3	2	3	4	2	2	4
78	3	3	1	4	2	2	2	1
79	6	3	2	3	4	2	8	1
80	3	4	1	4	8	2	4	4
81	3	3			6	1	2	4
82	1	3	1	4	3	2	6	1
83	5	3	2	6		2	2	4
84	5	3	2	4	6	2	4	1
85	3	3	2	6	6	3	8	1
86	3	3	1	3	4	1	6	3
87	1	3	3	3	4	3	4	1
88	3	3	2	2	4		6	3
89	3	3	2	2	5	2	6	1
90	3	3	2	6	5	2	6	1
91	6	3	3	2	5	2	3	2
92								
93	2	3	2	4	5	2	5	2
94	2	3	2	3	5	2	5	2
95	6	3	2	3	4	2	8	1
96	3	3	1	1	2		2	4
97	3	3	3	2	4	3	6	3
98	3	3	1	4	4	1	5	1
99	3	3	1	4	4	2	6	3
100	3	3	2			2		
101	8	4	1	7	5	1	9	3
102	6	3	1	4	6	1	5	1
103	6	3	4	4	2	4	4	4
104	6	3	3	4	6	3	8	1
105	1	3	1	4	6	1	5	4
106	3	3	1	4	5	1	8	4
107	4	3	1	4	2	1	6	3
108	8	3	1	7	5	1	5	4
109	3	3	1	3	5	1	1	1
110	7	3	1	6	5	1	8	1
111	3	3	2	2	5	2	7	1
112	3	3	2	2	5	2	8	2
113	6	3	2	5	5	2	8	1
114	3	3	1				9	1

Subject number	T_ Satis	Ev_ Capbl	F_ Capbl	Hd_ Capbl	H_ Alter	St_ Alter	Es_ Alter	Phys ical	Emo tion
61	2	1	1	2	3	2	2	3	3
62	1	1	1	1	1	1	1	3	3
63	2	1	2	1	3	1	2	4	4
64	2	2	2	3	3	2	2	2	3
65									
66	2	2	2	1	3	2	2	4	3
67	1								
68	1								
69	1								
70	1								
71	1	1	1	1	3	4	3	2	3
72	2	3	2	3	3	3	3	2	3
73	2	2	2	2	3	3	3	3	3
74	2	2	3	3	3	2	3	3	3
75	3	3	3	4	3	3	4	3	3
76	1	2	2	2	3	3	1	3	3
77	2								
78	1								
79	1								
80	2	4	4	3	3	3	4	3	3
81	1	4	4	3	3	3	2	4	4
82	1	3	2	1	3	2	1	3	3
83	1	1	1	2	3	1	2	3	3
84	2								
85	3	4	3	4	5	3	3	3	3
86	2	2	1	2	3	1	2	2	3
87	1	2	3	3	3	2	3	3	3
88	2	3	4	3	3	2	4	4	3
89	2	1	1	1	1	1	1	1	2
90	3	1	1	1	2	1	2	2	3
91	2	3	3	3	3	3	3	3	3
92									
93	1	2	4	3	3	3	3	3	3
94	2	2	1	2	3	2	3	3	3
95	1	4	4	4	3	3	3	1	5
96	2	3	3	1	3	2	2	5	4
97	2	2	2	3	3	2	3	3	3
98	2	2	1	2	3	1	1	4	3
99	1	3	2	4	4	3	2	2	3
100	2	1	1	1	2	1	1	3	3
101	1	4	3	3	2	1	1	3	3
102	2	2	1	2	3	2	2	3	3
103	1	4	4	4	4	3	3	1	3
104	2	2	1	2	3	1	1	3	3
105	2	2	2	2	3	1	1	4	5
106	2	1	2	2	3	2	3	3	3
107	2	2	3	2	3	2	3	3	3
108	1	1	4	1	3	2	2	3	3
109	2	3	2	4	3	3	3	2	3
110	1	1	2	2	3	2	2	3	3
111	1	1	2	1	2	2	2	3	3
112	2	2	3	1	2	1	1	3	3
113	2	2	3	3	3	2	2	4	3
114	1	1	1	1	1	1	2	2	3

Subject number	HGHT	WGHT	AGE	FAT	HR_Rest	HR50	HR75	HR100	HR125
61			39						
62			28						
63	172.5	72.5	51	20.8	72		99		122
64			53	29.2					
65			39						
66	173.0	85.5	37	21.5			101		121
67	178.5	68.5	23	12.9			129		157
68	180.5	72.0	28	10.5			106		145
69			46						
70	161.5	50.1	26	21.5			152		
71	172.0	83.5	37	19.2			117		151
72	183.0	76.5	39	16.2	79		106		145
73	185.0	81.5	35	20.4				111	
74	175.0	74.4	28	12.9	73			117	
75	175.0	70.3	39	19.2			103		136
76	183.0	86.6	42	24.6	80	96		113	
77	179.2	78.5	28	21.2	79		109		139
78	163.0	76.6	34	17.7	68	121	146		
79	172.0	90.6	31	25.1	76	111		130	
80	189.0	98.0	33	24.3	77	102		135	
81	179.5	101.5	37	23.5	88	120	137		
82	173.0	68.0	42	17.7	67	97		124	
83	177.4	73.0	33	20.4	73	107		135	
84	174.5		43						
85	178.4	76.2	30	16.2	73		121	141	
86	175.5	78.0	31	22.5	74		138	155	
87	176.5	94.4	39	25.9	75	107		122	
88	189.0	102.2	35	23.5			125	146	
89	168.0	73.8	44	17.7	65	91		107	
90	166.5	62.7	40	17.7	53		102	126	
91	175.5	78.5	40	19.6	79		116	132	
92			43						
93	188.0	100.6	49	29.3	74		100	118	
94	166.5	88.2	53	34.8		116	130		
95	174.0	73.7	45	24.6	72				
96	174.6	98.2	25	12.9	68		107		120
97	167.1	97.1	52	27.9	68	102			
98	171.5	75.6	47	23.0	76	105	132		
99	170.5	87.0	48	29.3	84	111	124		
100	174.0	82.6	24	20.1	72	115	135		
101	169.5	96.6	42	33.7	62		109		
102	176.5	90.8	21	20.1	90		120	138	
103	167.0	59.6	54	22.9	86	124	149		
104	170.0	58.8	29	8.1	76		120	144	
105	170.2	74.7	32	17.7	68		116	135	
106	176.5	86.0	45	24.6	80	107		118	
107	171.0	85.1	30	22.5	72	105		132	
108	177.0	76.9	43	25.9	72		96	108	
109	170.0	74.8	41	25.9					
110			56	22.9	72	118	134		
111	170.0	90.1	22	25.5	72		127	142	
112	176.5	75.6	24	14.7	60		105		125
113	180.0	104.0	24	26.9	74	115	128		
114	173.5	102.4	51	34.8	81	113	124		

Subject number	HR150	STAI_T	STAI M1	STAI M2	STAI M3	STAI H	STAI F	STAI T	LOC
61		24	20	20	20	20	20	23	
62		29	35	21		38	28	23	
63	140	41	39	33	36	46	41		18
64		34	37	39	29		58		
66		33	30						
67		42	35	23	20		29		15
68		35	35	33	28	43	50		8
69		47	37	43	30	49	56		17
70		42	52	50	53	53	50		
71		50	58	41	36	61	39		14
72		36	33	34		37	37	27	8
73		45	36	39	42	50	56	36	14
74	151	35	44	26	29	36	29	32	10
75	147	42	34			44	44	41	10
76		41	50	40	36	42	43	41	17
77		20	23	20		29	39	25	2
78		31	34	28	26	44	43	30	12
79		30	24	24	21	28	22	22	10
80		34	31	29	23	52	40	47	12
81		30	20	20	23	26	31	23	10
82		38	38	32	33	41	45	29	21
83		40	33	38	35	34	43	27	12
84		34	30	26	26	31	46	36	8
85		33	34	30	31	36	32	44	10
86		42	41	47	48	64	60	50	16
87		32	31	27	25	49	35	32	14
88		30	34	26	25	35	51	42	5
89		36	38	30	27	42	40	36	19
90		25	24	32	26	36	69	33	13
91		28		31	28	29	32	28	13
93		46	41	36	41	48	48	33	
94									
95		31	42	31	26	39	42	26	15
96		27	29	27	28	28	33	26	14
97		33	28	34	40	53	42	26	5
98			35	30	23	47	20	27	9
99			49	32	35	36	30	35	7
100		29	26	24	20	30	20	24	10
101		26	22	20	20	23	24	20	13
102		36	39	29	30	39	35	30	10
103		33	28	22	21	28	29	21	3
104		44	37	34	26	44	42	42	17
105		32	34	29	33	55	45	29	8
106		40	41	31	26	40	45	37	13
107		29	22	22	29	24	31	32	17
108		25	40	24	27	23	26	42	16
109		32	39	26	25	36	44	39	
110		34	22	29	20	26	22	27	9
111		27	35	20	24	45	54	28	11
112		21	30	20	20	26	20	20	7
113		31	37	27	28	50	46	37	21
114		29	20	20	20	23	23	20	17

Subject number	I&PTT	I&PTAS	I&PES	I&PDIS	I&PBS	RUFCE	RUFC2	RUFC3
61						34.9	32.0	
62						25.3	12.2	
63	22	8	5	5	4	30.5	103.5	65.3
64						46.4	25.8	22.4
66						42.3	6.4	
67	13	6	3	4	0	63.3	15.2	10.5
68	24	10	5	5	4	20.1	6.3	12.7
69	25	7	7	8	3		19.1	11.8
70							19.2	20.3
71	22	6	7	6	3	50.1	14.8	66.3
72	28	9	7	8	4	30.1	12.7	9.7
73	22	8	7	3	4	12.5	8.2	6.5
74	33	8	9	9	7	84.4	18.3	53.0
75	31	9	8	10	4	44.3	7.3	4.5
76	21	5	5	6	5	40.1	12.0	
77	29	9	9	8	3	16.3	27.0	11.1
78	30	10	6	6	8	12.1	8.7	13.2
79	17	4	4	4	5		30.2	12.1
80	16	4	4	6	2	56.4	29.5	37.8
81	25	7	6	6	6	44.1	3.3	3.2
82	33	10	7	8	8	16.2	34.5	16.3
83	18	6	3	6	3		35.6	53.0
84	19	9	4	3	3	87.5	9.1	70.2
85	19	8	5	3	3		3.6	19.0
86	17	2	6	7	2	26.8	6.4	4.6
87	16	4	4	4	4	18.4	3.7	9.8
88	19	5	6	6	2	55.8	7.0	13.1
89	26	4	7	7	8	19.7		29.3
90	27	8	5	7	7	26.2	16.0	5.9
91	10	1	3	3	3	14.1		53.7
93	25	10	6	6	3	20.6	6.2	25.6
94						36.2		17.4
95	23	8	6	6	3	28.7	33.2	10.4
96	10	4	2	1	3	21.2	4.0	2.6
97	24	7	7	7	3	21.5	22.9	26.4
98	22	5	5	7	5	20.5	20.0	10.2
99	18	6	5	3	4	56.9	9.4	11.6
100	20	8	7	4	1	53.3	7.7	57.6
101	13	1	3	6	3	17.4	11.2	6.0
102	10	6	1	3	0	46.5	2.8	5.6
103	19	9	7	3	0	47.2	14.9	16.7
104	24	8	6	7	3	46.7	11.2	44.5
105	24	9	6	4	5	36.6	8.9	7.8
106	18	2	4	7	5	9.3	2.7	2.7
107	26	9	5	6	6	13.4	2.2	4.3
108	17	5	1	7	4	8.5	2.2	9.0
109						11.9	5.2	10.5
110	15	6	4	2	3	15.6	23.6	13.9
111	29	8	7	6	8	12.1	3.2	3.8
112	12	6	2	2	2	3.3		1.0
113	26	8	4	10	4	24.7	9.4	32.7
114	23	7	5	9	2	30.2	15.7	36.6

Subject number	SCE	SCHB	SCHA	SCAA	SCFB	SCFA	SCTB	SCTA
61	8.2	14.0			4.9	12.0		
62	1.5	3.6			3.2	6.4		
63	5.4	8.0		12.8	14.7	12.8	7.6	7.0
64					11.7	14.8	6.6	
66				16.6	8.0	16.6	7.6	
67								
68								
69								
70								
71								
72								
73								
74	24.0	7.4	4.3	1.0	6.0	11.5	1.0	1.0
75	11.8	2.0		11.8	3.2		13.5	1.0
76	5.0	3.9	2.0		3.4		5.3	1.0
77	3.1	2.4	3.1	1.0		2.5	5.3	1.0
78	1.0	4.1	4.1	10.3	4.1			5.7
79		8.0	14.0	14.0	3.8	2.0	1.0	2.0
80	9.5	1.0		2.4	2.4	2.6	8.8	7.9
81	1.0	2.8	1.0	1.0	1.0	1.0	1.0	1.0
82		5.8	7.4	6.9	3.9		6.9	4.8
83	6.0	8.9	6.6	8.5	12.2	18.5	5.0	8.0
84	18.5	5.5		12.2	11.7	15.2	5.6	7.0
85	28.0	2.0	2.1	10.2	1.0	16.0	5.7	2.0
86	11.5	5.3	7.7	7.7	7.3	5.7	8.9	16.6
87		6.7	4.3	6.3	7.7	8.2	4.0	7.3
88	19.5	2.4		4.4	5.8	5.3	6.7	4.3
89	17.4	7.7	4.8	10.5	3.4	6.7		5.3
90	5.2	5.9	5.4	11.5	8.8	12.0	2.0	3.1
91		4.4	4.0	5.8		7.8	6.7	
93	6.7	9.9	21.5	6.7	8.2	4.8	4.8	
94	4.2		16.5		19.0	35.6	6.7	6.9
95		1.0	1.0	1.0	4.0	3.0	1.0	1.0
96	3.5	6.6	9.3	15.2	6.7	6.7	3.3	7.0
97		15.0	16.6					
98	16.5	13.6	8.7	13.0	9.3	13.0	7.5	5.5
99	9.8	8.7		11.0	1.0	6.0	2.3	4.5
100	12.2	13.8	11.5		11.8		1.0	2.3
101	12.3		9.8	14.5	4.1	3.9	2.3	6.0
102	22.0	6.0		4.4	1.0	1.0	1.0	3.9
103	19.0	6.0	8.7	13.0	4.4	7.7	1.0	4.5
104	21.0	8.0	18.0	13.0	6.1	4.8	7.7	5.0
105	10.5	5.6	8.0		7.0	1.0	3.4	1.0
106	10.5					8.0		
107	12.0	7.9	11.1		7.6		12.0	7.5
108	7.0	5.0	7.0	7.0	10.4	13.0	4.8	6.5
109	14.0	8.4	7.7	7.5	5.7		19.5	
110	8.7	6.0	5.7	11.0	5.7	6.8		7.5
111	7.0	9.7	9.7		12.5		5.4	12.0
112	10.0	8.0		11.9	6.1			5.3
113		16.0		18.0		10.0	3.3	8.3
114				16.0	4.4			1.0

Subject number	SCXB	SCXA	HRAHBRF	HRAH1	HRAH2R	HRA_H Post	HRAA1	HRAA2
61			54	64	98		69	100
62			87	94	116	117	108	144
63	1.0	1.0	69	77	111	102	66	133
64			97	125	140	146	111	137
66	8.0		76					
67			99	126	139	135	101	141
68			92	104	137	139	105	149
69			86	107	115	121		
70				123	143	139	97	132
71								
72			86	104	118	128	113	142
73			82	95	118	97	84	146
74				109	120	122	91	149
75		3.4	71	96	113	111	103	110
76	2.0	1.0	89	97	112	104	98	135
77		8.0		79	119	126	94	128
78	1.0	2.2	66	85	121	141	117	142
79		7.5	80	88	113		95	119
80	1.0	1.0	90	107	132	123	98	131
81	1.0	1.0	91	86	115	126	115	160
82	1.0	1.0	85	86	124	129	84	111
83	7.6	6.6	92	112	104	136	109	130
84			83					
85	2.0	2.0		99			95	116
86	11.5	11.0	82	110	130	127	91	
87	6.1	6.7	81	85	97	92	107	126
88	4.4	4.9	101	101	98	93	106	133
89		2.4		72	89	106	85	113
90	5.4	6.0		77	100	81	95	130
91	5.2	4.4	74	89	114	123	113	146
93	8.2	7.7	95	87	115	113	110	140
94	4.4	6.3	95	113				
95			78	102	133	128	95	138
96	4.0	4.4		83	120	129	97	134
97			74	71	96			
98	12.3	11.0	86	87				
99	1.0	1.0	78	107	117	122	115	147
100	1.0	4.1	88	115	127	117	135	153
101	1.0	1.0	60	70	101	89	97	138
102	4.5	4.5	92	109	137	128	128	159
103	1.0		78	93	109	105	120	126
104	8.2	4.0	76	89	114	127	104	145
105	1.0	3.8	73	61	85	121	77	118
106		7.5	74	83	100	111	111	122
107			79	87	118	138	115	149
108		4.0	65	86	120	107	88	145
109			90	130	139	126	131	168
110	6.1	5.7	83	107	122	118	111	127
111	7.5	7.5	97	109				
112	3.4	5.3	65	81	107	120	91	146
113	7.0	6.5	85	104	122	118	128	138
114	22.1	13.0	83	91	102	99	111	125

Subject number	HRAA3	HRAF1	HRAF2	HRAF3	HRAT1	HRAT2	HRAT3	HRASEA
61	61	63	109	94				
62	113	95	141	117	77	95	88	90
63		68	122	103	55	93	50	68
64		109	122	118	87	88	84	89
66		101	142	114	81	90	79	80
67	106	105	162	132	97	110	91	
68	122	83	125	113	80	95	71	92
69		76	108	105	70	88	73	83
70	102	92	148	134	85	98	75	87
71		103	143	135	92	106	105	99
72	96	76	132	108	71	85	64	74
73	90	74	134	117	69	83	64	69
74		82	108	101	71	76	71	
75	94				74	86	67	78
76	105	97	131	123	87	96	86	80
77	99	73	117	107	84	92	68	84
78	108	76	132	126	64	75	58	73
79	100					91	80	82
80	111	108	160	154	78	90	76	85
81	111	104	173	176	107	112	107	98
82	72	82	131	121	72	83	82	69
83	92	94	153	139	69	95	90	94
84		100	147	130	114	134	118	
85	97	80	142	121	75	93	65	78
86		95	151	141	90	113	88	95
87		92	110	113	79	95	73	84
88		100	150	87	89	103	82	91
89	90	82	139	111	76	89	76	73
90	86	96	156	145	76	117	75	
91	119	109	158	152	86	103	88	
93	112	97	144	136				
94		127	156	138	90	102	99	
95	94	83	134	105	75	88	70	
96	95	80	119	96	82	94	79	91
97		83	108	92				83
98		90	160	129	96	120	100	101
99	112				76	91		88
100	124	108	164	143	101	112	101	82
101	92	61	102	89	59	83	68	67
102	106	98	143	119	95	110	81	91
103	130	109	151	142	76	100	89	
104	123	101	164	146	61	93	70	
105	107	94	132	121	55	80	57	
106	95	95	127	116	85	96	89	
107	111	112	162	135	77	88	61	83
108	92					76		67
109	144	130	176	157	114	124	119	137
110	131	90	148	138	77	91	82	
111		94	150	136	86			82
112	118	74	135	116	65	83	64	79
113	114	96	129	123	71	82	65	
114	108	85	112	94				72

Combined Subjects

Subject Number	MPLOY	OFSHORE	LASTV YY	FIRSTV YY	WKS	TRNING	ORDER	SMOKE	CIGS
1	1	2				2	2	1	10
2	1	1	91	91	4	2	2	2	
3	1	2				2	2	1	30
4	1	2				2	2	2	
5	1	1	90	79	2	1	2	2	
6	1	2				2	2	2	
7	1	2				2	2	1	10
8	1	2				2	2	2	
9	1	2				2	2	1	20
10	1	1	92	91	3	2	2	1	15
11	1	2				1	2	2	
12	1	2				2	2	1	
13	1	1	87	79	28	1	2	1	20
14	1	2				2	2	1	15
15	1	2				2	2	2	
16	1	2				2	2	2	
17	1	2				2	7	2	
18	1	2				2	7	2	
19	1	1	91	80	25	1	7	2	
20	1	2				2	2	2	
21	2	2				2	2	2	
22	1	2				2	2	2	
23	1	1	90	80	25	1	2	1	20
24	1	1	92	87	20	2	2	1	15
25	1	2				2	2	2	
26	1	1	79	79	14	1	9	2	
27	2	1	83	77	30	2	9	2	
28	1	2				2	9	2	
29	1	1	92	77	26	2	9	1	40
30	1	2				1	9	1	15
31	1	2				2	9	1	
32	1	1	91	84	20	1	9	2	
33	1	2				2	9	1	15
34	1	1	92	81	10	2	9	1	10
35	2	2				2	9	1	20
36	1	2			2	2	6	2	
37	1	2				2	6	2	
38	1	2				2	6	2	
39	2	2				2	6	2	
40	1	1	92	76	2	1	4	2	10
41	1	1	92	73	28	1	4	2	
42	1	1	82	75	20	2	4	1	10
43	1	1	92	92	2	1	4	1	3
44	1	1	92	76	3	2	11	2	
45	1	1	88	86	3	2	10	2	
46	1	1	84	74	26	1	10	2	
47	1	1	92	82	20	2	10	1	20
48	1	1	83	75		1	10	1	20
49	1	2				2	10	1	15
50	1	2				2	10	2	
51	1	1	92		30	2	10	2	

Subject Number	SPORT	FREQ	REASON	FIT	SWIM	H_EXP	A_EXP	F_EXP
1	1	7	2	2	2	2	2	1
2	1	4	2	2	4	2	2	2
3	2		2	3	3	2	2	2
4	1	4	2	2	3	2	2	2
5	1	3	3	2	2	1	1	1
6	2		2	2	3	2	2	2
7	2		2	2	1	2	2	2
8	2		2	4	4	2	2	2
9	2		2	4	4	2	2	2
10	1	4	2	3	3	2	2	2
11	2		2	4	1	2	2	1
12	1		1	1	4	2	2	2
13	1	7	2	2	2	1	1	1
14	2		2	3	3	2	2	2
15	1		3	3	3	2	2	2
16	1	3	2	3	3	2	2	2
17	1	5	2	3	3	2	2	2
18	2		2	3	3	2	2	2
19	1	1	2	3	2	1	1	1
20	2		1	4	3	2	2	2
21	1	10	1	3	2	2	2	1
22	1	3	2	2	2	2	2	1
23	2		2	3	2	1	1	1
24	1	3	2	3	3	2	2	2
25	2		2	2	3	2	2	2
26	1	1	1	3	4	2	1	1
27	1	3	1	2	2	2	2	2
28	1	4	2	3	2	2	2	2
29	1	7	2	3	1	2	1	1
30	2		2	3	3	2	2	1
31	1	2	1	2	2	2	2	2
32	1	4	2	3	2	1	1	2
33	2		2	3	4	2	2	2
34	2		2	3	4	2	2	2
35	1	4	1	2	2	2	2	2
36	1	1	3	3	3	2	2	2
37	1	2	1	3	2	2	2	1
38	2		2	3	4	2	2	2
39	2		1	2	2	2	2	2
40	1	4	2	3	3	1	2	1
41	1	4	2	1	3	2	1	1
42	2		2	3	3	2	2	2
43	2		3	4	3	1	1	1
44	1	3	2	3	3	2	2	2
45	1	2	2	4	2	2	2	2
46	2		2	3	2	2	1	1
47	1	1	2	3	2	2	2	2
48	2		2	2	2	1	1	1
49	1	8	2	2	3	2	2	2
50	1	2	1	2	1	2	2	2
51	1	7	2	2	2	2	2	2

Subject Number	L_EXP	MEFCT	LEFCT	ACHIEVE	F_COPE	F_DIF	F_SATIS	H_COPE	H_DIF
1	2	3	4	1	1	3	1	4	3
2	2	2	3	1	1	3	2	2	3
3	2	1	3	1				3	2
4	2	2	3	2	1	3	2	3	3
5	1	3	2	2	1	3	2	3	3
6	2	2	3	1	1	3	1	3	3
7	2	3	2	2	1	3	2	3	3
8	2	2	3	1	1	3	2	6	3
9	2	2	3	1	2	2	2	6	3
10	2	4	3	2	4	2	2	7	2
11	1	2	3	2	1	3	2	5	1
12	1	1	3	1	2	6	1	7	4
13	1	4	2	2	1	3	2	3	3
14	2	3	2	2				3	2
15	2	2	3	1				2	1
16	2	1	3	2	1	2	1	3	3
17	2	4	3	3	1	3	1	2	2
18	2	4	2	1	1	3	1	6	3
19	1	2	3	2	1	3	1	3	2
20	2	1	3	2				6	2
21	2	2	4	1	1	3	1	3	2
22	2	3	4	2	1	6	2	3	2
23	1	3	2	2	1	3	2	3	2
24	2	2	3	2	1	3	2	3	2
25	2	1	2	1				7	3
26	1	2	3	1	6	3	1	3	3
27	2	3	2	2	6	5	1	4	2
28	2	3	1	2	4	1	2	3	2
29	1	1	2	2	6	3	1	7	3
30	1	2	1	2	1	3	2	4	2
31	2	4	3	1	9	3	1	6	2
32	2	1	3	2	4	3	2	6	2
33	2	2	3	1					
34	1	1	3	1					
35	2	1	2	2					
36	2	1	3	1	1	3	2	3	2
37	2	3	4	1	1	4	1	7	3
38	2	2	3	1	2	6	2	6	1
39	2	1	2	1	1	3	1	7	2
40	1	1	3	1	1	3	1	6	3
41	1	1	3	2	9	7	1	6	4
42	2	1	2	2	3	6	2	4	3
43	1	1	4	2	1	3	2	3	3
44	2	2	3	1	1	3	2	3	3
45	2	4	2	1	1	6	2	3	2
46	1	1	3	2	1	6	1	3	2
47	2	1	2	2	1	3	3	3	2
48	1	4	1	2	6	3	1	6	3
49	2	2	3	1	1	3	1	3	3
50	2	1	4	1	9	3	1	3	2
51	2	1	2	1					

Subject Number	H_ SATIS	A_ COPE	A_DIF	A_ SATIS	T_ COPE	T_DIF	T_ SATIS	EV_ CAPBL
1	1	5	7	2	2	1	1	1
2	3	4	6	3	2	1	2	1
3	2				8	3	2	1
4	2							1
5	1				9	4	2	1
6	1	2	7	1	5	2	1	1
7	2	4	2	2	2	3	2	1
8	3	3	4	3	4	1	2	1
9	2	5	6	2	6	3	2	1
10	1	6	4	2	1	1	1	1
11	2	2	7	2	4	2	2	1
12	1	6	2	2	6	4	2	2
13	2	2	4	2	6	3	2	1
14	1	6	4	2	8	1	2	1
15	1	6	6	1				
16	1	3	4	2	2	4	1	1
17	2	6	6	1	2	3	1	1
18	2	5	4	2	1	3	2	1
19	1	3	4	1	8	1	1	2
20	3	6	6	2	8	1	2	1
21	1	3	4	1	6	3	1	1
22	2	6	6	2	5	1	2	1
23	1	4	6	3	2	3	2	1
24	2	4	6	2	4	3	2	2
25	1	4	6	2	6	3	1	1
26	1	2	2	1	6	3	1	1
27	1	2	4	1	6	3	1	1
28	2	4	6	2	6	1	1	1
29	1	4	6	2	8	3	1	1
30	2	4	6	2	2	3	2	2
31	2	4	6	2	4	3	2	1
32	2	6	6	2	2	1	1	1
33							1	
34					8	1	1	
35					8	1	2	
36	1	3	5	2	9	4	1	3
37	1	5	7	1	5	1	1	1
38	2	5	4	2	1	1	2	2
39	1	4	6	1	4	1	1	2
40	1	5	4	1	2	1	1	1
41	1	3	7	1	5	4	1	2
42	2	6	3	2	4	1	2	1
43	1	3	2	2	9	4	1	1
44	1	3	4	2	2	3	1	1
45	2	3	3	2	5	1	2	2
46	2	2	3	1	6	3	2	2
47	1	4	3	1	4	3	2	1
48	2	2	4	2	4	3	2	1
49	1	6	6	1	2	1	1	1
50	2	5	2	1	8	1	2	2
51		3	6	1	8	2	1	

Subject Number	F_ CAPBL	HD_ CAPBL	H_ ALTER	ST_ ALTER	ES_ ALTER	PHYSC AL	EMOTI ON	LASTV MM	FIRST VMM
1	1	1	2	1	1	4	5		
2	1	2	3	1	2	3	4	10	10
3	1	1	1	1	1	2	3		
4	2	1	3	1	1	4	4		
5	2	1	2	1	1	3	3	8	
6	1	1	2	1	2	4	4		
7	1	1	2	1	1	3	4		
8	1	1	3	1	1	2	4		
9	1	1	2	1	2	2	2		
10	1	1	2	1	1	2	2	1	10
11	1	1	2	1	1	3	3		
12		1		1	1	1	4		
13	2	2	3	1	2	3	3		
14	2	2	2	1	2	4	3		
15									
16	1	2	1	1	1	2	3		
17	1	1	3	1	1	4	4		
18	2	1	3	1	1	3	3		
19	1	1	3	2	1	4	3	9	
20	1	1	1	1	1	1	1		
21	1	1	1	1	1	2	2		
22	2	1	3	2	2	5	5		
23	1	2	3	1	2	4	3	2	
24	2	1	1	2	2	3	4	4	5
25	1	1	1	1	1	2	2		
26	1	1	1	1	1	4	2		
27	1	2	3	1	1	4	3	5	2
28	1	1	3	1	2	4	4		
29	2	1	3	2	2	2	2	4	10
30	2	2	4	1	1	2	2		
31	1	1	3	1	1	3	3		
32	2	2	3	2	2	4	2	10	
33									
34								4	4
35									
36	1	1	1	1	1	5	5		
37	1	1	4	1	2	3	2		
38	2	1	2	1	2	2	2		
39	1	2	3	1	2	2	1		
40	1	2	3	1	1	3	3	8	7
41	1	1	3	2	2	3	3	11	
42	2	2	2	1	2	5	3		
43	2	2	3	1	2	2	2	10	3
44	1	1	2	1	1	2	2	11	4
45	2	2	3	1	1	3	3		
46	2	3	3	1	2	2	3		
47	1	1	2	2	2	4	4	11	
48	1	1	2	1	1	1	2		
49	1	2	2	1	2	3	3		
50	3	4	3	2	2	3	3		
51								11	

Subject number	HGHT	WGHT	AGE	FAT	HR Rest	HR50	HR75	HR100	HR125
1	191.0	90.0	22	14.7	76		105		135
2	174.0	73.2	21	16.4	66		110		143
3	172.5	67.8	21	8.1	85		138	157	
4	173.0	77.0	22	12.9					
5	191.3	93.1	38	20.4	59			114	
6	171.0	64.0	29	12.9	80			121	
7	174.0	75.0	22	17.7	72			127	152
8	167.0	83.5	41	29.3	77	100		115	137
9	178.0	76.5	43	19.6	86	117		147	
10	179.2	78.0	28	16.4	83		104		129
11	178.5	89.1	32	20.4	77		106		131
12	185.5	72.0	50	15.6	60	76		105	
13	178.0	81.0	37	14.2	67		90		112
14	175.0	73.2	25	13.3	79		111		151
15	172.5	69.0	32	20.4	71		119		152
16	178.0	83.0	50	27.9	82	102		125	
17	179.0	80.0	23	12.9	68		106		140
18	175.6	79.1	40	24.6	89	116		137	
19	182.0	90.9	34	25.1		129	147		
20	162.0	80.7	47	25.9	91	109	119		
21	178.5	111.0	31	25.1	74		110	124	
22	174.0	65.7	24	14.7	89		128	157	
23	177.5	84.0	31	22.5	77		113	136	
24	186.5	78.2	23	10.5	83		113		134
25	176.0	72.2	24	17.7	68		119	145	
26	171.5	89.0	40	28.2	72	111	124		
27	185.0	85.4	46	22.2	60	115	125		
28	176.0	71.1	24	17.7	65		123	145	
29	177.5	77.3	42	24.6	65	109	126		
30	186.0	74.1	19	8.1	65	128		139	
31	175.5	87.0	30	24.3			122	140	
32	187.0	83.5	28	16.4	72		124	136	
33			59						
34			33						
35			31						
36	174.0	92.8	36	28.4	64		109	122	
37	185.5	89.0	46	23.0			112	117	
38	164.0	99.0	40	37.6	86	132	141		
39	172.0	76.0	38	23.5	66		107		129
40	182.3	91.5	38						
41	178.0	77.3	53	20.8	84	105		121	
42	181.0	82.3	41	15.0	84	100		121	
43	183.3	90.4	37	23.5	70		107	121	
44	181.0	105.0	47	30.3		109		128	
45	169.0	101.2	46	27.1	68	112		134	
46	171.0	88.7	44	27.1	84	127	136		
47	170.0	84.4	38	23.5	71		111	123	
48	163.4	65.3	51	20.8	78	125	142		
49	171.4	68.1	37	14.2	66		104		133
50	170.8	72.5	33	19.2	74		107	117	
51	186.0	116.0	34	25.9	54			103	

Subject number	HR	STAI_T	STAI M1	STAI M2	STAI M3	STAI M4	STAI M5	STAI H	STAI A
	150								
1	156	23	30	23	23	23	25	30	28
2	166	38	64	46	35	35	30	59	50
3		26	32	30	28	30		44	
4		49	52	31	29	28	24	51	
5	138	31	26	20	20	20	23	34	
6	162	34	33	24		25	24	46	25
7		30	28	30	27	31	33	26	
8		33	54	42	30	34	30	59	
9		31	43	44	30	35	32	57	52
10		39	44	31	32	37	26	48	39
11		33	36		29	37	30	43	32
12		47	35	23	20	24	25	45	29
13		33	36	30	30	30	30	33	30
14		40	35					33	39
15		38	37	21				51	54
16		36	36	37	30	31	25	49	41
17		33	32	29	27	33	31	35	31
18		40	56	53	38	44	50	55	47
19		39	37	37	29	25	32	36	30
20		32	70	42	58	72		79	71
21		39	37	32	31	36	36	43	37
22		40	40	36	33	40	39	38	53
23		40	28	31	31	28	30	41	35
24		43	43	27	28	30	28	48	37
25		34	33		28	28		24	24
26		30	28	20	20	20	20	38	35
27		23	20	20	20	20	20	20	23
28		35	45	37	33	27	41	47	52
29		26	39	20	20	20	20	50	44
30		41	42		46	42	38	49	46
31			33	28	23	21	21	33	30
32		30	36	26	29	26		40	39
33		34	35	21					
34		32	40	45					
35		26	23	23					
36		25	35		21	32	22	51	47
37		28	35		26	30	22	26	30
38		30	61		52	59	27	69	66
39		43	46		33	34	26	42	40
40		38	45	32	26	29	24	44	44
41		31	25	21	21	20	20	25	29
42		44	46	32	28	30	33	39	36
43		49	33	33	30	42	30	46	57
44		30	39	31	25	29	35	48	54
45		42	41	31	34	35	37	36	42
46		24	23	25	20	20	20	58	48
47		29	43	39	29	27	26	40	36
48			36	34	44	29	29	36	37
49		33	29	23	21	21		38	34
50		24	30	28		25	24	35	32
51	114	32	23	20		23		20	20

Subject number	STAI F	STAI T	LOC	I&PTT	I&PTAS	I&PES	I&PDIS	I&PBS
1	31	28	16	30	10	6	7	7
2	52	32	15	12	1	3	6	2
3	49	33	19	24	4	6	7	7
4		25	12					
5	47	21	12	22	9	4	7	2
6	34	22	14	28	10	6	8	4
7	47	31	16	29	9	5	8	7
8		32	11	14	3	4	3	3
9	46		16	12	4	4	4	0
10	43	32	11	15	3	6	6	0
11	47	29	15	12	5	3	2	2
12	48	33	12	21	8	3	6	4
13	30		7	25	9	6	4	6
14	36	36	14		8	4		7
16								
17	40	35	14	21	8	6	4	3
18	40	31	14	30	9	7	8	6
19	60	35	19	24	7	7	7	3
20	46	31	13	16	6	2	5	3
21		46	15	21	5	5	5	6
22	37	37	16	21	8	6	4	3
23	33	37	18	21	10	5	3	3
24	46	34	18	32	8	9	8	7
25	37	33	14	29	10	8	8	3
26	31	26	8	24	8	5	8	3
27	21	22	9	26	8	4	7	7
28	23	20	13	28	10	6	8	4
29	49	46	13	25	8	5	7	5
30	43	41	14	23	8	5	6	4
31	51	41	15	20	8	5	5	2
32	48	27	13	18	8	5	3	2
36	41	38	13	34	10	9	9	6
37		23						
38		38						
39		23						
40	50	27	9	16	7	3	4	2
41	29	22						
42	63	39	13	15	0	5	5	5
43	53	31	13	16	6	8	2	0
44	42	32	14	28	6	8	8	6
45	21	21	7	11	7	4	0	0
46	45	41	11	18	4	6	2	6
47	53	34	16		8	5	6	
48	50	30	10	15	6	4	2	3
49	43	45	10	35	10	9	9	7
50	45	56	12	29	6	7	10	6
51	34	41	8	23	9	5	4	5
	34	33		14	5	4	3	2
	21	29	15	7	1	1	2	3
	32	28	15	21	3	7	6	5
	23	20	12	23	8	4	8	3

Subject number	RUFCE	RUFC2	RUFC3	RUFC4	RUFC5	SCE	SCHB	SCHA
1	24.8	6.6	7.8	8.2	3.3	9.6		
2	25.6	8.2	58.7	6.3	9.1	12.8	26.6	
3	47.0	6.3	8.1	9.7		5.4		
4	55.8	8.0	30.9	28.3	6.7			
5	11.3	25.2	7.0	14.6	9.1	5.9		
6	146.7	59.8	64.2	87.4	64.6		14.0	7.9
7	13.5	1.5	33.0	4.7	28.8	10.7		4.0
8	26.3	24.5	11.6	15.8	11.0	1.0		10.8
9	21.0	7.0	31.6	9.6	2.5	5.2		
10	52.7	7.2	14.0	28.3	16.2	17.5	7.5	15.0
11	20.2	8.0	9.2	9.1	7.1	11.5	3.6	
12	36.6	41.6	68.3	63.5		1.0	4.5	7.6
13	35.0	36.0	40.8	6.6		13.0	7.4	2.0
14	14.4	6.8	5.7	5.8	4.3	1.0	1.0	1.0
16	41.3	6.3	7.3	10.2	8.1			
17	20.3	6.0	6.1	10.9	7.8	17.8		19.6
18	52.4	35.3	15.1	19.6	15.8		5.2	13.5
19	21.1	8.7	4.2	7.4	5.2	3.9	5.3	16.6
20	9.8	6.4	6.5	10.7		8.5		
21	24.4	22.0	7.0	17.4	27.8	15.2		24.4
22	58.4	46.2	8.0	7.7	7.7	24.0	3.5	16.8
23	24.8	31.4	8.2	8.6	14.4	12.2	3.2	
24	49.3	8.5	6.7	5.1	5.7	18.0	6.6	17.2
25	24.6	9.4	26.3	12.1	28.6	22.0		15.2
26	41.6	4.4	21.6	10.5	45.9	8.5		
27	56.5	31.5	29.3	46.6		14.5		
28	30.6	8.6	7.2	9.4	15.6	14.5		
29	31.3	5.6	6.4	25.9	10.9	3.5		
30		11.1	10.4	7.0	36.4		3.8	6.4
31		20.8	25.1	6.6	26.0		9.0	5.4
32		32.6		47.4	21.7		8.2	20.5
36			10.8	9.5	5.8	13.8	4.8	7.0
37	18.4		9.1	9.0	11.6		4.8	4.4
38	46.1		58.5			19.0	9.0	
39	23.9		22.2	24.1	23.1	8.3	1.0	1.0
40	27.4	6.2	10.9	10.1	5.7	6.0	3.6	3.0
41	39.2	8.2	7.7	14.4	4.7	6.0	5.6	3.2
42		6.7	6.0	5.6	7.2		3.2	3.2
43	16.4	6.1	6.0	9.9	39.2	6.8	6.0	7.0
44	33.6	24.5	12.1	22.1	7.5	11.0	8.7	12.0
45	8.6	3.5	8.2	7.2	6.7	11.0	3.3	2.2
46	56.9	22.0	16.8	18.0	17.0	6.6	2.0	
47	41.1	14.0	16.1	4.0	6.6	5.8	1.5	1.0
48	38.2	7.1	28.5	12.1	16.1	9.0	3.4	4.5
49	69.4	4.6	6.3	7.7	5.5	15.0	1.0	4.1
50	17.1	52.4	19.3		15.1		1.0	1.0
51	5.1	3.6	3.6	5.2		3.4	2.0	1.0

Subject number	SCAB	SCAA	SCFB	SCFA	SCTB	SCTA	SCXB	SCXA
1	18.0	23.0	7.4	8.0	2.0	2.0		
2	38.0	53.0	41.0		7.6	10.0		
3			12.8	13.8	5.3	3.3		
4			10.2			9.0		
5			16.1	25.2	16.1			
6		9.0	5.9	14.0	1.0	3.0		
7		1.5		13.4	18.6	9.6		
8								
9		3.8	3.9	5.2		1.0		
10	25.5	21.5	9.3			2.3	1.0	3.6
11		8.0	4.1	3.9		4.0	1.0	1.0
12	10.7	11.5	3.6	2.9	3.0	2.1		
13	5.1	3.6	10.0	3.6		2.2	7.5	8.7
14	2.0	3.8	2.1	1.0	2.9	5.1	2.0	
16								
17	13.2		12.1	15.6	5.3	2.1		5.6
18	14.5	19.5	43.0	40.0	15.9	13.8	10.9	10.2
19	5.5	18.0	27.0	22.0	5.3	7.0	2.0	2.0
20					2.5	2.4	3.5	
21	14.0	12.9	8.9	8.5	9.5	7.0	2.1	3.2
22	3.2	13.5		7.6	2.0	5.0	12.1	6.1
23	10.9	9.5		7.0	2.2	8.0	5.5	2.2
24		10.9	11.8	11.2	8.5	7.6	10.0	13.5
25	9.5	7.6	11.2	10.2	2.4	7.0	12.2	11.2
26					2.2	1.0		
27								
28					1.0	1.0		
29					1.0	2.5		
30	7.2	8.7	5.7	2.3			6.7	7.7
31	5.8	16.0	7.5	10.5			10.5	10.0
32	11.0	9.2	9.8	10.5			12.0	11.5
36			8.8	10.0	4.0	5.2	1.0	5.0
37	17.2	22.1		5.0	3.4	4.0	7.0	6.5
38	45.0	50.0			4.8	9.5	80.0	82.0
39	3.5	1.0	10.0	7.5	14.8	6.0	3.5	1.0
40	5.1	9.1	3.4			4.8		4.4
41	4.8	5.6	3.6	3.8	3.8	1.0	4.4	4.8
42	1.0	1.0	3.8	3.2	1.0	1.0	1.0	3.2
43	8.0	10.0			4.8	5.0	3.8	7.6
44	13.0	18.5			3.2	4.4	8.0	7.5
45	2.2	2.2	2.2	5.8	12.7	14.7	5.7	3.7
46	20.0	19.0	4.9	7.1	42.0	8.6	6.6	5.7
47	3.0	2.7	4.5	7.7	5.8		2.2	3.4
48	12.0	9.6	3.7	7.1	52.0	42.4	8.0	
49	6.2	3.0	4.0	13.0	5.8	5.4	2.7	1.8
50	3.0		12.0	1.3	5.8	1.0	3.0	1.0
51	4.5	5.7		8.0	1.0	4.9	3.4	4.1

Subject number	HRA HBRF	HRAH1	HRAH2C	HRAH3C	HRA_ HPST	HRAA1	HRAA2	HRAA3
1	93	120	131	126	134			
2	100	104	119	119	122	124	137	90
3	104	98	128	120	118			
4	92	107	125	120	109			
5	72	81	98	100	94			
6	78	73	105	108	107	92	156	94
7	72	97	90	103	90	101	157	95
8	94	99				117	118	91
9	107	121	132	126	120	116	151	122
10	79	136	140	131	121	129	166	124
11	85	95	108	122	119	102	146	113
12	69	103	102	95		104	109	71
13	70	72	116	113		81	103	74
14	94	97	123		116	120	143	105
16		105	110	116	114	105	132	100
17	96	88	105	118	101	112	147	108
18	96	127	131	135	142	134		
19	106	120	133			142	167	134
20	104	106	113	113	116	111	122	106
21	85	107	111	118	42	109	133	98
22	88	122	133	132	123	119	177	129
23		113		122	108			
24		106		130	106	115	140	107
25		110		140	110	109		
26	92	103	99	106				
27		109	113	120	143	113	139	96
28	78	105	117	127	120	124	157	102
29	87	106	110	108	114	111	152	108
30	98	124	139	142	130	124	147	122
31	70	123	123			122	153	114
32	65	123	115	94	90	110	169	129
36	96	122	131	141	129	104	143	124
37	89	113	123	129	125	110	130	110
38	130					161	161	155
39	85	94	109	113	73	98	146	108
40	74	93	104	120	129	89	127	81
41	83	96	103	109	115	108	136	118
42	78	90	102	112	89	96	117	92
43	71	87	96	100	100	105	116	89
44	103	117	128	133	135	130	141	116
45	69	90	105	104	112	117	139	109
46	83	116	119	125	117	135	150	127
47	73	82	94	106	113	88	135	102
48	95	120	130	140		129	148	116
49	92	104	114	117	134	113	132	97
50	97	104	129	136	115	115	155	110
51	91	75	97	107	94	106		

Subject number	HRAF1	HRAF2	HRAF3	HRAT1	HRAT2	HRAT3	HRASEA
1		143	128	86	104	97	91
2		159	115	67	98	65	86
3	113	160	137	100	115	94	111
4	79	116	103	100	90	111	82
5	93	139	117	64	99	68	70
6		138	117	67	76	54	
7	82	152	118	95	105	90	
8	87	125	110	63	98	58	
9	93	147	136	78	97	83	95
10	95	156	125	72	85	66	76
11	80	125	104	76	97	85	82
12	65	136	103	52	71	50	64
13	78	124	92	92	91	70	73
14	95	133	119	79	93	69	93
16	83	126	110	83	100	85	89
17	85	125	97	64	78	60	73
18	96	154	128	87	109	87	
19	122	174	146	95	117	113	108
20				89	99	90	97
21				90	107	96	81
22	88	155	126	95	115	98	94
23	84	136	131	86	101	77	91
24	93	145	118	85	112	87	97
25	94	146	111	76	99	88	89
26		164	153		93	99	76
27		141	132	69	98	72	71
28		145	134	82	95	85	82
29		119	113	74	92	73	87
30	112	158	139	79	92	91	97
31	115	163	139	72	86	69	
32	65	147	121	58	77	61	
36		144	125	78	99	76	87
37				97			80
38		179	158	99	123	99	
39				67	113	62	79
40	107	141	121	77			89
41	100	125	122				
42	86	140	115				
43	85	132	117				
44	111	152	135	84	90	88	95
45	97	117	99	58	77	71	70
46	95	123	106				83
47	79	119	112	81	94	104	87
48	96	137	139	91	100	93	96
49	91	137	118	80	93	76	
50	109	158	135	82	102	82	
51	84	131	108				