THE DEVELOPMENT OF AN OBJECTIVE INDICATOR OF OCCUPATIONAL STRESS USING THE EMOTIONAL STROOP PARADIGM

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Abstract

In 2015-16, work-related stress, anxiety and depression accounted for approximately 11.7 million working days lost to ill health, explaining 37% of all work-related cases of ill health in the UK and defining the need for organisational risk assessment. However, it is widely acknowledged that current methods used in risk assessments to identify and evaluate occupational stress and its' consequences have considerable limitations. This thesis was concerned with the consideration and evaluation of occupational stress and contemporary measures of occupational stress prior to the construction and piloting of an occupational stress- related Stroop task as an objective indicator of occupational stress in different occupational settings. Previous research has demonstrated robust emotional Stroop interference for colour naming of threat-related stimuli by anxious individuals. Cognitive theories of emotion and attention offer various underlying explanations for why this happens but generally agree that anxiety and similarly stress, elicit an automatic, attentional bias towards threatening stimuli in emotional Stroop tasks. Therefore, it is predicted that the colour naming performance of participants (across a range of different occupations) higher in occupational stress will be inhibited by occupational stress-related words in an emotional Stroop task.

Study One was primarily concerned with the construction of appropriate word sets for an occupational stress-related Stroop task. Data from interviews (*N* = 10), a focus group (*N* = 7) and self-report occupational stress scales (*N* = 4) were content analysed to provide a set of 20 relevant occupational stress-related words. Neutral,

social threat and physical threat control word sets were also constructed and all stimuli were balanced for lexical characteristics known to affect colour naming times, with a particular focus on word frequency using a British-English frequency list rather than the routinely used American lists. The final occupational stress-related Stroop task contained 80 words for computer presentation in a single word, semi-random sequence, once in each of four colours.

Study Two employed the occupational stress-related Stroop task to elicit attentional bias in white-collar workers (*N* = 80) who were chosen as fairly representative of a substantial proportion of the workforce in the UK. Participants were divided into high (*n* = 18) and low stress (*n* = 17) groups based on sources of pressure scores from an established work stress questionnaire which followed completion of the emotional Stroop task. Analysis of colour naming latencies revealed significantly slower times in the high stress group for occupational stress words compared to neutral words supporting Hypothesis One and also in contrast to the low stress group in accordance with Hypothesis Two.

Study Three tested the utility of the occupational stress-related Stroop with an opportunity sample of Further Education teachers (*N* = 15) using the same method as in Study Two to test the extended utility of the task to a different occupational group who might report different psychosocial factors associated with their job role. Teachers are reported to have higher levels of perceived stress and consequent strain than the average working person so it was reasonable to assume they would exhibit attentional bias towards occupational stress-related stimuli. Analysis of colour- naming latencies showed that the high stress group (*n* = 15) were significantly slower for occupational stress-related words than neutral supporting Hypothesis One, and when compared to the low stress group (*n* = 13) lending support to Hypothesis Two. The high stress group also had significantly slower response times for physical threat-related words in comparison to neutral which was discussed as an unexpected finding.

Study Four extended the use of the occupational stress-related Stroop to a sample of police firearms officers (*N* = 52) to investigate whether the generic occupational stress-related stimuli elicited attentional bias towards occupational stress-related words in higher stress participants. Analysis of colour naming times indicated significantly slower responses in the high stress group only (n = 13) for occupational stress words in comparison to neutral words (and in comparison to other threat words). These findings supported Hypotheses One. No significant differences were observed for interference scores between occupational stress and neutral or for any other word types when comparing the high and low stress (*n* = 13) group. This was contrary to Hypothesis Two and possible explanations for this anomaly were discussed.

These results taken together suggest that the occupational stress-related Stroop task constructed for this doctoral research was relatively successful as an objective indicator of occupational stress across three different occupational groups as the higher stress participants took significantly longer to colour-name occupational stress-related words in comparison to neutral in Study Two, Three and Four demonstrating Stroop interference within each of the high stress groups (white-collar workers, teachers and firearms officers) towards occupational stress-related words. The findings are less conclusive in terms of significant differences in Stroop interference towards occupational stress-related words between the high and low stress groups as although significantly longer interference scores for occupational stress words were found for white-collar workers, this was not the case for firearms officers. Whilst significantly more interference for occupational stress words was found for teachers, they also exhibited significant interference from physical threat words. Possible reasons for this were discussed. The stronger findings for analysing colour-naming latencies (within-groups differences) in comparison to analysing interference scores (between-subjects) is however in line with numerous other emotional Stroop tasks and has been blamed on issues with test-retest reliability which requires further consideration.

The occupational stress-related Stroop task requires further piloting in conjunction with established measurement methods such as self-report or physiological indicators in organisational risk assessment to determine its potential as a reliable stress measurement tool across occupational settings.

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Chapter One: Literature Review

Overview

Section One of this chapter examines prevailing definitions and conceptualisations of stress and reviews the psychological, physiological, behavioural and organisational outcomes proposed by a significant body of stress research. Occupational stress is defined and influential models of occupational stress are introduced and evaluated. Traditional methods for measuring occupational stress are outlined and critiqued defining the need for further consideration of measurement methods and tools.

Section Two of this chapter reviews the considerable body of research on the effects of anxiety on cognitive performance. Anxiety is defined and cognitive theories of anxiety (and emotion), which have emphasised the importance of attentional biases in the development and maintenance of anxiety disorders, are examined. These theories also provide explanations for cognitive vulnerability in anxious or stressed individuals and cognitive biases in performance including attentional bias towards self-evaluated threats. The emotional Stroop paradigm, which has been frequently used to elicit and measure attentional bias in emotional disorders, is reviewed together with consideration of the possible mechanisms underlying the observed bias effects. Emotional Stroop research is examined together with the possible causes and correlates of differing patterns of emotional Stroop interference.

Finally, a rationale is advanced for the employment of an occupational stress-related Stroop task to elicit and measure attentional bias as a supplementary, objective indicator of occupational stress across occupational groups.

1.1 Occupational Stress

Many theorists have offered definitions of what stress is, what causes it, and why some people feel 'stressed' by a situation whilst others do not (e.g. Cox, 1993; Lazarus and Folkman 1984; McEwen, 2000; McGrath, 1970; Selye, 1950, 1976). The conclusion from the majority of these definitions is that stress is generally considered to exert a negative influence on those who experience it and there is a general belief that repeated or prolonged stress may have detrimental consequences in terms of the individual's physical and psychological well-being. In particular, occupational stress has become a priority issue in all employment sectors and also within various government agencies particularly in Europe and the USA This concern has been reflected in extensive media and public interest and resulted in the continuing attention of professional and scientific associations as well as trade unions. However, whilst data on working days lost, absences, work- related illness, staff turnover, and retirements are commonly collected by the internal agencies of many countries, the reliability and validity of data collection methods used by these agencies has been questioned and calls made for more rigorous data collection procedures (Cox et al., 2000). Despite problems with assessing the existence and size of the problem, there is still cause for concern over the reported detrimental effects on the psychological and physical well-being of occupationally stressed individuals which provides some justification for additional measurement techniques that could be used in conjunction with existing methods.

The following sections consider the prevailing theoretical definitions of stress, and outline the physiological stress response before identifying reported physiological, psychological and behavioural outcomes to the individual as well as adverse organisational consequences. Several dominant theories of occupational stress are reviewed and the concept of psychosocial work hazards is introduced. Finally, measurement of stress and popular methods and instruments used in this process are outlined and evaluated.

1.1.1 Theoretical Approaches to Defining Stress

Many researchers have offered numerous theoretical frameworks to explain the sources, processes and consequences of stress and to thereby arrive at a working definition. Three main approaches conceptualising stress have emerged from various reviews of the stress literature namely; physiological, epidemiological and psychological (Cooper et al., 2001; Cox and McKay, 1981; Cox et al., 2000; Ganster and Perrewé, 2011). These approaches are also applicable to occupational stress and whilst they might propose differing definitions of stress they have interrelated elements.

1.1.1.1 Physiological Approach

The physiological approach focuses on occupational stress as an individual's *response* to environmental variables and treats stress as a dependent variable in the stress process (Cox, et al., 2000).

Selye (1979:1) posited an early, influential physiological approach which defined stress as, "…the non-specific response of the body to any demand" and claimed that if this response is repeated, intense or prolonged, it contributes to diseases of adaptation Selye (1976). Selye (1950, 1976) observed that living organisms respond in a general way to a range of different agents such as trauma, infections, nervous strain, excess heat or cold. Reactions to these agents are diverse but all of them put the body into a state of stress.

Selye (1950: 4667) further described this response as a syndrome with interrelated adaptive reactions termed "the General Adaptive Syndrome (G.A.S.)" which develops over three stages when a stressor is encountered and aims to maintain homeostasis of the individual's physiological processes. In the first or alarm stage the body reacts with the 'fight or flight 'response (Cannon, 1915), where the neuroendocrine system releases adrenalin and cortisol, and the sympathetic nervous system (SNS) is activated. The second or resistance stage is where the parasympathetic nervous system (PNS) tries to restore normality to many physiological functions. Heart rate, blood pressure and respiration rate are increased. Blood glucose, cortisol and adrenalin are still high but the individual appears normal despite still fighting the stressor. Finally, in the exhaustion stage, if the stressor continues and overtakes the individual's capacity to resist, resources are exhausted and s/he can become susceptible to disease and even death (Selye, 1950).

Selye's (1950) physiological account of the stress response characterises it as a negative, aversive state of 'distress'. However, he acknowledged that stress can also have an adaptive effect by assisting the body's resistance to threatening situations. Selye (1976) termed this adaptive response, 'eustress'. Eustress or positive stress have been largely overlooked in the stress literature (Le Fevre et al., 2003) but where it has been considered, research generally concludes that eustress is, "the positive, healthy response that leads to motivation and challenge." (Hargrove et al., 2011: 184). Moreover, Dhabar et al. (2011) characterised eustress as a response to short-term stress that can prepare or even strengthen the immune system for the physiological changes of an acute stress response.

Le Fevre et al. (2006) concur with Selye's (1976) original proposition that whether stress is distinguished as distress or eustress is dependent upon, not only the intensity and duration of the stressor but also its source, the amount of control an individual feels they have over it, and its perceived desirability. This positions the individual’s appraisal of a given situation as fundamental to determining whether the response is characteristic of ‘distress’ or ‘eustress’.

Selye’s (1950) conceptualisation of a stress as a general response was questioned by subsequent research providing evidence of a variety of physiological responses which differed according to different situations and contexts that people experienced (Goldstein and Eisenhofer, 2000). Furthermore, the homeostasis model where the body strives to maintain equilibrium of internal processes (e.g. concentration of carbon dioxide in the blood) and which underpins Selye’s theory, has been challenged more recently by the Allostastic Load (AL) model in terms of effectively explaining the stress response (Ganster and Rosen, 2013; Juster et al., 2010; McEwen, 1998; McEwen, 2000; McEwen and Wingfield, 2003; Sterling and Eyer, 1988).

The AL model proposes that efficient regulation of internal processes is not simply about maintaining equilibrium but rather that it, “…requires anticipating needs and preparing to satisfy them before they arise.” and suggests that individuals, achieve physiological stability through change. (Sterling, 2012: 106). The AL model situates the central nervous system as the mediator of physiological adjustment to environmental stressors (Sterling and Eyer, 1988; Sterling, 2004) and proposes that this will be the first area to show signs of chronic stress (McEwan and Seeman, 1999).

The term allostasis refers to changes in the internal systems (e.g. cardiovascular, neuroendocrine) involved in coping with threats to homeostasis (Ganster and Rosen, 2013). Allostatic systems work around set points which can be reset (adapted) after they have overrun their normal limits due to repeated exposure to excessive demands. Unlike Selye's (1950, 1955) model, the central nervous system and specifically the brain, are instrumental in determining the need for adaptation as it is said to evaluate past experiences and knowledge of environmental conditions thus introducing the importance of cognitive appraisal to the physiological stress process (Ganster and Rosen, 2013).

Researchers have long recognized the usefulness of incorporating a physiological approach into research on occupational stress (Caplan and Jones, 1975; Ganster et al., 1982) and this can be seen in more recent research, which has used the AL model to explain stress as a response to environmental challenges (Ganster, 2005; Zellars et al., 2009; Ganster and Rosen, 2013). Over recent years, Selye's (1955) model has waned in popularity and the AL model has become the dominant physiological approach in stress research (Juster et al., 2010; Lupien et al., 2006).

1.1.1.2 Epidemiological Approach

The epidemiological or *stimulus based* approach views stress as the independent variable in what is termed the stressor-strain process. Stressors are defined as characteristics of the (work) environment that trigger physical or psychological strain, and strains refers to responses to these stressors (Beehr, 1995; Griffin and

Clarke, 2011; Hurrell et al., 1998; Rubin et al., 1993). This description of stress is analogous to concepts in engineering and physics (e.g. Hooke's Law, 1658) where stress or tension is placed on an inanimate object by an external force and when it reaches a certain threshold a strain reaction is triggered which could be irrevocable and harmful (Cox and Mackay, 1981; Sutherland and Cooper, 2000). According to this approach, individual differences in reaching a stress threshold can account for variances in resistance and vulnerability to stress.

The epidemiological approach has been fairly dominant in occupational stress research where stress is defined as, "…an aversive or noxious characteristic of the work environment…" (Cox et al., 2000: 10). Research using this approach has mainly focussed on identifying psychosocial sources of occupational stress or *stressors* (e.g. excessive workload, deadlines, lack of consultation and management styles) that give rise to outcomes (strains) such as reduced job satisfaction, staff absences, high staff turnover and burnout (e.g. Cooper et al., 2001; Spector and Jex, 1998).

Epidemiological and biological explanations of the stress process whilst useful in conceptualising stress fail to consider individual differences that occur in the perception and activation of the stress response and thus ignore contextual and cognitive mediators of stress. Both these approaches have been criticised for viewing the individual as a passive entity in the stress process and for not recognising the interaction between individuals and their environments (Cox, 1990; Sutherland and Cooper, 1990). Furthermore, the epidemiological approach's insistence that stressors trigger strain does not allow for a reciprocal relationship between stressors and strain where an individual's level of strain may actually make them more vulnerable to stressors (Cooper et al., 2001).

1.1.1.3 The Psychological Approach

The psychological approach recognises the importance of environmental factors and the individual's dynamic interaction with the environment. Stress can be viewed as an intervening variable involving environmental stressors, the response to these stressors and either the *interaction* or *transaction* between an individual and his/her environment.

There has been a growing consensus in the stress literature towards the psychological approach to defining stress in general and work stress in particular (Cox et al., 2000). Psychological approaches to work stress are in line with the World Health Organisation's (WHO, 2016) current definition, "…the response people may have when presented with work demands and pressures that are not matched to their knowledge and abilities and which challenge their ability to cope." (Leka et al., 2003: 3).

The psychological approach includes interactional (structural) and transactional (process) models of stress. Interactional models, for example, Person-Environment (P-E) Fit theory (e.g. French et al., 1974, 1982), focus on the structural features of the individual's interaction with their environment, including whether the person's characteristics (e.g. beliefs and capabilities) meet environmental demands (e.g. work-role demands). A mismatch between the two can result in stress (French et al., 1974, 1982).

Transactional models concentrate more on the psychological processes occurring during the interaction between the person and the environment, particularly cognitive appraisal and coping ability (e.g. Lazarus and Folkman, 1984, Lazarus, 1991). Cognitive processes are predominant in the transactional approach to stress where the individual's cognitive appraisal decides the level of demand, the response to the demand and the adequacy of their coping resources to deal with the demand (Lazarus and Folkman, 1984).

Despite the varying conceptualisations of stress there is a growing cohesion and consistency within stress research in favour of the psychological approach to stress, which perceives stress as a negative psychological state involving cognitive and emotional elements and which also encompasses psychosocial and organisational contexts. (Cox et al., 2000). To this end, Levi and Levi (2000) in research contracted by the European Commission offer a definition of work stress that encompasses the psychological approach to stress:

"A pattern of emotional, cognitive, behavioural and physiological reactions to adverse and noxious aspects of work content, work organisation and work environment . . .characterised by high levels of arousal and distress and often by feelings of not coping. Stress is caused by poor match between us and our work, by conflicts between our roles at work and outside it, and by not having a reasonable degree of control over our own work and our own life." (Levi and Levi, 2000: 4-5)

1.1.2 Occupational Stress as a Health and Safety Issue

The Health and Safety Executive (HSE) as the body responsible for operational and procedural issues related to health and safety at work in the UK, reported that occupational stress, anxiety and depression are the second most frequently reported work-related health problem with 488,000 people (a prevalence rate of 1510 per 100,000 workers) affected by work-related stress, anxiety or depression in the period 2015-16 (HSE, 2016). Work relate stress, anxiety and depression also accounted for approximately 11.7 million days and 45% of all working days lost to ill health in 2015-16. Furthermore, stress, anxiety and depression accounted for 37% of all work-related cases of ill health making this a leading cause of absence from work due to ill-health (HSE, 2016). Stress was more prevalent in public service jobs (e.g. health and social care, education, public administration) and the main workplace factors cited as causing stress, anxiety and depression were tight deadlines, lack of support from management and having too much responsibility (HSE, 2016).

Similarly, the Samaritans (2015) found that 46.6% of people surveyed in the UK reported that work was the thing that ‘bothered them the most in the last 12 months’, with only relationships (48.6%) and major life events such as the death of a loved one, separation or a starting a new job having a greater effect (50.8%). This survey data is not telling us anything new as occupational stress has been a continuing concern for many years. For example, the Trades Union Congress (TUC, 1998) following a nation-wide survey conducted by company health and safety representatives stated that 77% of respondents perceived stress to be the main workplace hazard. Heavy workload and reduced staff levels were cited as the major causes of stress followed by management techniques and long hours.

With respect to workers unions attitudes to work-related stress, the latest biennial survey of Trades Unions Congress (TUC: 2016) Health and Safety representatives in the UK reported that stress was the most frequently cited workplace hazard with 70% of TUC reps identifying stress in the top five reported hazards (an increase since the last survey in 2014) – the others being bullying/harassment, overwork, back strains and long working hours. As with the HSE (2016) data, stress as a workplace hazard was reported as being of more concern in the public sector rather than the private sector. For example, in central government 93% of respondents cited it as a top-five concern, 89% in the educational sector and in 82% in health services.

Statistics reporting on occupational stress have generally been at around the same incidence and prevalence rates for the last ten years (HSE, 2016) so although the popularity of occupational stress research has waned a little following the massive interest during the 1990's and early 2000's, occupational stress has not gone away and still requires attention.

Consequently, there is a continuing need to identify the sources of occupational stress and understand the mechanisms involved in order to reduce its impact on employees. However, major methodological problems exist, including that of clearly defining occupational stress and differentiating it from stress arising from other sources.

Research has been unable to completely distinguish between the detrimental effects of variables occurring in the work environment as opposed to non-work environments and although some stressors can be categorised as work-based there is often an interaction between the two. The main stressor may arise outside work, for example, relationship problems with a spouse but may be aggravated by work. Equally, a stressor in the work environment, for example a heavy workload, may be the primary cause of stress but may spill over and influence home life.

Following the epidemiological and psychological definitions of stress and the proposed stressor-strain relationship, occupational stressors are viewed as characteristics of work that workers perceive as threatening for example, certain tasks and role requirements, interpersonal conflict, and some management actions, whereas strains are negative responses that result when such demands exceed the individuals' perceived coping resources (Koslowsky, 1998). The following section outlines work hazards with a particular focus on psychosocial stressors given that they been the dominant consideration in occupational stress literature.

1.1.3 Work Hazards

Work hazards can be identified as either physical; stemming from the physical work environment, or psychosocial; stemming from other characteristics of the work environment (Cox et al., 2000).

1.1.3.1 Physical Hazards

Several physical hazards have been investigated in terms of their effects on health and psychological well-being (Neale et al.,1983; Gobel et al., 1998). Physical work hazards include safety hazards (e.g. slips, trips faulty equipment); biological hazards (e.g. communicable diseases, insects/pests), chemical hazards including exposure to carcinogens (e.g. asbestos, pesticides); ergonomic hazards (e.g. repetitive tasks, incorrectly adjusted chairs and workstations); and physical hazards (e.g. noise and temperature).

Exposure to physical hazards in the workplace can have adverse effects on the body which can range from asymptomatic biochemical and physiological changes, to pathological diseases and ultimately death (Concha-Barrientos et al., 2004). There are acknowledged difficulties in collating reliable illness and mortality data for physical work hazards (Driscoll et al., 2005). However, Driscoll et al. (2005) concluded from published estimates of global burden of injury and disease due to physical occupational factors that there were approximately 2 million work-related deaths per year, with disease being the primary cause of these deaths. Research has also investigated the health effects of specific physical hazards for example, chronic exposure to asbestos in the workplace, which has been implicated in the development of cancer and pneumoconiosis whilst repetitive heavy lifting or continuous vibration can lead to lower back pain (Concha-Barrientos et al., 2004).

Whilst it is acknowledged that physical hazards appear to be a significant factor in the development of negative health outcomes in the workplace and might even combine with psychosocial hazards, further discussion of physical hazards are beyond the scope of this research where the focus is primarily on psychosocial characteristics of the workplace.

1.1.3.2 Psychosocial Hazards

Since the 1950's researchers have become increasingly interested in psychological features of the work environment as stressors (Sauter and Hurrell, 1999; Cox et al., 2000). During that time, the focus has shifted from the individual perspective, to effects on health arising from the interaction of the individual's thoughts and behaviours with aspects of the work environment which became known as psychosocial hazards (Cox et al., 2000).

Psychosocial hazards have been defined as, "…those aspects of the design and management of work, and its social and organisational contexts that have the potential for causing psychological or physical harm." (Leka and Cox, 2008: 1).

Many different psychosocial work stressors have been proposed by occupational stress research and various ways of categorising these for occupational risk assessment have been put forward. Some theorists categorise them as stressors associated with the demands of the job or available job resources (Bakker and Demerouti, 2007; Demerouti et al., 2001a). Demerouti et al. (2001a) conceptualise job demands as physical, social or organisational elements of work that can have adverse psychological and physical outcomes (e.g. work load, time pressure, physical environment). Job resources are described as physical, psychological, social or organisational elements of work that can act as protective factors (e.g. supervisor support, reward, job security) to buffer the effects of job demands by increasing coping ability (Demerouti et al., 2001a).

Other researchers have categorised psychosocial hazards as elements of either the job context or job content (e.g. Cox et al., 2000). There appears to be a general consensus from a wide range of occupational research in terms of the types of work characteristics thought to be potential psychosocial hazards (e.g. Cooper and Marshall, 1976; Cox, 1978, 1985b; Cox and Cox, 1993; Frankenhauser and Gardell, 1976; Karasek and Theorell, 1990; Kasl, 1992; Warr, 1987). Cox et al. (2001: 68) proposed a taxonomy of these psychosocial hazards in terms of whether they originate from job content or job context. Psychosocial hazards related to *job content* are as follows:

i) Work Schedule including factors such as, inflexible, unpredictable, unsociable or long working hours and shift work.

ii) Workload/Pace of Work comprising elements such as, excessive time pressure, work overload/underload, and lack of control over work pace.

iii) Work Environment and equipment relating to aspects such as, reliability, availability, suitability and adequate repair/maintenance of work equipment and amenities.

iv) Task Design including mundane, repetitive work cycles, insufficient use of job competencies, and disjointed, pointless work.

Psychosocial hazards as components of the *job context* have been classified as follows (Cox et al., 2001: 68):

i) Work Role which includes role conflict and role ambiguity and having responsibility for others.

ii) Organisational Culture relates to lack of support and encouragement for personal development or in solving problems; unclear organisational aims; and poor communication.

iii) Decision Latitude including, lack of autonomy at work and little or no consultation over decision-making

iv) Career Level relating to under or overpromotion, low pay, job insecurity, lack of career mobility

v) Interpersonal Relationships comprising factors such as, lack of social support, interpersonal conflict, isolation (physical or social), relationships with management

vi) Home-Work Boundary which includes, lack of support at home, difficulties managing dual careers with a partner, and differing demands from work and home.

In terms of psychosocial hazards there is no conclusive evidence of a direct pathway between workplace stressors and ill health. Rather the association is believed to be indirect and mediated by other factors such as lifestyle (obesity, smoking, drinking to excess); coping, social support and various personality dimensions (Cox et al., 2000).

Models of occupational stress also include discussion of psychosocial factors that might be associated with reported stress levels and adverse effects on health and well-being and these are outlined in the following section.

1.1.4 Models of Occupation Stress

Research has been unable to completely distinguish between the detrimental effects of variables occurring in the work environment as opposed to non-work environments and although some stressors can be categorised as work-based, there is often an interaction between the two. As previously mentioned, the main stressor may arise outside work but may be aggravated by work. Equally, a stressor in the work environment may be the primary cause of stress but may spill over and negatively impact on home life. Despite these limitations, various models underpinned by the definitions of stress formerly outlined have been produced to explain the process of occupational stress. Psychological models (interactional and transactional) that have tended to dominate the occupational stress research literature are outlined and discussed in the following sub-sections.

1.1.3.2 The Person-Environment Fit Model

The Person-Environment (P-E) Fit model (Caplan, 1983, 1987a, 1987b; Caplan and Harrison, 1993; French and Caplan, 1972; French et al., 1982) is based primarily on the interactional definition of stress and concentrates on the interaction between the person's (worker's) characteristics (e.g. abilities) with those of the (work) environment (e.g. job demands) suggesting that occupational stress results when there is an incongruous fit between the person and the work environment. Consequently, this may contribute to adverse psychological, physiological and behavioural outcomes (French et al., 1982).

Edwards et al. (1998) explain that the P-E Fit theory is further distinguished by a distinction between objective and subjective descriptions of the person and the environment. Objective descriptions of the person are their actual, existing characteristics and abilities whereas subjective descriptions relate to the person’s perception of their characteristics and abilities (self-identity). In the same way, the objective environment relates to real events and situations whereas the subjective environment relates to the person’s perception and interpretation of situations and events (Edwards et al., 1998). These distinctions provide four person-environment constructs namely: objective P-E fit (the fit between objective person and the objective environment); subjective P-E fit (the fit between subjective person and the subjective environment); contact with reality (the level of correspondence between the subjective and objective environment); accuracy of self-assessment (level of correspondence between the objective and subjective person). More recent conceptualisations of the P-E fit propose that the subjective elements of the theory are central to positive mental health and general well-being (Edwards et al., 1998) and that a combination of the subjective person and environment equals perceived (subjective) P-E fit.

This association between perceived P-E fit and the subjective person-environment can be better appreciated by considering three P-E fit research approaches namely, *atomistic, molecular* and *molar*. Research employing the atomistic approach measures the subjective person and environment separately and relates them to each other in some way to represent P-E fit (Cable and Judge, 1996; French et al., 1992). The molecular approach measures the perceived difference between the person and the environment highlighting short falls between for example, the person's needs and environmental rewards (Cable and DeRue, 2002). Finally, the molar research approach directly assesses the perceived similarity or match between the person and the environment for example, studies that examine the match between the person and the organisation they work for (Cable and DeRue, 2002).

Following on from this, Edwards et al. (2006) detail three dominant themes used in research to examine the fit between the person and the environment, (i) *needs-supplies* which examines comparisons between the person's psychological needs (e.g. ambitions, values) and environmental supplies (e.g. pay, promotion) (ii) *demands-abilities* which is used to compare the demands of the environment (e.g. workload, role expectations) to the person's abilities (e.g. competencies, knowledge) (iii) *supplementary fit* refers to comparison of similarities between the person and the environment on a given dimension. In this instance environment relates to other people, organisations or professions for example, looking at similarities between the values of person and the values of the organisation that employs them.

Both the needs-supplies and demands-abilities components of the P-E Fit model require comparisons of “commensurate dimensions” (Edwards et al., 1998: 6) for example, needs-supplies fit regarding promotion requires that the person’s need for promotion is compared with opportunities for promotion in the work environment.

In addition to the elements of PE-fit already outlined, Su et al. (2015) identified several different types of fit namely, the fit between the person and the job (P-J fit); the fit between the person and their organisation (P-O fit); the fit between the person and their work group (P-G); the fit between the person and their supervisor (P-S fit) and finally the fit across organisations and vocations (P-V fit).

Research strategies for measuring P-E fit have varied immensely in terms of what is measured. Some studies have directly asked participants to estimate their perceived fit with the subjective environment; whilst others have indirectly asked for comparisons (using separate measures) of their perceived fit with the objective environment. Some studies have looked at the individual types of fit (e.g. Kristof-Brown et al., 2005; Lauver and Kristof-Brown, 2001; Verquer et al., 2003) and found associations between specific type of fit such as person-organisation fit and work attitudes, organisational commitment and job satisfaction. Other studies have found associations between P-Fit overall and various work attitudes including job satisfaction and employee unhappiness (e.g. Cennamo and Gardner, 2008; Spokane et al., 2000; Tinsley, 2000).

Many studies of P-E fit have used measures adapted from established scales assessing different facets of work to account for the elements of the person and the environment in order to assess degree of fit (e.g. Edwards and Rothbard, 1999 and French et al., 1982; Yang et al., 2008). More recently, measures of P-E fit have been constructed including, the Perceived Fit Scale (Cable and DeRue, 2002), the General Environment Fit Scale (Beasley, 2012) and the Perceived Person-Environment Fit Scale (PPEFS; Chuang et al., 2016), which all claim to have good psychometric properties. In terms of measuring specific types of fit such as person-organisation, it appears that most studies have used individual items designed or adapted from established scales specifically for this purpose (e.g. Cable and Judge, 1996; Lauver and Kristoff-Brown, 2001).

The main criticisms of the P-E Fit theory are that the concepts of 'demand' and 'fit' are inadequately defined and that the theory assumes a lack of fit always causes distress thus disregarding eustress as an outcome (Edwards and Cooper, 1990; Le Fevre et al., 2003). There are also issues surrounding the measurement of P-E fit because of the various types of fit and different ways of measuring it.

1.1.3.3 The Job Demand-Control Model

The central focus of the Job Demand-Control (JDC) model (Karasek, 1979, 1997; Karasek and Theorell, 1990) is the interaction between job strain (stress) and job control (decision latitude). The JDC model (Figure 1) makes two testable predictions firstly, that psychological strain and physical illness are likely to occur when job demands are high and decision latitude (control) is low (Karasek, 1979) with the risk of strain being further increased if social support is lacking (Job Demand-Control-Support model, JDC-S: Johnson and Hall, 1988). Secondly, it predicts that when job demands and job control levels are both high, active behaviours such as motivation, learning and coping are more likely to develop, introducing the notion of positive stress. Conversely, when job demands and control levels are both low this is more likely to lead to poor motivation, negative learning and a gradual loss of previously acquired job skills (Karasek, 1979, 1997; Karasek and Theorell, 1990).

Research findings offer some support to the JDC model in predicting adverse health outcomes for example, Oeij et al. (2006) found that high demand- low control jobs as compared to the other JDC type jobs, were related to greater incidence of stress-related illness, musculoskeletal disorders and lowest satisfaction with working conditions. Kivimaki et al. (2012) found an association between job strain as explained by the JDC/JDC-S model and cardiovascular disease, whilst a meta-analysis by Hausser et al. (2010) found some support for the additive effects of the JDC/JDC-S on psychological well-being in cross-sectional research which was lower for longitudinal research.

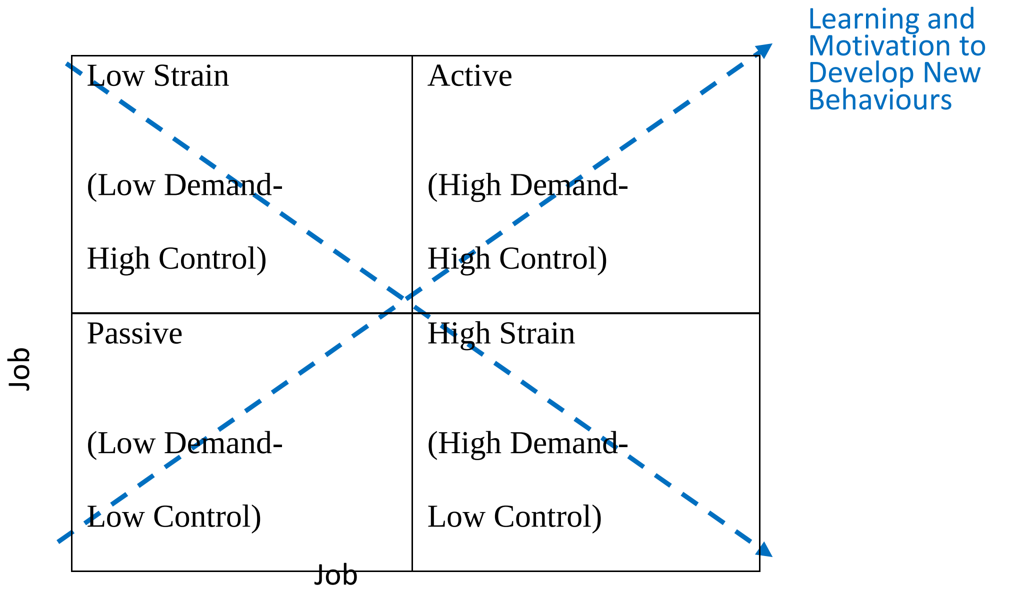

Figure 1.1. Karasek's (1979) Job Demand-Control Model

The need to measure the components of the JDC model gave rise to the Job Content Questionnaire (JCQ; Karasek et al., 1998) which has been translated into several languages and widely used in occupational stress research (e.g. Kawakami and Haratani, 1999; Landsbergis, 1988; Mark and Smith, 2012; Noblet, 2003; Van Vegchel, De Jonge and Landsbergis, 2005). Given that the JCQ has been used extensively in occupational stress research it is content analysed as part of the methodology to obtain appropriate occupational stress-related words for the emotional Stroop task used in this doctoral research and is described in detail in Study One.

Support for Karasek's (1998) Demand-Control model has been mixed with suggestions that there are issues conceptualising and operationalising the two central constructs of job demands and job control (Cox and Griffiths, 2010; Sauter and Hurrell, 1989) and that whilst the two constructs might be useful independently, interaction of the two is not consistently reliable in terms of predicting physical or psychological strain (Cox and Griffiths, 2010; Hausser et al., 2010). Perrewe and Zellars (1999) further argued that the JDC/JDC-S models do not explain the effect of individual differences in susceptibility to stress in so much as, individuals with the same amount of demand and control do not all experience adverse health or behaviour outcomes. This can probably be explained by differentiating between the existence of a stressor and the individual's perception of whether or not the stressor is demanding.

Despite research findings often being weak or inconclusive the JDC/JDC-S model has heavily influenced occupational stress research and policy (Cox and Griffiths, 2010) and a later adaptation of the JDC model, the Job Demand-Resources model (JD-R; Bakker and Demerouti, 2007; Demerouti et al., 2001) is still widely used. The JD-R model follows the same basic premise as the original but the central focus is on job demands and job resources rather than job control. Job demands in the JD-R model are characteristics of work that demand prolonged physical and mental exertion (e.g. heavy workload, time pressure) which it is proposed can lead to adverse physical and psychological outcomes. Job resources refers to characteristics of work (organisational and social) that either; reduce job demands; provide opportunity for personal development; or are functional in terms of meeting work objectives for example, consultation on decision-making, autonomy and managerial support (organisational) and support from colleagues, supervisors and family (social) (Demerouti et al., 2001).

The JD-R model also offers an explanation for occupational burnout (Maslach 1981; Maslach et al., 1996) as a result of the interaction between job demands and job resources where the first stage is excessive, prolonged job demands leading to exhaustion. The second stage is where there is a lack of resources preventing achievement of work objectives, disengagement occurs. Consequently, high job demands lead to exhaustion but not disengagement; low job resources lead to disengagement but not exhaustion. When high demands and low resources occur together this interaction can result in both exhaustion and disengagement which Demerouti et al. (2001a) claim are components of burnout as it applies to occupation types beyond the human services.

Burnout has generally been hypothesised to be a potential adverse outcome of prolonged strain in human service workers (e.g. hospital staff, police, teachers) which is characterised by, "…emotional exhaustion, depersonalisation and reduced sense of personal accomplishment." (Leiter and Maslach, 1988: 297). Demerouti et al. (2001b) proposed that the JD-R model could explain how slightly different manifestations of burnout (exhaustion, disengagement and non-achievement of work objectives) could be found in other occupational areas.

Demerouti et al. (2001a) investigated this claim and found support for the JD-R model in that job demands were positively associated with exhaustion and job resources were negatively associated with disengagement for both human service and other occupations thereby suggesting a more general application of the burnout concept which was similarly found in other research (Bakker et al., 2005; Xanthopoulou et al., 2007).

1.1.3.4 Transactional Model of Stress

Lazarus (1991) and Lazarus and Folkman, (1984) initially posited a theory of occupational stress, which focuses on the transaction between an individual and his/her work environment. The theory distinguishes between work stressors and how a person cognitively appraises or perceives them as threatening whilst taking into account their resources for example, coping strategies that may or may not exist. The transactional approach centres on the individual's perception of occupational stress but also considers individual differences that might mediate the stress process such as personality or coping skills.

Lazarus (1991) and Lazarus and Folkman (1984) proposed three phases in the stress process. In the first phase, *primary appraisal* is used by the individual to decide whether an experienced situation is potentially threatening that is, if there is "anything at stake" (Lazarus, 1999: 76) in terms of having personal meaning. Lazarus (1999) proposes three types of primary appraisals: i) harm/loss If it is considered threatening *secondary appraisal* determines the adequacy of the person's response attributes which are available to deal with the demands. In the third *challenge* or *coping* phase the individual's perceived coping strategies and resources are challenged to meet the demands of the stressor.

It has been suggested that stress awareness may occur at different levels during the appraisal process (Cox and McKay, 1981). Initially there may be an increasing awareness of the presence of stress symptoms such as insomnia or forgetfulness. At the second level, there may be a vague acknowledgement that the problem exists before the third level of awareness is reached where the problem is identified and its significance appreciated. Finally, the individual becomes so aware of the problem that it is analysed fully and its consequences evaluated. “Stress occurs when there are demands on a person which tax or exceed his adjustive resources” (Lazarus, 1976: 47).

The original transactional model of stress proposed by Lazarus and Folkman (1984) and Lazarus (1991) was extended by Cox et al. (2003) and Leka et al. (2003) with some important developments. Firstly, there is an increased focus on the individual’s subjective perception in determining whether events and situations are stressful, with an emphasis on dismissing objective data. Secondly, there is re-consideration of the individual’s appraisal of their own ability to meet demands and their awareness of the changing nature of their ability due to naturally occurring factors such as fatigue, age, or illness. Emphasising the dynamic aspect of the individual’s ability to meet demands, permits associations to be made with organisational factors such as training and support as well as introducing related elements for example, resilience and emotional intelligence. Thirdly, there is a recognition that insufficient demand due to boring, repetitive work can be as harmful as excessive demand in terms of triggering stress, which not all models of stress acknowledge. Finally, although this factor has been considered in stress research previously, there is a renewed emphasis on the impact of internal demands stemming from the tension between the individual's needs and the requirements for job demands to be important to him/her. All of these developments to Lazarus and Folkman's (1984) transactional approach have allowed this extended model to develop a risk management approach to occupational stress which follows traditional health and safety frameworks and to form a taxonomy of psychosocial hazards that can be utilised to deliver effective interventions (Cox et al., 2000).

Brief and George (1991) criticised Lazarus and Folkman's (1984) theory for focussing on individual differences rather than identifying 'stressors' that may adversely affect whole groups of workers irrespective of individual differences. However, the main limitation of the transactional model is that it is difficult to measure the transaction process between the different components and ultimate attempts to do so, have usually resulted in measurement of the respective aspects (stressors, strains and individual abilities e.g. coping) as static elements with one-dimensional effects (Cox and Griffiths, 2010).

1.1.3.5 The Effort-Reward Imbalance Model

Siegrist's (1996, 2002) Effort-Reward Imbalance (ERI) model follows the transactional approach which suggests that stress occurs when there is a lack of reciprocity or mutual interchange between the amount of perceived effort a worker expends on the job and the perceived rewards they receive. Effort relates to job demands or work responsibilities whereas rewards include, pay, job security, development opportunities, and promotion.

When a large amount of effort is required to meet extrinsic work pressures and the reward is insufficient (e.g. pay or work status) or there is little likelihood of reward that is, promotion or a pay increase, this represents a reciprocity deficit (costs vs. benefits) which in turn may lead to work strain. The ERI model has its origins in distributive justice with the belief that effort expended at work and rewards for this work are part of the psychological contract based on social reciprocity between the individual and the organisation. When deficits in reciprocity are repeated or severe this can damage the psychological contract and foster a sense of injustice and unfairness in the individual possibly also lowering self-esteem (Siegrist, 1996, 1999).

Siegrist (1999) extended the original ERI model to include the effect of a personality factor, 'over commitment' in that individuals prone to over commitment to their jobs are hypothesised to have more intense strain responses to imbalances between effort and reward than those with low work commitment (Siegrist, 1999, 2002).

The ERI model has been the subject of several research reviews (Kivimaki et al., 2006; Schnall et al., 2000; Stansfeld and Candy, 2006; Tsutsumi and Kawakami, 2004; van Vegchel et al., 2005) and conclusions so far indicate that the ERI model can explain a considerable amount of variance in adverse health effects.

The ERI model has been criticised for displaying a tendency to over emphasise the interaction between effort (e.g. job demands) and the workers' skills or attributes rather than paying adequate attention to the way that specific job pressures influence emotional health and productivity (Vagg and Spielberger, 1998).

The models of occupational stress outlined have all influenced occupational stress research and some have directly given rise to self-report instruments used to assess occupational stress. The transactional approach to occupational stress emphasises the individual's cognitive appraisal of situations and events (work-related stressors) in determining whether adverse outcomes are experiences. This approach is the most relevant to the theories and proposed mechanisms underpinning attentional biases in cognitive processing in emotional states and disorders that will be outlined in Section 2 of this chapter.

1.2 Stress and Health

It is commonly assumed that when stress is repeated, prolonged or intense it can lead to physiological, emotional, cognitive and behavioural changes in the individual experiencing it (Cohen et al 1995; Ganster and Rosen, 2013; Sauter and Murphy, 1995). There is also a suggestion that this assumption should be questioned and that the negative health effects of stress might be simply a, “cultural truism” (Levanthal and Tomarken, 1987: 27).

Changes in the individual triggered by stress may be transient, reversible and satisfactorily dealt with by the psychophysiological systems in the body and therefore may not necessarily cause any long-term discomfort or adverse effects (Cox et al., 2000). Nevertheless, it is likely that the unpleasant emotional elements of the stress experience detract from the individual’s well-being and overall quality of life which, for some individuals under certain conditions could then result in poor physical ill health, psychological and social problems as well as negative attitudes at work (e.g. low job satisfaction, lack of motivation) and poor work performance. Furthermore, pre-existing health conditions are thought to be a source of stress which might make the individual more vulnerable to other environmental stressors by reducing his/her coping resources. Taking these situations into consideration there is some justification for the common assumption that stress and ill health are associated (Cox et al., 2000).

The following sections outline the physiological response to stress and provide an overview of the evidence for adverse physiological, psychological and behavioural outcomes for individuals as well as considering the potential costs to organisations.

1.2.1 The Stress Response

Research attempting to outline and explain the stress response started with the work of theorists such as Cannon (1929, 1932) and Selye (1936, 1950). Cannon (1932) and Selye (1950, 1956, 1976) proposed that stressful situations trigger inherent physiological responses, which are characterised by rapid arousal initiated by the hypothalamic-pituitary-adrenocortical (HPA) axis and the sympathetic-adrenomedullary (SAM) systems. As previously detailed, Selye (1956) also suggested that repeated or prolonged activation of these responses promotes the *'diseases of adaptation'* due to increased trauma to the body. Other research has supported the potential relationship between the physiological response to stress and health outcomes (Frankenhauser, 1991; Schneiderman et al., 2005).

The physiological response to stress begins with activation of the hypothalamus when imminent threat is perceived via cognitive appraisal. This in turn, activates the HPA system leading to the release of corticotrophin-releasing factor (CRF) into the nervous system and release of various hormones including growth hormone, prolactin, and adrenocorticotrophin hormone (ACTH). ACTH stimulates the secretion of corticosteroids (including cortisol) which assist in returning the body systems to normal after stress. Cortisol activity affects many organs of the body and in this stage of the stress response suspends digestion, increasing blood sugar and the heart pumps more blood to the muscles, mobilising energy. Enzymes such as enkephalin and beta-endorphins are also released (Cohen, 1995).

With initial activation of the hypothalamus, the SAM system is simultaneously activated along with the HPA system. Activation of the SAM system stimulates the adrenal medulla and brings about the secretion of adrenaline and noradrenaline leading to the fight-or-flight response (Cannon, 1932). Breathlessness, dry mouth, excessive perspiration, increased pulse rate, raised blood pressure, as well as feelings of intense arousal are typical, physical reactions to the acute activation of this response (Schneiderman et al., 2005).

If stress continues after the initial fight-or-flight reaction, physiological responses enter a second stage (Rubin et al., 1993; Selye, 1936, 1976) in which SAM activity decreases, less adrenaline is released but corticosteroids are still secreted at higher than normal levels. In addition to the mobilisation of resources for energy, the immune system is also activated so that immune cells (e.g. killer cells and macrophages) move from the spleen and lymphatic system and enter the bloodstream at elevated levels. These immune cells are transported to areas of the body most likely to incur damage in physical confrontation (e.g. the skin) assisting the body to resist microbes that might enter these areas during physical conflict (e.g. skin wounds) and promote healing (Dhabar and McEwen, 1997).

Zegans (1982) proposed that the physiological changes associated with the stress response can occur in three different ways: as a response to the appraisal of threat or not being able to cope; as a response to appraisal of threat when coping is not possible; and as a non-specific response during the early alarm state. These physiological responses might then play a part in subsequent illness because, i) damage is caused by the initial acute response particularly in individuals whose health is already compromised ii) repeated instances of the physiological stress response might lead to long-term damage and iii) chronic experience of the physiological stress response might cause lasting damage (Zegens, 1982). This is in line with other stress research which suggests that where exposure to stressors is particularly severe, frequent or chronic the stress response can become maladaptive and pathology can occur (Ganster and Rosen, 2013; Selye, 1956, 1976).

Numerous occupational stress researchers have proposed that physiological responses to psychosocial stressors related to work can be *directly* linked to a range of adverse physiological, psychological and behavioural outcomes (Ganster, 2005; Greenberg, 2010; Halpern, 2005; Zellars et al., 2009). In addition, adverse outcomes can occur *indirectly* through their relationship with a range of unhealthy behaviours such as increased smoking in response to psychosocial stressors (MacLeod et al., 2002). Further research is warranted to investigate both the direct and indirect links of psychosocial stressors and adverse outcomes.

1.2.2 Physiological, Psychological and Behavioural Outcomes of Stress

In terms of the physiological, psychological and behavioural outcomes of stress, the occupational stressor-strain literature details physiological and psychological symptoms as responses (initial adaptation) to the acute experience of stress whereas, physiological diseases and psychological disorders are viewed as outcomes of the repeated or chronic experience of stress (either directly or indirectly). This progression of the stress responses is consistent with Selye's (1936, 1976) general adaptation syndrome; alarm (fight or flight response), resistance (adaptive physical and psychological symptoms) and exhaustion (physical disease, psychological disorders and mortality).

Various physiological and psychological symptoms have been reported as initial adaptation to acute or initial stages of the stress response. Similar physical reactions to those produced by the fight-or-flight stress response (e.g. increased blood pressure, dry mouth, excessive perspiration) are produced by strong emotions such as anger, fear and anxiety, which are also characterised by a state of high arousal (Steimer, 2002; Sapolsky, 2004). These emotions were originally developed as adaptive means of ensuring reproduction of the species (Steimer, 2002), and were functional in prehistoric times because they ensured caution, defence, curiosity and experimentation, however, repeated, prolonged or excessive experience of them may be maladaptive today (Selye, 1956; Steimer, 2002).

If the acute stress response continues over time, physical symptoms such as, gastro- intestinal problems e.g. indigestion and irritable bowel syndrome (Levy et al., 2006; Mönnikes et al., 2001); backache (Zautra et al., 1998); headache (Schramm et al., 2015); sleep disturbance (Ertel et al., 2008) as well as psychological symptoms such as emotional exhaustion and frustration have been reported (Chen and Spector, 1991; Thompson et al., 2005).

In terms of physical symptoms, a meta-analysis of 79 studies by Nixon et al. (2011) investigated associations between specific self-reported health outcomes (i.e. backache, headache, eyestrain, gastro-intestinal problems, dizziness, fatigue, appetite loss, and sleep disturbance) and psychosocial work stressors (i.e. lack of control, role ambiguity, role conflict, organisational constraints, interpersonal conflicts, work hours, and work load). Findings showed significant correlations (albeit small) between all seven of the work stressors with physical symptoms.
In relation to psychological symptoms, a meta-analysis of 61 studies conducted by Lee and Ashforth (1996) found that job demands (stressors) such as role ambiguity, role conflict and workload were significantly correlated with emotional exhaustion.

Ganster and Rosen (2013) conducted a review of the work stress research and concluded that whilst there was some evidence that psychosocial work stressors appeared to be associated with negative physical symptoms, work stressors were most strongly related to psychological (affective) symptoms for example, emotional exhaustion rather than physical symptoms. In separate meta-analyses conducted by Sverke et al. (2002) and Cheng and Chan (2008) it was found that job insecurity had stronger relationships with psychological symptoms than with physical symptoms.

Outcomes of the experience of long-term or frequently repeated stress can be physiological (e.g. heart disease, hypertension and lowered immunity);

psychological (e.g. depression, burnout); and behavioural both in terms of the individual (e.g. increased maladaptive health behaviours including smoking, drinking, under/overeating and lack of exercise) or the organisation (e.g. absenteeism, increased staff turnover).

1.2.2.1 Physical Outcomes

Associations between chronic work stress and heart disease have been frequently reported in the stress literature over time (Hemingway and Marmot, 1999; Karasek et al., 1981; Kuper and Marmot, 2003). In terms of the physiological stress response, it is believed that stimulation of the cardiovascular system via the sympathetic nervous system (SNS) response to stress temporarily raises blood pressure (Zimmerman and Frolich, 1990) however, there is little empirical evidence that chronic stress directly leads to more permanent hypertension. It is proposed that other factors such as sedentary lifestyle, obesity and smoking might interact or become more likely when people feel ‘stressed’ (Steptoe and Kivimäki, 2013) and these behaviours are more responsible for hypertension.

There is a substantial and relatively recent body of empirical evidence for associations between stress, and coronary heart disease (CHD), cardiovascular disease (CVD; CHD, hypertension and stroke) and artery damage (e.g. Brownley et al., 2000; Kivimaki et al., 2006: Hamer et al., 2006; Steptoe and Kivimäki, 2013). A meta-analysis of studies between 1989 and 2011 by Steptoe and Kivimaki (2013) found a 1.3 times increased risk of CHD in adults reporting workplace stress and proposed that this was due to advanced metabolic changes due to repeated and/or chronic stress responses. Stress was also implicated in the progress of CVD and the development of stress cardiomyopathy (disease of the heart muscle). However, it should be noted that the risk was still relatively small in comparison to unhealthy behaviours including, smoking, lack of exercise and obesity.

Other research has found evidence for associations between psychosocial stress (including work stress) and increased risk of stroke (Booth et al., 2015; Tsutsumi et al., 2009) as well as CVD (Backe et al., 2012; Fishta et al., 2015).

Karasek and Theorell (1996: 23) claimed to have established a, "…clear relationship between adverse job conditions (particularly low decision latitude) and coronary heart disease" and research evidence largely supports this claim (Kuper and Marmot, 2003; Kivimaki et al., 2006; Kivimaki et al., 2012).

In general, the findings of empirical research regarding CHD, CVD and artery damage seem to indicate that high responsivity to stress due to factors such as, genetic influences, early life experiences, individual abilities and resources such as coping, in addition to repeated exposure to work stressors is associated with heart and circulatory pathology but further longitudinal studies are recommended (Steptoe and Kivimaki, 2013).

During the acute stress response, stress hormones such as cortisol can be beneficial to the immune system by preparing it for any further threat from the stressor (Segerstom and Miller, 2004). However, with prolonged, repeated or intense stress, the immune system can become compromised due to changes (dysregulation) in cytokine profiles. Cytokines assist communication between cells in immune responses and stimulate the movement of cells towards sites of inflammation, infection and trauma (Glaser and Kiecolt-Glaser, 2005; Roitt et al., 1988).

Dysregulation of cytokines and increases in pro-inflammatory cytokines can occur in both intermediate and chronic stress and this has been associated with increased vulnerability to infections, slower post-operative recovery, poorer response to vaccination, delayed wound healing, a range of age-related illness, and a detrimental accumulative effect on well-being (Glaser and Kiecolt-Glaser, 2005; Glaser et al., 2000; Kiecolt-Glaser et al., 1995, 2002; Schneiderman et al., 2005). It is important to note that individual vulnerability factors such as age and illness can mediate the effect of intermediate and chronic stress in terms of further compromising the immune system (Segerstrom and Miller, 2004).

Changes in neuroendocrine activity and in the immune system as a response to chronic stress have also been associated with cancer albeit with inconclusive results (Thaker and Sood, 2007). The consensus from research investigating links between cancer and stress is that there is some evidence for the relationship between chronic stress and the progression of cancer (e.g. Chida et al., 2008; Moreno-Smith et al., 2010) but less evidence of stress being directly implicated in the onset of cancer (Chida et al., 2008; Lillberg et al., 2003). Furthermore, a number of studies have found no association between stress and the onset of cancer (Duijts et al, 2003; Michael et al., 2009).

1.2.2.2 Psychological and Behavioural Outcomes

Numerous research studies investigating psychological outcomes of chronic exposure to work stressors have focussed on depression. Bonde et al. (2008) conducted a review of 16 company-based, follow-up studies (published up to 2007) reporting associations between psychosocial stressors and major depression. Depression status was established using either DSM criteria or standard self-report measures (e.g. the Job Content Questionnaire: Karasek et al., 1998). Their findings showed a moderate elevated risk of depression onset linked to psychosocial stressors. Similar associations between job demands and the onset/development of depression were also found in a meta-analysis of 14 company-based, longitudinal studies conducted by Netterstrom et al. (2008).

Another psychological disorder frequently considered as an outcome of occupational stress is burnout. As previously outlined, burnout has generally been characterised as an adverse outcome of prolonged job strain in human service workers (e.g. hospital staff, police, teachers) although other researchers have suggested that the components of burnout can be experienced generally by workers with chronic occupational stress (Bakker et al., 2005; Demerouti et al., 2001a; Xanthopoulou et al., 2007b).

Burnout is described as having three principal components namely, emotional exhaustion, depersonalisation, and reduced personal accomplishment (Leiter and Maslach, 1988; Maslach, 1993). The experience of burnout can have adverse outcomes including, a decline in quality of job performance, increased staff turnover, absenteeism and low morale (Jackson and Maslach, 1982; Maslach, 1982). A number of studies have found significant associations between burnout and job strain using self-report measures of both psychosocial stressors and burnout (Faragher et al., 2005; Guglielmi and Tatrow, 1998; Leiter and Harvie, 1996; Maslach et al., 2001).

With respect to general psychological well-being or general mental health, numerous studies have reported on the relationships between psychological well-being and job strain whilst other have focussed on individual psychological outcomes such as anxiety disorders, mood disorders, and self-esteem. A review of 11 longitudinal studies by Stansfield and Candy (2005) investigated associations between psychosocial stressors and new onset of common mental health disorders including, neurotic disorders, anxiety disorders, and mood disorders as classified by DSM or ICD criteria. Using the components and measures of the Job-Demand Control model (Karasek, 1979, 1997; Karasek and Theorell, 1990) and the Effort-Reward model (Siegrist, 1996, 2002) they found that high-demands and low control as well as effort-reward imbalance were significantly associated with the onset of mental health disorder. Various other research has reported similar findings with a range of adverse psychological outcomes including anxiety, mood disorders and self-esteem (Cox et al., 2000; Leka and Jain, 2011; Nieuwenhuijsen et al., 2010; van der Doef and Maas, 1999; Tennant, 2001).

1.2.2.3 Cognitive Outcomes of Acute and Chronic Stress

In addition to physiological, psychological and behavioural outcomes of stress, deficits in cognitive characteristics such as, memory (e.g. Kuhlmann et al., 2005a, 2005b) attention (e.g. Sanger et al., 2014; Vedhara et al., 2000), concentration (e.g. Demerouti et al., 2007; Van der Linden et al., 2005) and general cognitive failures (e.g. Mahoney et al., 1998) have been reported in response to both acute and chronic stress.

Studies investigating the effects of stress on memory have frequently focussed on the neurobiological effects of cortisol during the stress response when glucocorticoids (in particular, cortisol) from the adrenal cortex are released with the activation of the HPA axis. Several studies have utilised laboratory experiments either artificially inducing stress (to produce the HPA response and the release of cortisol) or in some cases administering cortisol, prior to the encoding and retrieval of word lists and have then measured memory as a function of cortisol level. Overall, the conclusions from these studies are that higher cortisol levels impair memory retrieval (Kuhlmann et al., 2005a; Kuhlmann et al., 2005b; Buchanan et al., 2006; Tollenaar et al., 2008).

1.2.2.3 Behavioural Outcomes

Occupational stress can impact upon the individual's incentive to carry out health promoting behaviours such as regular exercise, relaxation, adequate sleep and healthy eating habits. Overeating or undereating may occur and there may also be an increase in health compromising behaviours such as eating high fat and/or high sugar foods, smoking and alcohol consumption (Landsbergis et al., 198 8). It has been hypothesised that undesirable emotional states such as occupational stress motivate individuals to engage in health compromising behaviours because they are pleasurable and improve the person's mood (Zillman and Bryant, 1985).

Ng and Jeffery (2003) conducted a large, longitudinal study across different organisations (females: n = 6,620 and males: n = 5,490) over a two-year period investigating the effect of stress on health-related behaviours including, smoking, drinking alcohol, exercise, and healthy eating. They found that over the two years, higher stress significantly predicted current smoking and decreased probability of giving up, exercising less, and eating a higher fat diet, but did not predict alcohol intake. Similar associations have been found between stress and increased fat consumption (Hellerstedt and Jeffery, 1997; Laitenen et al., 2002); snacks, caffeine and fast food (Pak et al., 2000; Steptoe et al., 1998); increased alcohol intake (Heslop et al., 2001; Steffy and Laker, 1991; Steptoe et al., 1998); higher levels of smoking and decreased probability of giving up (Carey et al., 1993; House et al., 1986; Steptoe et al., 1996); and lower levels of physical activity (Aldana et al., 1996; Heslop et al., 2001; Kivela and Pahkala, 1991; Steptoe et al., 1996). Conversely some studies have shown increased exercise with stress (Spillman, 1990) or no relationship between exercise and stress (Hellerstedt and Jeffery, 1997; Steptoe et al., 1998); and other studies have shown no relationship between alcohol intake and stress (Alterman et al., 1994; Greenlund et al., 1995). Whilst health compromising behaviours have been primarily associated with occupational stress in this review, they are also a secondary source of adverse physical outcomes in themselves (Cox et al., 2000).

Psychological and behavioural consequences of occupational stress also include negative attitudes towards work such as decreased job satisfaction, lack of organisational commitment and low morale (Faragher et al., 2005; Kompier and Levi, 1994) as well as absenteeism, accidents, high staff turnover, family-work conflicts and lowered job performance (Cooper and Marshall, 1976; Dollard et al., 2000; Michie and Williams, 2003; Quick and Quick, 1984). These outcomes also impact upon the organisation.

1.2.2.4 Organisational Consequences

The notion of “organisational healthiness” is analogous to individual healthiness and refers to the general condition of the organisation in the same way that individual health refers to the general condition of the person (Cox and Thomson, 2000: 87). Healthy organisations are defined as those which are "…fit-for-purpose, thriving and able to adapt in the longer term" (Cox et al., 2000: 88). A healthy workplace "…maximizes the integration of worker goals for well-being and company objectives for profitability and productivity" (Sauter et al., 1996: 250). This highlights the fundamental requirement for a combination of a healthy organisation and healthy employees in order to achieve and maintain a healthy workplace.

Historically, the health of an organisation would have related to its success at making a profit (Robin, 2003) whereas in contemporary society there is an emphasis on promoting the health of its employees. One example of this is that approximately 90% of U.S. companies with 50 or more employees provide health promotion programmes for its workers (Aldana et al., 2001).
Stress-related consequences for the individual also impact on the organisations that employ them, particularly if significant numbers of employees are experiencing those negative consequences. There have been suggestions that if a significant number of employees in an organisation are experiencing stress-related difficulties then the healthiness of that organisation can be questioned (Cox et al., 2000).

Adkins et al. (2000) specify four guiding principles for a healthy workplace; firstly, that organisational health is on a continuum from mortality to vibrant health and that a healthy workplace should aim to move towards vibrant health rather than be satisfied with avoiding mortality; secondly, that organisational health is an ongoing process which requires constant vigilance, appraisal and action; thirdly, that organisational health is systematic and reliant upon all interrelated elements of the organisation being healthy. To this end, regular risk assessment is essential. The final guiding principle is that healthy workplaces require healthy work relationships. All of these principles should be followed in order to ensure and maintain organisational healthiness.

The notion of organisational healthiness emphasises the role of the organisation in achieving and maintaining 'healthiness' rather than placing the focus on the individual, department or group of workers. (Grawitch and Munz, 2006).

The organisational outcomes frequently associated with work stress include reduced staff levels due to high staff turnover (Kim and Stoner, 2008; Tuten and Neidermayer, 2004), absenteeism (Darr and Johns, 2008; Jacobsen et al., 1996; Tuten and Neidermayer, 2004) together with diminished productivity and performance (Hunter and Thatcher, 2007; Park, 2007; Tuten and Neidermayer, 2004). These all have repercussions for the health of the organisation as well as the individual.

Absenteeism is seen as a withdrawal or escape mechanism when occupational strain is present (Dilts et al., 1985; Dwyer and Ganster, 1991) and can be for health reasons (including certified absences of more than three days) or for other reasons (absences of at least one day). Both forms of absence can be due to occupational stress (Westman and Etzion, 2001). Levels of absenteeism may rise when employees cannot face work due to stress (Greiner et al., 1998; Neubauer 1992; Rentsch and Steel, 1998). Alternatively, they may go to work and perform badly. This phenomenon of presenteeism is where individuals are physically present at work despite feeling unhealthy (Aronsson et al., 2000; Cooper et al., 1996; 2016) and is as damaging as absenteeism to performance and productivity levels (Johns, 2010); and possibly more damaging to staff and customer relations (Lu et al., 2013). Employees may also use absenteeism as a means of short-term rest and recuperation from high-stress work and then return to work with renewed energy (Kohler and Mathieu, 1993).

In relation to staff turnover, Arshadi and Damiri (2013) found a significant relationship with occupational stress and also that organisation-based self-esteem mediated this relationship. Other research has also offered support for an association between occupational stress and either actual staff turnover or intention to leave (Jaramillo et al., 2006; Kim and Stoner, 2008).

On a cautionary note, although there is substantial research evidence for physical, psychological and behavioural outcomes of psychosocial stressors (for acute and chronic exposure), the majority of this research is correlational using self-report measures. This means that causal relationships cannot be established and intervening variables such as personality, coping and social support are often not considered. Further investigation using longitudinal research is required in order to establish causal relationships between occupational stressors and adverse health outcomes and the possible moderating/mediating effects of individual or group differences to the stress process. Much of the findings from occupational stress research are also subject to various biases known to influence self-report measures such as social desirability (Ganster and Schaubroeck, 1991) and common method bias (Lindell and Whitney, 2001). These biases will be considered further in the section on measures of occupational stressors.

Employee Compensation Claims

Whilst there is currently no government legislation to enforce the control of occupation-related stress in the UK (Pilkington et al., 2001), employers are reminded of the requirement to comply with the Health and Safety at Work Act, 1974 (HSAWA: National Archives, 2017) and The Management of Health and Safety at Work Regulations, 1999, 2006 (MHSW: National Archives, 2017) which state that employers in the UK have a responsibility or 'duty of care' to identify and protect employees from aspects of the work environment detrimental to their health and safety.

"It shall be the duty of every employer to ensure, as far as is reasonably practicable, the health, safety and welfare at work of all his employees" (HASWA; 1974: 2)

“Every employer shall make a suitable and sufficient assessment of the risks to the health and safety of his employees to which they are exposed whilst they are at work…” (MHSW Regulations, 1992: 3).

Failure to comply with these responsibilities in the UK can result in the HSE or other authorised bodies bringing criminal prosecution cases with a penalty of a fine for the employer if found guilty. In addition, breaches of common law duty of care can result in civil prosecution as personal injury claims (Cox et al., 2006). A landmark case in the UK, Walker v Northumberland County Council (1995), demonstrated the success of civil action against organisations by their employees. where a council employee was awarded substantial damages for ‘psychiatric injury’ experienced as a consequence of work-related stress. In the case of Ingram v Hereford and Worcester County Council (2000), a warden employed by the councilwas awarded £203,000 damages, which was a record amount for work related stress. Such cases only serve to emphasise the need for employers to conduct effective risk assessments in order to put in place stress management policies and interventions aimed at reducing the risk of occupational stress.

To summarise the literature on occupational stress and health, the relationship between stress and health outcomes has been frequently investigated and research concludes there are significant associations with a range of physical, psychological and behavioural outcomes for workers (e.g. Elovainio et al., 2015; Hargrove et al., 2011; Kasl, 1998; Schneiderman et al., 2005). Furthermore, there is evidence for negative organisational consequences of a 'stressed' workforce which raises questions about the role the organisation plays in the stress process and in particular the requirement for regular monitoring and evaluation of the workplace to achieve and maintain organisational healthiness and to comply with HASWA and MHSW regulations (Cox et al., 2000). The following section reviews and evaluates various methods that have been used to measure and evaluate occupational stressors and strains in organisational risk assessments and also to further work stress research.

1.3 Measurement of Occupational Stressors, Strains and Outcomes

The measurement of occupational stress is crucial to the development of appropriate and effective stress reduction interventions. Lack of clarity in the definition of occupational stress and confusion between different theoretical frameworks has stimulated questions about the reliability and validity of measurement procedures available to interdisciplinary groups consisting of scientists and clinicians. The causes and consequences of occupational stress are multivariate; therefore, assessment instruments should be comprehensive in nature and preferably include both subjective and objective measures of stress (Semmer et al., 2004; Rick et al., 2000).

1.3.2 Risk Assessment

Cox (1993) argued that risk management of psychosocial stressors (or hazards) should follow a similar framework of health and safety procedures as those prescribed for physical hazards. The risk management framework for psychosocial stressors involves several steps,

- Identification of psychosocial hazards
- Assessment of the associated risk (who might be harmed and how)
- Employing appropriate strategies to control the risks
- Checking and evaluating the effectiveness of control strategies
- Re-assessing the risk

It is important to note that the presence or experience of psychosocial stressors in the workplace does not mean that employees are being harmed, and evaluation of any associated harm is also necessary in order to implement strategies to control it (Leka et al., 2005).

The HSE (2017) define risk assessment as,

> "…a careful examination of what could cause harm to people in the workplace. Doing a risk assessment will help employers identify the significant risks in their workplace, and avoid wasted effort by effectively targeting these."

In terms of the contemporary philosophy on risk management of occupational stress in the UK, the Health and Safety Commission (HSC) who have overall responsibility for health and safety matters in the UK, together with other policy makers decided that action was required to establish a strategy for risk management and reducing occupational stress in the UK. To this end, research was commissioned by the HSE which resulted in the provision of the HSE UK Management Standards (Mackay et al., 2004). The Management Standards represent conditions to be achieved for the health and well-being of employees and efficient organisational performance (HSE, 2017) and subsequently led to the construction of the HSE Indicator Tool (Cousins et al., 2004). The HSE Indicator tool will be detailed further in the section on self-report measurement of occupational stress in this Literature Review.

Use of the Management Standards programme is claimed to permit assessment of the organisation's current state, using surveys and other methods to assist in making risk assessment less complex by identifying risk factors, helping employers to focus on causal factors and their prevention, and to provide a 'yardstick' by which employers can assess their success in dealing with causes of stress (Cousins et al., 2004; Mackay et al., 2004).

The Management Standards were derived from a review of previous research but were mainly influenced by Cox's (2001) taxonomy of psychosocial stressors and Karasek's (1997) Demand-Control-Support model, previously outlined. They constitute six psychosocial stressors namely: 1) Job Demands (e.g. workload, work environment); 2) Job Control indicated by the degree of autonomy over how the job is carried out; 3) Support in terms of encouragement, feedback and provision of resources by the organisation, management and colleagues; 4) Relationships at Work in respect to provision of positive workplace strategies to improve relationships with others); 5) Role in terms of the organisation providing clarity regarding role requirements); and 6) Organisational Change demonstrated by the way in which the organisation and management communicate change (Mackay et al., 2004).

The HSE provide a standard and a set of specified states to be achieved, drawn up in consultation with academics and experts, for each of the six Management Standards. As an example, the 'Demands' standard is: "Employees indicate that they are able to cope with the demands of their jobs; and; Systems are in place locally to respond to any individual concerns." (HSE, 2007: 13). Achievable states for 'Demands' are:

> "The organisation provides employees with adequate and achievable demands in relation to the agreed hours of work; People's skills and abilities are matched to the job demands; Jobs are designed to be within the capabilities of employees; and Employees' concerns about their work environment are addressed." (HSE, 2007: 13).

The HSE (2001) recommend that their Indicator Tool (Cousins et al., 2004) is used in risk assessment and proposed five stages to the procedure, which are the same as those previously cited by Cox (1993): (i) identify hazards (ii) identify who is at risk of harm and how (iii) evaluate if there are adequate precautions already in place (iv) record the findings and (v) review and revise the assessment as required.

Several limitations have been identified from the published research including, that the Management Standards may not recognise occupation-specific elements of psychosocial stressors (Bartram et al., 2010); and that the benchmark standards do not represent occupations that are known to have high stress levels such as teachers and health workers (Houdmont et al., 2012; Bevan et al., 2010)

In order to follow the basic concepts of risk management it helps to conceptualise hazards, harm and risk as defined by a variety of UK occupational health literature (e.g. Cox, 1993; Cox et al., 2000; Mackay et al., 2004). Hazards (psychosocial) are said to arise from the design, organisation and management of work (e.g. patterns of working, workload, working environment). Harm can be acute or chronic and is the impact of hazards on the psychological and physical health of the worker, which may arise from the same physiological stress response (McEwan, 2000). Harm can also refer to organisational outcomes including, worker absence, sickness and reduced performance. Finally, risk is the probability that exposure to a particular hazard will result in harm. Risk assessments should aim to lower hazard exposure to a level where no harm ensues (Mackay et al., 2004).

As discussed, identification of psychosocial stressors and their associated risk are the first two objectives in risk assessment. These objectives have been met using various measurement methods and instruments, including interviews, focus group discussions, self-report scales, physiological measures, and observations sometimes in conjunction with organisational records (e.g. absence, time-keeping, hours worked). It is beyond the scope of this thesis to discuss all of the methods available for use in occupational risk assessment. However, some of the most popular and frequently used methods are reviewed and evaluated in the following section subsequent to a discussion on objective versus subjective measurement of work stressors and strains.

1.3.3 Objective vs Subjective Measurement

A source of debate in occupational stress research has been the utility of subjective versus objective measurement methods (e.g. Bailey and Bhagat, 1987; Frese and Zapf, 1988; Frese and Zapf, 1999; Perrewé and Zellars, 1999; Schaubroeck, 1999). Theorists have suggested that the justifications for the use of objective measures and conceptualisations of stressors are “practical, theoretical and methodological” (Frese and Zapf, 1988: 376). Practical, in that subjective measurement enables a focus on organisational change rather than on the individual and therefore, can identify the need for redesigning the work environment which can only be justified on the basis of objective measurement and not the individual’s subjective appraisal. Theoretical, since action theory espouses that whilst individual subjective appraisal of stressors is important, receiving feedback from the objective environment assists with reality-based cognitions. Finally, methodological justification for objective measures rests on the premise that subjective measures (e.g. self-report measures) can produce ‘trivial correlations’ between stressors and strain measures (Frese and Zapf, 1988; Kasl, 1978) either due to common method variance or overlap in scale content (Lindell and Whitney, 2001). In addition, research has most frequently investigated linear relationships between stressors and strains and failed to consider the effects of moderator variables such as social support or coping (Sonnentag et al., 2003). These factors will be discussed further in the evaluation of stress measurement methods later in this review.

In order to understand the debate, it is useful to define what is generally meant by the terms ‘subjective’ and ‘objective’ with reference to occupational stress measurement. Frese and Zapf, 1988 propose three different conceptualisations. Firstly, ‘objective’ defined as related to material objects and processes and unrelated to psychological processes; and ‘subjective’ involving psychological processes. Secondly, ‘objective’ as real and ‘subjective’ as unreal or imagined. Finally, ‘objective’ as not influenced by individual cognitive and emotional processing of features of the work environment (Frese and Zapf, 1988: Sonnentag et al., 2003) and ‘subjective’ taken to be a process involving the individual’s appraisal and perception of the work environment.

The first conceptualisation is limited as it disallows the idea of objective psychological stressors, if they are non-material. Correspondingly, the second conceptualisation limits discrimination between objective and subjective stressors since unreal perceptions of stressors are rare in the workplace. The third explanation of ‘subjective’ and ‘objective’ is in greater accordance with the transactional approach to occupational stress (Lazarus and Folkman, 1984; Lazarus, 1991) as idiosyncratic, defined by the individual’s perception and appraisal of the environment as it allows psychological stressors to be conceptualised as objective. Furthermore, when ‘objective’ is defined as not being influenced by individual perceptions and appraisals it allows for non-observable psychological processes (e.g. a demand for intense concentration) to be described as objective stressors in the same way as non-material but observable events (e.g. being reprimanded by a supervisor), providing they are free from cognitive and emotional processing (Frese and Zapf, 1988). This is problematic in itself because the major features of the interactional stress process, that is appraisals, are cognitive.

Frese and Zapf (1988) suggest a conceptual strategy to overcome this problem, that is, to think of stressors as those defined by ‘the average person’ as leading to a stress response. In this way, “…the average person’s stressor is unrelated to the concrete individual’s cognitive and emotional processing’s” (Frese and Zapf, 1988: 378).

The transactional definition of occupational stress allows for the individual’s subjective cognitive appraisal of the work environment together with the objective measurement of their emotional, cognitive and physiological reactions (Lazarus and Folkman, 1984).

Three variables currently dominate the measurement of occupational stress; *occupational stressors,* which are work-related environmental factors, believed to contribute to adverse health outcomes, *occupational strains*, which are the psychological and physical responses to occupational stressors and *health outcomes* or enduring, detrimental health conditions that arise following exposure to occupational stressors (Cox et al., 2000). In addition, individual differences thought to mediate the stressor-strain relationship such as hardiness/resilience (e.g. Ganster and Schaubroeck, 1991; Jackson and Firtko, 2007), locus of control (e.g. Chen and Silverthorn, 2008; Spector et al., 2002), type A personality (e.g. Judge et al., 2002), coping styles (e.g. Lazarus, 2000; Parkes, 1994) and social support (e.g. Cohen, 2004; Viswesvaran et al., 1999) are sometimes (but not always) assessed.

Methods employed in the measurement of occupational stress include both subjective and objective methods. Subjective methods include, self-report questionnaires, interviews, daily diaries, checklists and focus groups. Objective measures include, physiological indicators (e.g. salivary cortisol), workplace observations and organisational data. The following sections present a critical overview of some commonly used subjective and objective measurement methods and their application to the assessment of workplace stress.

1.3.4 Self-Report Measures

Self-report measures are the most widely used subjective method of occupational stress measurement. They are the easiest and most convenient to obtain, can be analysed statistically and interpreted easily, and claim to possess psychometric reliability and validity (Paulhus and Vazire, 2007). Self-reports also allow anonymous responses which cannot be linked to measures of behaviour or others reports (Gosling et al., 2004). Since they are influenced by individual variables such as cognitive appraisal processes and evaluation of coping strategies they are thought to provide a richer, more in-depth assessment of the individual’s experience of stress than physiological or observational indicators alone (Cooper et al., 2001).

Defining self-report measures as subjective is an oversimplification because they may contain not only the individual’s appraisal of the work environment for example, the perceived level of job demands (Frese and Zapf, 1988) but also items which reveal objective reality for example, the respondents age, gender, occupation, and working hours. However, reported findings are generally based on correlations between stressors and strains and sometimes consider the effect of moderator variables such as social support and coping. Self-report methods that have been used in occupational stress research include standardised questionnaires, daily diaries and checklists. The following sections place the main focus on reviewing self-report questionnaires given their dominance in contemporary occupational stress research.

1.3.4.3 Self-Report Scales/Questionnaires

Measurement of stressors, strains and health outcomes using self-report scales is by far the most popular method used in occupational stress research (Rick et al., 2000; Sonnenberg et al., 2003).

Questionnaires that assess occupational stressors are widely available with some scales also measuring occupational strain and the moderators-mediators of the relationship between them. Some of the most popular self-report questionnaires used in occupational stress research over the years are outlined in the following section.

The Job Diagnostic Survey (JDS; Hackman and Oldham, 1975)

The JDS was used to assess occupational stress more often than any other psychometric measure in the 1970's and 1980's, but has since declined with the emergence of other measures (Vagg and Spielberger, 1998). There are 15 subscales centring on the five core characteristics identified by Hackman and Oldham (1975). These are *skill variety* which is the degree to which the job requires the use of different talents and skills; *task significance* that is, the degree to which the job has a substantial impact on the lives or work of others; *task identity* is the degree to which a job requires completion of a 'whole' and identifiable piece of work; *autonomy* which how much discretion, freedom and independence the employee is allowed in scheduling and carrying out the job;

feedback from the job itself, meaning the degree to which carrying out work activities provides direct, clear information about their personal work effectiveness. Two additional dimensions are included; *feedback from others* is the amount of clear, informative feedback about work performance is provided by supervisors and managers; and dealing with others which measures how much the employee has to work closely with other people.

The JDS also assesses experienced psychological states and the moderators of these states on affective outcomes. These moderators include pay and other compensation, job security, peers and co-workers and supervision. The final dimension measured is Individual Growth Need Strength or the need of an employee to gain personal growth and self-esteem in their work (Hackman and Oldham, 1980).

There are two forms of the JDS, the original 83-item scale and a shorter 53-item scale both of which use a 7-point scoring scale where 1 indicates low and 7 indicates high scores on each subscale (Hackman and Oldham, 1975). Psychometric properties for the JDS are generally adequate. Internal consistency alpha reliabilities for the 15 subscales are reported as ranging from .56 to .88. Content, concurrent and face validity are reported as satisfactory (Hackman and Oldham, 1975).

The JDS aims to obtain an objective comparison on each of the subscales in that participants are asked to indicate the existence of certain work characteristics and how each of these makes them feel. Example items include, *'To what extent does your Job require you to work closely with other people (either 'clients', or people in related jobs in your own organization)?'* Participants are asked to give an objective response to the degree that this occurs in terms of a 7-point scale (with1 being very little and 7 being very much). They are then asked on a separate subscale to rate how this makes them feel for example, *'The people I talk to and work with on my job.'* Participants are then asked to respond on a 7-point scale (with 1 being extremely dissatisfied and 7 being extremely satisfied) in terms of the degree of satisfaction they have with that aspect of their work. Both versions of the JDS, scoring keys and some limited norm data are freely available and are suitable for use across different occupations.

Whilst the JDS provides helpful information on workers' feelings concerning their jobs (Renn et al., 1993) it does not address the perceived frequency or severity of specific occupational stressors.

The Job Content Questionnaire (JCQ; Karasek, 1985)

The JCQ measures the level of job demands (and frequency) in comparison to the amount of control the worker has over decisions at work. The Demand-Control model (Karasek, 1979, 1997; Karasek and Theorell, 1990) provided the conceptual framework for the JCQ which was originally developed to evaluate work related social and psychological elements contributing to cardiovascular disorders (Karasek et al., 1983).

The most recent version of the JCQ (Karasek et al., 1998) assesses five work related dimensions; *decision latitude, psychological demands and mental workload, job security, exposure to physical hazards* and *social support*. The full, recommended version of the JCQ (Karasek et al., 1998) has 21 subscales (containing 49 items) including skill discretion, decision authority, general psychological demands, role ambiguity, social support, co-worker hostility, general physical loading and skill obsolescence. The JCQ evaluates the frequency of specific work-related events but does not take into consideration the perceived severity of stressors (Vagg and Spielberger, 1998).

Karasek et al. (1998), claimed 'generally acceptable' Cronbach's alpha coefficients for internal reliability (overall average for women of .73 and for men .74) with the most acceptable values being for decision latitude, physical demands, supervisor support and co-worker support scales. However, there is a paucity of independent published research on the psychometric properties of the JCQ, therefore no conclusive judgements may be made regarding its reliability and validity.

The JCQ is available for use and can be applied across different occupations. It is a copyright instrument and not published in the public domain, however the authors make it freely available for non-commercial research using under 750 participants.

The Job Stress Survey (JSS; Spielberger, 1994)

The JSS is a 30-item self-report scale which measures the severity and frequency of workplace events and experiences thought to affect psychological well-being (Spielberger, 1994). The items in the JSS were chosen to represent generic stressors in different occupational situations for example, '*working overtime*'. Participants are asked to indicate the severity or amount of stress associated with each stressor item on a 1 to 9 scale in comparison to a standard stressor (*'the assignment of disagreeable duties'*) which is rated at 5. They are then asked to indicate (on a 1 to 9+ scale) the number of days over the last six months that they have experienced (frequency) each stressor.

The JSS provides overall scores for severity and frequency along with an overall Job Stress Index (sum of cross-product scores for severity and frequency). There are also subscales measuring job pressure (10 items) and organisational support (10 items) for which severity and frequency scores can be calculated.

In terms of psychometric properties, Spielberger and Reheiser (1995) reported good internal consistency reliabilities from a large-scale study (*N* = 2,839) involving corporate, university and military samples ranging from .81 to .93 for severity; .74 to .92 for frequency; and .71 to .93 for overall Job Index.
Face, content and construct validity have been reported as acceptable (Rick et al., 2001). but there is little or no reliable data on other forms of validity at this time. The JDS provides a useful measure of severity of generic stressors and in particular

it offers information on the frequency of these stressors which is something that many other self-report measures fail to do (Spielberger and Reheiser, 1995). However, there is a shortage of data on its reliability and validity, furthermore there is no evidence that the JSS can predict consequent adverse health outcomes. (Rick et al., 2001). The JSS is a copyright instrument and is available commercially.

The Occupational Stress Indicator (OSI: Cooper et al., 1988)

The OSI which was cited more frequently than any other measure of occupational stress between 1991 and 1996 (Vagg and Spielberger, 1998), was developed from the Cooper and Marshall (1976) stressor-strain model of occupational stress. Central to the development of the OSI was the transactional model of stress (Cox, 1978, Lazarus, 1966, McGrath, 1970) which involves assessing the effects and sources of stress together with individual differences in perception of stress whilst placing cognitive appraisal at the centre of the stress process. Work demands or sources of pressure are secondary in this model with the primary focus being placed on individual perception of pressure.

The OSI is a 167-item self-report scale measuring stressors, strains, outcomes and moderating variables. It is divided into six domain scales: pressure in the job (61 items); coping (28 items); type A behaviour (14 items); job satisfaction (22 items); locus of control (12 items); and mental and physical health (16 items). Each of these are divided into subscales making a total of 28 subscales.

Due to its popularity in stress measurement, the psychometric properties of the OSI have been frequently challenged. Robertson et al. (1990) investigated the internal consistency reliability of six OSI domain scales and concluded that five (pressure in the job, coping, type A behaviour, job satisfaction and mental and physical health) showed acceptable reliability (with alphas ranging between .58 to .88) whilst the sixth (locus of control, α = .38) required further development. Discriminant and convergent validity was found to be good for four of the OSI domain scales tested (job satisfaction, type A and mental health) but poor for the locus of control scale and further development of this scale was recommended (Robertson et al., 1990).

The psychometric reliability of the OSI was questioned and consequently re-examined by Davis (1996: 179) who concluded that it "…*appears to be at best moderately reliable*...". Davis' analysis found the internal reliability of the subscales questionable. The individual difference scales including Type A behaviour, locus of control and coping strategies were particularly weak with reliability coefficients at or below the minimal acceptable level (α = .70; Kline, 1993a) for an internally consistent measure.

Davis (1996) also remarks that most of the subscales are too short to fulfil the basic criteria of a reliable test (Kline, 1993a) with the exception of the 'Sources of Pressure' subscale (61 items). Analysis of the 'Sources of Pressure' subscale (the longest scale and therefore more likely to produce more reliable results) showed reasonable reliability coefficients for all items (α = .73 to .85) although it was suggested that this subscale might need re-analysing for each specific organisation (Davis, 1996). Other studies have also questioned the validity and factor structure of the OSI (Evers et al., 2000; Lyne et al., 2000) and its ability to predict harmful outcomes (Bradley and Eachus, 1995; Cooper et al., 1999) and generally recommended that further work is required on the scale items. The OSI has a substantial set of norm data and is available for use commercially.

The Pressure Management Indicator (PMI; Williams and Cooper, 1998)

The Pressure Management Indicator (PMI; Williams and Cooper, 1998) was developed to overcome the limitations highlighted in the OSI and to improve psychometric validity and reliability. Although it has not been used as extensively as the OSI, it is reviewed here because it was used in Study One, Two and Three of this doctoral research.

As with the OSI, the PMI measures the major dimensions of occupational stress, namely stressors, strains and enduring outcomes together with moderating variables. Items were generated through structured interviews and a review of measures assessing the underlying constructs (Williams and Cooper, 1998). Stressor scales include items evaluating exposure to pressure from workload, relationships, career development, managerial responsibility, personal responsibility, home demands and hassles. Strains and outcome scales include items gauging job satisfaction, organisational satisfaction and security, organisational commitment, anxiety, depression, resilience, worry, physical symptoms and exhaustion. Scales assessing moderator variables such as drive, impatience, control, decision latitude, work-life balance, social support and coping strategies are also incorporated into the PMI.

Several modifications were made during the development of the PMI following suggestions for improvements on the OSI. The word ‘stress’ was removed from the title because it could imply that stress was a problem in the organisation and also to remove the chance that respondents may report stress more than if a neutral word was used. ‘Pressure’ was deemed to be a more neutral word and hence the questionnaire was renamed the Pressure Management Indicator.

Another criticism was that the OSI took too long to complete (30-45 minutes) because some of the items were lengthy, ambiguous or complex. To remedy this, items were analysed for item-distribution characteristics (Williams, 1996) and those not showing normal distribution were removed. This enabled simplification of the items making them acceptable to all staff levels without reducing the psychometric properties and cutting the time taken to complete the revised questionnaire to 20- 35 minutes.

In order to lessen the possibility of organisational or industry bias the data set was taken from hundreds of different organisations with normative data being established on more than 20,000 people from various occupational groups (Resource Systems, 1999,) Steps were also taken to ensure that the PMI was applicable across cultural boundaries and that the items reflected changing work demands, job insecurity and changes involved in the use of modern technology.

Scores from the normative data set showed that all the PMI scales (excepting daily hassles with α = .64) met or exceeded the target reliability (α = .80) for internal consistency and therefore it was concluded that the PMI was an improvement on the OSI (Williams and Cooper, 1998)

HSE Indicator Tool (Cousins et al., 2004)

The HSE Indicator Tool was designed to be used to identify stressors by comparing participants' responses to items representing the Management Standards (HSE, and if the group of employees generally endorse the negative elements of a given stressor then further investigation is required. The Management Standards Indicator Tool contains 35 items and comprises seven subscales that measure each of the six Management Standards, with one subscale for each of Demands, Control, Role, Relationships and Change and two separate subscales for Support (Management and Colleagues) and it is freely available from the HSE website (HSE, 2017).

The HSE provides benchmark data for the six Management Standards measured with the Indicator Tool, representing averages taken from 136 organizations against which an organisations' performance in terms of each standard can be compared (Brookes et el., 2013). A data scoring and analysis template as well as user manuals are available to assist with analysis and interpretation.

Psychometric analysis of the Management Standards Indicator Tool indicates good internal consistency reliability with alphas ranging from .78 to .89 (Cousins et al., 2004). Edwards et al. (2008) found evidence for confirmation of the factor structure of the Indicator Tool and reliability figures in line with the initial analyses conducted by Cousins et al. (2004).

The Indicator Tool has been widely used by UK organisations in recent years with many organisations perceiving it as a government recommended instrument for risk assessment of work stress. There is also a range of published research generally reporting that the Indicator Tool is effective is identifying occupational sources of stress (e.g. Bartram et al., 2009; Bevan et al., 2010; Edwards and Webster, 2013; Hackett et al., 2009; Kerr et al., 2009). A systematic review of 13 studies (10 of which were conducted in the UK) that had used the Indicator Tool concluded that it is a psychometrically sound measure to investigate occupational stress within organisations and that the benchmark data allows comparisons and identification of areas for organisational improvement (Brookes et al., 2013).

In terms of limitations, it has been suggested that the HSE Indicator Tool is limited when used as the only instrument in risk assessment as it does not measure occupational strains as outcomes of perceived stressors (Bevan et al., 2010) and it does not include demographic variables such as absence or sickness levels and therefore precludes comparisons amongst work groups (Verrier and Harvey, 2010). However, these limitations are also true of various other self-report measures of occupational stress for example, the JSS (Spielberger et al., 1994) and the JCQ (Karasek, 1985).

The HSE Indicator Tool was still in its infancy when deciding on a suitable self-report measure to use as a comparator in the current research and it was felt that the Pressure Management Indicator (PMI; Williams and Cooper, 1998) as a revised version of the Occupational Stress Indicator (OSI; Cooper et al., 1988) which has been one of the most frequently used measures of occupational stress in the UK, was a more appropriate instrument.

1.3.4.4 Self-Report Measures of Occupational Strains

Whilst some self-report measures include scales assessing physical and psychological strains for example, the OSI (Cooper et al., 1988), others focus on assessing psychosocial stressors and use separate scales to assess strains. These include self-report scales such as, the Beck Depression Inventory (BDI; Beck et. el., 1961), the General Health Questionnaire (GHQ; Goldberg, 1978), the Depression, Anxiety and Stress Scales (DASS: Lovibond and Lovibond, 1995) which were developed for clinical use and consequently applied to the measurement of occupational strain and adverse health outcomes. These measures whilst not specifically designed for measuring occupational strains have been used frequently in conjunction with other measurement tools and associations with stressors such as job demands and lack of control are often cited in occupational stress literature (e.g. Johnson et al., 2005; Lee et al., 2011; Nieuwenhuijsen et al., 2003; Stansfield et al., 1995).

Another strain concept frequently assessed is ‘burnout’ (Maslach, 1982). The Maslach Burnout Inventory (MBI; Maslach and Jackson, 1981, 1986) is often cited in research on occupational stress amongst human services workers such as doctors, nurses and teachers where associations have been found with stressors such as high job demands and lack of work resources (e.g. Hackenen et al., 2006; Mallett et al. 1991; Schaufeli and Bakker, 2004).

1.3.4.5 Daily Diaries

Daily diaries or logs are another approach used to assess occupational stressors although they have not been widely adopted by researchers, possibly due to the level of participant commitment required in order to complete diary data on a daily basis.

Although the term ‘diary’ implies free writing of daily experience, typically a set of self-report scales are incorporated to provide some consistency and allow statistical analysis whilst some studies have used self-report scales at the beginning and end of the data collection period (e.g. Xanthopoulou et al., 2008). Research has employed daily diaries to investigate various stressors including home-work spillover and work engagement (e.g. Grzywacz et al., 2002; Harris et al., 2003; Jones and Fletcher, 1996; Xanthopoulou et al., 2008).

Daily diaries are believed to be reliable and valid in terms of reporting the daily experience of stressors and coping strategies given they are completed in a short time frame after the experience in comparison to other self-report measures (Tennen et al., 2000)

1.3.4.5 Personal Interviews

Although interviews collect the interviewee's subjective perceptions and opinions of stressors and strains they are considered to be investigator-based rather than totally self-report. Kvale (1996: 174) described an interview as, "a conversation, whose purpose is to gather descriptions of the [life-world] of the interviewee". In occupational stress research this would be in terms of interpreting the meaning of responses to questions about the work experience.

Individual interviews are usually conducted face-to-face (sometimes over the telephone) and can take the form of either a structured, semi-structured, unstructured or focus group interview. Structured interviews follow a pre-defined set of questions, which are asked in the same order without any change of wording to each and every respondent. The respondent's answers are recorded and transcribed verbatim. Probes, if allowed at all, are scripted beforehand. In this type of interview, the interviewer and the interviewee have little flexibility and, on this count, they can be very similar to self-report questionnaires (Berg, 2007).

Semi-structured interviews follow a prepared interview schedule or checklist giving questions for discussion but allowing flexibility. The format of the interview schedule is based on the assumption that the respondents have had a particular experience (e.g. occupational stress) which they can talk about. This permits the respondent to answer in detail and for the interviewer to probe or ask follow on questions where required (Rubin and Rubin, 2005). The respondent's answers are recorded and transcribed as for structured interviews.

Unstructured, open-ended interviews lack the standardisation of structured interviews making it difficult to compare responses from different participants, but because of their flexibility of approach have the potential for richer, deeper responses (Gubrium and Holstein, 2002). Good interviews require an experienced, trained interviewer with the necessary techniques to avoid intimidating or influencing the respondents. There is a potential for interviewer bias as he/she may bring pre-determined beliefs to the interview or may simply influence answers by his/her gender, age, appearance or manner. Social desirability may also affect the honesty of responses and interviews are relatively time-consuming at both the preparation and data collection stages (King, 1994).

Focus group discussions are usually open-ended interviews conducted by one or two interviewers of a small group consisting of 3-12 people. Focus groups contain people who are homogenous on some important feature for example, marital status, income level or profession and are therefore representative of a pre-defined section of the population being studied and not merely a random sample. The purpose of the study determines the topics for discussion by the group (Barbour and Sshostak, 2005).

Focus group discussions typically have a moderator or facilitator who explains the purpose of the study, reads out each open-ended question and encourages full participation by every group member. After the interview, a preliminary report may be written and transcripts of tapes or notes are prepared for analysis. The interactions between people in focus groups can produce large amounts of data, which are different to that obtained from individual interviews. Whilst this provides richer material for analysis it makes the process of transcription lengthy and difficult.

Focus groups may be difficult to organise (e.g. having enough people in one place at the same time), the group dynamics can affect answers and multiple focus groups may be required to cover all the sub-groups in the population being surveyed. Participants may be reticent to give real answers if this reduces their social desirability within the group. Where occupational stress is concerned, people may not wish to admit feeling stressed in front of others in case this jeopardises career advancement.

Melchior et al. (2007) used interviews and found associations between work stressors (e.g. demands, work control, lack of work support) and depression and anxiety in young working adults (*N* = 972). Other research has also used interviews or focus groups to investigate workplace stressors and strain (e.g. Almeida et al., 2002; Berland et al., 2008)

1.3.4.6 Evaluation of Self-Report Measures

Despite their popularity and utility in occupational stress research, self-report measures have various limitations. The main premise of self-report is that they are reliant upon the individual's subjective appraisals of the experience of stress, which supposes that the individual knows they are stressed, why they are stressed and will readily admit to it. Furthermore, these evaluations are open to unconscious repression of stress and conscious defensiveness by the individual being unable to or deciding not to disclose stress sources and symptoms (Semmer et al., 2004).

Whilst cognitive appraisals are considered important in relating the experience of stress, Cohen et al. (1995) suggest that an individual's cognitive schemas may influence self-reports of stress symptoms because the questions themselves may actually initiate the association of stress with particular symptoms. In this way, self-reports may reflect the individual's beliefs about stress which are reinforced by societal stereotypes and which might influence them to associate experienced physical and psychological symptoms with occupational stress (Salancik and Pfeffer, 1979).

A further limitation is that the validity of self-report responses may be reduced by the participants' tendency to respond to questions in a particular way. Social desirability, acquiescence and extreme responding (Paulhus and Vazire, 2007) are examples of these tendencies which are referred to as response styles when they are consistent across time and assessment situation, and as response sets when they are specific to a given situation. Social desirability may affect responses because the respondent may not want to admit difficulties with personal matters such as mental health (Paulhus, 2002). Conversely, the respondent may exaggerate stress levels due to experimenter-demand characteristics (Orne, 1962; Zizzo 2010). To control for social desirability bias, the test constructors can use only items considered neutral in social desirability but this is not always practical (Paulhus, 2002).

Acquiescent responding occurs when a participant tends to consistently agree with questions, for example, some measures of job strain ask participants which symptoms they have experienced. A respondent may agree with all the questions and this could indicate either that they are experiencing high levels of job strain or that they are exhibiting acquiescent responding. This can be controlled for in the construction of self-report measures by having appropriate reversed scored items (Paulhus and Vazire, 2007).

Extreme responding is the tendency to choose extreme high or low scoring responses on self-report measures. Factors such time pressure, emotional state and ambiguity of questions can induce extreme responses and confound the results. Extreme responding is not easy to control for; one method might be to have forced dichotomous, 'Yes/No' response but this can reduce reliability unless the scale has a high number of items (Paulhus and Vazire, 2007).

Individual differences may also affect the validity of self-reports for example, respondents' negative affect, neuroticism, emotional reactivity or their current state of well-being (Costa and McCrae, 1980). Negative affect bias has been frequently identified as confounding the effects of stressors on reported strains with the suggestion that individuals high in negative affect are more likely to perceive work characteristics as stressful and report more negative outcomes (Brief et al., 1988; Chen and Spector, 1991; Watson et al., 1987). However, this proposed bias due to negative affect can be questioned as negative affect could also determine the types of jobs people are employed in for example, jobs with higher stress, low autonomy and repetitive or boring in nature (Spector et al., 1995). Furthermore, negative affect when included as a moderator in studies, has not always reduced associations between stressors and strain (Spector et al., 1999).

The results of self-report questionnaires may lack predictive validity, as it can't be assumed that certain work factors identified as stressors, necessarily have a negative impact on well-being in everyday life or are merely disliked characteristics of the work environment (Bailey and Bhagat, 1987; Briner, 2000). There is a lack of association between self-report measures of physical and psychological symptoms and potentially clinical, harmful levels (Briner, 2000).

There is also the issue of Common Method Variance (CMV; Lindell and Whitney, 2001) which is believed to occur when researchers use self-report measures to assess both levels of perceived stressors (e.g. workload) and strain (e.g. psychological health outcomes). Potential sources of CMV include, the use of the same respondent and /or method when measuring both the predictor (independent variable) and the outcome (dependent variable); the design, complexity and ambiguity of self-report scale items, as well as the length of the scales and the context in which they are administered for example, same time and place (Eichorn et al., 2014).

CMV can be controlled for or reduced in various ways for example, by changing the design of the study so that different methods of measurement are implemented for the predictor and outcome variables; by collecting the data from the predictor and outcome variables at different times and in different places; or by withholding the purpose of the question to reduce sensitivity of the questions to the respondent involving minor deception (Eichorn et al., 2014). Some of these methods can be applied relatively easily whilst other involve time and money and therefore, may not be practical (Podsakoff et al., 2003). There are also various statistical methods that can be utilised involving latent variable modelling (LVM: See Eichorn et al., 2014 for a full review).

To control or reduce CMV bias when measuring occupational stressors and strain, independent measurement methods for the predictor and outcome could be applied for example, self-report measures of occupational stressors and clinical assessments of health outcomes or other objective measures of occupational strain (e.g. work records).

Most of the limitations with self-report measures have long been recognised (Kasl, 1986; Contrada and Krantz, 1987; Levanthal and Tomarken, 1987; Frese and Zapf, 1988) and contribute to the view that the use of subjective measures of occupational stressors and strains may result in an overestimation of the relationship between them.

1.3.5 Physiological Measures

Physiological measures are used to assess physiological indicators of stress, which may be traced back to Cannon (1929) and his research on psychological states that accompany emotions together with Selye’s (1936) General Adaptation Syndrome research on responses to noxious or aversive stimuli and more recently the Allostatic Load model (McEwen, 1998). Physiological responses are viewed as a route by which psychosocial stressors can affect health outcomes. Physiological indicators of the stress response may be measured to indicate occupational stressors, those most at risk and to more objectively predict the physical outcomes of stress. Physiological indicators also provide a way to avoid common method variance reported when self-reports measure both stressors and strains (Semmer et al., 2004) and are not easily influenced by experimenter demands or participants' expectations about stress and health which reinforces the notion of them as objective measures (Fried et al., 1984).

Contemporary measurement of physiological responses includes, but is not restricted to, measures of neuroendocrine activity (e.g. cortisol, adrenaline and noradrenaline); measures of cardiovascular response and measurement of immunological responses.

1.3.5.3 Measurement of Neuroendocrine Activity

Changes in neuroendocrine activity during and after stressful experiences are determined by measuring levels of circulating or excreted catecholamines, corticosteroids and hormones in the blood (Cohen et al., 1997). Measurement of neuroendocrine changes has proved increasingly popular over recent years and is currently employed to investigate the links between the work-related stress response and disease processes and the possible interaction between stress-related changes and the systems of the body (e.g. Akinola and Mendes, 2012; Backé et al., 2012; Chandola et al., 2010; Segerstrom and Miller, 2004; Thayer et al., 2010)

As previously cited, when a stressful situation or event is encountered, SAM activity increases and catecholamines (e.g. adrenaline and noradrenaline) are released into the bloodstream. Circulating and excreted levels of adrenaline and noradrenaline are assessed by blood and urine samples respectively. Blood sample assays tend to detect recent SAM activity due to the short turnover of circulating catecholamine levels (1-2 minutes) that reflect transient acute stress responses and not the effects of chronic stress. Urine samples, which measure comparatively stable excreted catecholamine values, tend to be more popular as they reflect average levels during the day. They are not absolute values but are useful in longitudinal studies of an individual or comparison between individuals.

During and after exposure to perceived stressors the adrenal cortex via the HPA axis produces and excretes increased amounts of corticosteroids, in particular cortisol. Increased levels of cortisol may be gauged from blood or urine samples. Salivary cortisol, which has been shown to increase with exposure to physical and psychological stressors is also frequently measured (Ganster and Rosen, 2013; Kirschbaum et al., 1996; Kirschbaum and Hellhammer, 1994).

1.3.5.4 Cardiovascular Responses

The Cardiovascular (CV) system is extremely responsive to physiological, psychological and behavioural conditions. When confronted with a stressful situation the heart rate increases and blood pressure rises as an element of the 'fight or flight' response (Selye, 1936). Blood pressure can be monitored with an arm cuff and sphygmomanometer or by automated equipment. Structured diaries, which consider lifestyle variables such as physical activity, posture, drug, alcohol or tobacco use, may be employed in conjunction with blood pressure tests for a more holistic account. Heart rate is usually measured by electrocardiogram (ECG) which the participant has to be wired up to whilst the reading is being taken. Changes in peripheral blood flow have also been observed, for example, by measuring blood flow in the fingers as a means of assessing stress effects on the CV system.

Unfortunately, some of these measures can elicit 'white coat hypertension' where the participant reacts to the stress of the occasion by displaying elevated blood pressure levels and this can give misleading results (Pickering et al., 1988). Studies using physiological measures of CV responses have sometimes used them in conjunction with other measures such as, self-report scales, and clinical interviews or alone (e.g. Backe et al., 2012; Hjorskov et al. 2004; Kivimaki et al., 2002).

1.3.5.5 Measurement of Immune Response

Various studies have reported immunological changes in response to everyday stressful situations or events (Glaser et.al., 1990; Glaser and Kiecolt-Glaser, 2005; Segerstrom and Miller, 2004). The immune system may also become compromised on a longer-term basis by chronic stressors with adverse health effects such as upper respiratory tract infections, slower wound healing, inflammation and lowered response to vaccines (Baum et al., 1993; Cohen et al., 2007; Glaser and Kiecolt-Glaser, 2005; Kiecolt-Glaser et al., 2002). Immunological changes are usually gauged by in vitro blood tests that measure cells, protein and functions. Blood assays monitor the number of various types of blood cells (e.g. macrophages, neutrophils) in response to stress (Segerstrom and Miller, 2004). They also measure the level of cytokines especially pro-inflammatory cytokines which have been linked to poorer health (Ershler and Keller, 2000).

1.3.5.6 Evaluation of Physiological Measures

Physiological systems have specific rhythms over time, for example, the circadian rhythm of circulating cortisol reaches a peak in the morning (Kirschbaum and Hellhammer, 1994) whilst adrenaline and noradrenaline reach peak levels later in the day (Van der Beek et al., 1995). In addition, all physiological systems are subject to individual differences due to various factors, for example, drugs, caffeine, alcohol, oral contraceptives, personality and current level of health, are able to affect catecholamine and cortisol levels (Kirschbaum and Hellhammer, 1994).

Physiological measures are also sensitive to activities that require mental and/or physical energy so it might be these normal activities that bring about cardiovascular or other physiological responses and not stress (Semmer et al., 2004). This means that physiological measures require very careful timing which reduces their utility.

In addition to the measurement issues already mentioned, there are problems with collection of samples where participants are expected to do this and complete protocol questions on food and alcohol intake, smoking and other behaviours themselves. Non-compliance with instructions can bias measurements for example, Kudielka et al. (2003) found that as many as a quarter of participants did not provide morning saliva samples in the time frame specified for cortisol testing.

Another measurement concern is that resting values of physiological indicators that are used as comparison to stress responses are not always reliable. Any of the factors previously cited can affect resting values as well as individual occurrences such as worry about upcoming events or arguments at home (Semmer et al., 2004).

There is no doubt that physiological measures are useful in the measure of stressors and the prediction of associated health outcomes, however, they may be considered intrusive, inconvenient, time-consuming, expensive and sensitive to a range of extraneous measurement variables. In order to establish a causal relationship between occupational stress and adverse health outcomes it may be advisable to combine the measurement of different physiological stress responses with psychological and epidemiological measures.

1.3.6 Observational Methods

Observational reports of job stressors do not rely on workers' subjective perceptions and are therefore hypothesised to be more objective and less prone to the biases inherent in self-report scales. Ratings can be made by more than one observer and analysed for inter-rater reliability and memory biases can also be discounted as observations are collected at the actual time of the events (Lepore, 1995)

Observational techniques include naturalistic observation where an independent ‘expert’ observer might typically use a standardised rating scale e.g. observer version of the Instrument for Stress Oriented Task Analysis (ISTA: Semner et al., 1995) to assess a range of work characteristics in terms of stressors based on his/her observations, which may be supplemented by self-report scales or interviews with the workers and their supervisors.

An early study by Elo and Vehviläinen (1983) investigated the validity of workplace observations using an observer checklist constructed to contain work factors such as repetitiveness and responsibility for safety together with physical, chemical and other possible stressors. Their research showed congruence between the expert observers (occupational health nurse and health and safety officer) and the worker or supervisor ratings of stress factors indicating support for observational methods. Unfortunately, this checklist has been little used in subsequent research possibly because information has to be collected by trained, experienced observers and the measurement tool may need to be adapted for use on specific occupations. Nevertheless, other research has provided support for the validity of observer ratings of job stressors and strains (e.g. Kälin et al., 2000; Grebner et al., 2005).

Despite claims that observational methods are objective they may not characterise ‘the true objective environment’ (Greiner and Krause, 2000). Observations of workers are only snapshots of workplace activities given time limitations and consequently can miss infrequent events such as imminent deadlines or broken equipment. The more unpredictable events are, the more likely they are to be missed by observers (Semmer et al., 2004).

There is also the fact that some stressors are not observable for example, cognitive demands and therefore reduce the validity of the observation (Semmer et al., 2004). Observers accounts can also produce a ‘halo effect’ where gaps in information are substituted with prevalent information or information that fits the stereotype expectations of the job (Spector et al., 1989).

Where ratings are not made by independent observers but by the worker’s supervisors or managers, observations may be biased by knowledge of the job or individual’s being observed. In addition, the workers being observed might try to hide any signs of stress so it does not affect their work progression (impression management) or they might appear to be stressed when they are not, in order to bring about changes to unsatisfactory work practices (Semmer et al., 2004). Likewise, supervisors and managers might make observations that underestimate or emphasise stressors in the workplace (Schonfield 1992b).

Observer reports raise the issue of individual privacy and whether the intrusive nature of the evaluation itself could then contribute to work pressures. Several concerns have been raised over the validity of observer ratings, in particular systematic underestimation of the relationship between occupational stressors and psychological or physiological disorders (Semmer et al., 2004). Factors which may contribute to this other than those already cited include; lack of observer training and lack of adequate knowledge of the workplace under observation; observer perceptions and appraisals of a particular work environment in comparison to other work environments, evaluation apprehension effects due to the observer's presence, and the overrepresentation of organisations with better working conditions due to exclusion from those with stressful working conditions (Frese and Zapf, 1988).

Observer reports can provide valuable information in certain situations (Roxburgh, 1996) however, taking into consideration the limitations identified they might be more effective when used in conjunction with self-report methods using structural equation modelling to analyse results (Semmer et al., 2004).

1.3.6.3 Organisational Data

Some research into occupational stressors has utilised objective indices of occupational stressors, such as average hours worked, days absent, staff turnover, punctuality records, productivity and health care claims as an adjunct to self-report methods (e.g. Goldberg et al., 2007; Melchior et al., 2005; Sommer et al., 2004). However, using organisational archive data raises the issue of individual privacy and whether the intrusive nature of the evaluation itself could then contribute to work pressures. Taking this into consideration together with the fact that organisational data is not usually relied upon as a major element of risk assessment it will not be reviewed in further detail.

1.4 Summary of Occupational Stress and its Measurement

In the preceding review of occupational stress, epidemiological, physiological and psychological definitions of the stress concept were considered together with descriptions of the stress process and the physiological, psychological and behavioural outcomes to acute and chronic stress.

Various theoretical frameworks used to explain occupational stress were examined and stress-related consequences both to the individual and to the organisation were highlighted, emphasising the legal and moral responsibility of organisations to safeguard the psychological and physical well-being of their employees.

It was acknowledged that difficulties exist in reliably identifying and assessing occupational stress due to the limitations of measurement instruments and popular stress measurement methods were briefly evaluated. Methodological problems, particularly with self-report measures were also identified.

The serious consequences of occupational stress both at individual and organisational level, together with the inadequacies of commonly used measurement methods such as self-report scales in identifying and evaluating occupational stress and its outcomes, indicate the need for alternative or supplementary measurement techniques to those previously discussed.

The following section of this literature review considers the cognitive perspective of anxiety, stress and attention, the conceptual overlap between stress and anxiety and critically reviews research using the emotional Stroop paradigm which has been extensively employed to investigate attentional biases towards threatening information in emotional disorders. A rationale is offered for the use of an occupational stress-related Stroop task as an alternative or supplementary measure of occupational stress.

1.5 Anxiety, Stress and Attention

There is a considerable body of research reporting on cognitive processing biases for threatening information in emotional disorders and states. Attentional, interpretative and memory biases have been exhibited in a variety of psychopathologies and also in non-clinical samples with maladaptive emotional states (Gotlib et al., 2004; Mathews and MacLeod, 1994, 2005; MacLeod and McLaughlin, 1995; Voncken et al., 2003; Williams et al., 2000). Given that anxiety can be a psychological and physiological outcome stress, it seems reasonable to propose that attentional bias may be also exhibited in individuals who report higher levels of (occupational) stress.

The main focus of this section of the thesis is on attentional biases to threat-related stimuli as they relate to anxiety rather than on types of stimuli found to be associated with attentional biases in other emotional conditions such as, addiction, depression, eating disorders and chronic pain. Although attentional bias has been reported in other conditions, the aetiology and manifestations of these are very different to anxiety disorders and as such beyond the scope of this thesis.

Research with clinically anxious and non-clinically anxious individuals has centred on attentional bias towards threat-related stimuli and variously considered how this bias affects performance on a range of experimental cognitive tasks as well as proposing mechanisms that might account for attentional bias (Williams et al., 1996,1997).

The following sections outline definitions and characteristics of anxiety, attention and attentional bias with a focus on the cognitive perspective. A number of influential cognitive theories of anxiety that offer explanations for attentional bias are outlined. These theories propose that attentional biases in particular play a role in the development and maintenance of anxiety in both clinical and non-clinical populations (e.g. Eysenck, 1992; Eysenck et al., 2007; Mogg and Bradley, 1998; Williams et al.,1997). The conceptual overlap between stress and anxiety is discussed and an argument put forward for consideration of anxiety as symptomatic of stress (and occupational stress) and therefore likely to produce the attentional bias that is proposed by the aforementioned theories of anxiety.

In line with these theories, research on stress and attention is introduced which propose that stress activates automatic cognitive responses including attentional bias. The section on Attentional Bias and Anxiety continues by introducing the emotional Stroop paradigm (Mathews and Macleod, 1985), an experimental method that has been employed to elicit and measure attentional bias for threat-related stimuli in clinical samples with various psychopathologies (e.g. anxiety disorders) as well as non-clinical samples in maladaptive affective states. Research using the emotional Stroop task is reviewed and operational variations together with underlying mechanisms for Stroop interference are considered.

1.5.2 Anxiety

Anxiety or fear was traditionally regarded as one of the basic emotions in nearly all theories of human emotions (e.g. Plutchik, 1980; Russell, 1991) but was not fully recognised as a distinct and pervasive human emotional disorder until early in the 20th century. In differentiating between fear and anxiety, it is proposed that fear is an innate alarm response to current or imminent, perceived threats whereas anxiety is an affective state focussed on preparation for potential future threats (Barlow 2002, Sylvers et al., 2011).

There is no universally accepted definition of anxiety (Barlow, 2002) and various descriptions have been proposed from differing perspectives. From a biological perspective, anxiety has been defined as, "…a psychological, physiological, and behavioral state induced in animals and humans by a threat to well-being or survival, either actual or potential. It is characterized by increased arousal, expectancy, autonomic and neuroendocrine activation, and specific behavior patterns." (Steimer, 2002: 231). As with the stress response, these changes are viewed as adaptive and have the function of assisting the individual to cope with adverse or unpredictable situations or events but can also hinder everyday coping abilities if prolonged or excessive. (Steimer, 2002).

Freud (1936) proposed from a psychodynamic perspective that anxiety played a central role in the development of both personality and psychosomatic disorders and further asserted that anxiety was ‘something felt’ – a specific unpleasant emotional state or condition of the human organism that included experiential, physiological, and behavioural components.

Spielberger (1966) defined anxiety as a psychological construct in which a subjective response to a perceived potential stressor elicits apprehension and tension. Beck et al. (1985) describe anxiety as involving complex physiological, affective, cognitive and behavioural changes. Physiological changes take the form of autonomic nervous system arousal (fight or flight response) whilst affective changes comprise feelings of apprehension and/or fear. At the cognitive level, anxiety brings about thinking difficulties including poor concentration; sensory-perceptual indications such as hypervigilance and losing touch with reality. Behavioural symptoms include defence and flight from the perceived threat; inhibition of risk-taking behaviour and disengagement of motor responses (Beck et al.,1985: 51). More recently Eysenck et al. (2007: 336)) describe anxiety as, “…an aversive emotional and motivational state occurring in threatening circumstances.”

Spielberger et al. (1970) further dichotomised anxiety into trait and state anxiety. Trait anxiety is an inherent disposition to react to situations perceived as threatening with anxiety and can be defined as, "…relatively stable individual differences in anxiety proneness..." (Spielberger et al., 1970:3). Neuroticism which closely resembles trait anxiety, is included as a major dimension of most influential personality theories (e.g., Cattell and Kline, 1977; Eysenck, 1967; Costa and McCrae 1980) and the two concepts have frequently and positively correlated with each other on a range of self-report measures (Watson and Clark, 1984).

State anxiety is the currently experienced intensity of anxiety and can be further defined as, "…unpleasant, consciously perceived feelings of tension and apprehension, with associated activation or arousal of the autonomic nervous system" (Spielberger, 1972:29). State anxiety is often associated synonymously with stress due to having similar physiological, psychological and behavioural indicators. However, it might be useful to distinguish between them in that state anxiety is one of many adverse symptoms of stress whereas stress can be defined as a response to a specific stressor.

1.5.3 Anxiety Disorder

Anxiety is of major interest in clinical psychology with the Diagnostic and Statistical Manual (DSM-5, American Psychiatric Association, 2013) providing diagnostic descriptions and criteria for the principal category of anxiety disorders. The DSM-5 differs from the DSM-IV (American Psychiatric Association, 2000) in that the previous category of Anxiety Disorders has become three separate categories in the DSM-5. These categories are, i) Anxiety Disorders (including general anxiety disorder (GAD), specific phobias and social anxiety disorder, ii) Obsessive-Compulsive and Related Disorders (including body dysmorphic disorder and trichotillomania) and iii) Trauma and Stressor-Related Disorders (including post-traumatic stress disorder (PTSD), acute stress disorder and reactive attachment disorder).

The diagnostic criteria differ for each of the Anxiety Disorders for example, GAD in adults consist of persistent, excessive anxiety and worry about everyday events accompanied by three of the following symptoms occurring more often than not during a six-month period; restlessness, being easily fatigued, difficulty concentrating, irritability, muscle tension and sleep disturbance (DSM-5: American Psychiatric Association, 2013).

In terms of mental health disorders, anxiety disorders are relatively common and a recent meta-analysis of 87 studies across 44 countries, reported the global prevalence of anxiety disorders as 7.3%, ranging from 5.3% in African cultures to 10.4% in European and Anglo cultures (Baxter et al., 2013: 897).

1.5.4 Anxiety and Performance

Anxiety has been shown to impair performance across a range of cognitive functions including, memory, concept formation, problem solving and attention

(Sieber et al., 1977; Spielberger, 1966). Performance on most tasks is adversely affected by high levels of stress or state anxiety (Eysenck, 1992). This finding is consistent with what is termed the Yerkes-Dodson law (Yerkes and Dodson, 1908) which proposes that a curvilinear relationship exists between performance and the arousal stemming from stress and anxiety. Thus, performance on cognitive tasks is better when arousal is moderate compared with when arousal increases or decreases from that optimal level. Performance is poor at high and low levels of arousal with increases in task complexity resulting in larger performance deficits (Yerkes and Dodson, 1908).

1.5.5 Attention

Attention serves as a strategy to assist our limited capacity information processing system in dealing with the flow of incoming stimuli assailing our senses. It involves selection or prioritisation of some stimuli to be processed more extensively and to determine response or behaviour, to the exclusion (partial or complete) of other stimuli (Wells and Mathews, 1994). Auditory and visual attention have been investigated using a variety of different methods including the dichotic listening task (Moray, 1959; Treisman, 1960), and the Posner task (Fox et al., 2001; Posner, 1980).

The study of attention has for the most part been separated into selective (focussed) attention and divided attention. Selective attention involves the processing of only one incoming stimulus and divided or selective attention refers to the processing of at least two incoming stimuli at the same time (Pashler, 1998).

Additionally, research on sustained attention or vigilance is used to offer explanations for concentration and distractibility in individuals (Kannass et al., 2006; Manley et al., 1999) whilst hypervigilance (general and specific) has been linked to attentional biases towards threat-related stimuli in anxiety and other emotional disorders and states (Eysenck, 1992). It has also been suggested that allocation of attention is somewhat dependent on the relevance or salience of the stimuli to the individual in that increased relevance results in allocation of attention (Bundesen et al., 2005; Norman, 1968).

The characteristics of attention have been extensively studied over the years (e.g., Cattell, 1986; Moray, 1959; Posner and Snyder 1975; Posner and Peterson, 1990; Shiffrin and Schneider, 1977). Moray (1959) and Posner and Snyder (1975) agreed that attention varies with level of arousal and has a limited processing capacity.

Posner and Snyder (1975) and Shiffrin and Schneider (1977) distinguish between two types of attentional processes, namely controlled or strategic (conscious, relatively slow, require attention and have limited capacity) and automatic (unconscious, fast, no demands on attention, no capacity limitations). Novel or difficult tasks usually require controlled processes whereas some tasks may become automatic with considerable practice (Posner and Snyder, 1975; Schneider and Shiffrin, 1977).

1.6 Cognitive Theories of Anxiety and Attention

Numerous cognitive theories attempt to provide explanatory frameworks for the aetiology and maintenance of attentional biases in anxiety. Four influential cognitive models proposing that anxiety plays a major role in the development and continuance of attentional bias are outlined in the following sections. These are, Schema Theory (Beck, 1976; Beck, et al., 1979, 1985 Beck and Clark, 1988, 1997); Mathews and MacLeod (1994) Prioritisation Model; Hypervigilance Theory (Eysenck, 1992); and Attentional Control Theory (Eysenck et al., 2007).

1.6.1 Schema Theory (Beck, 1976; Beck, et al., 1979, 1985 Beck and Clark, 1988, 1997)

The schema theory of anxiety and other emotional disorders (Beck, 1976; Beck, et al., 1979, 1985 Beck and Clark, 1988, 1997) is based on clinical observations and posits that anxiety disorders develop and are sustained by the activation of certain memory structures or schemata, which are stored representations of previous knowledge and experience (Beck and Clark, 1988:24). Bartlett (1932) suggested that schemata influence memory processes whilst other theorists have contended that schemata may modify processes involved in attention, perception and comprehension (e.g. Schank, 1972, Dalgleish and Watts., 1990, Beck and Clark., 1997, Mogg et al., 1997).

Beck and Emery (1985) theorised that individuals might possess pre-disposing factors such as particular cognitive styles involving unrealistic goals or unreasonable attitudes, hereditary physical diseases, inadequate life experiences or traumatic developmental experiences which makes them vulnerable to anxiety.

There are many different schemata, each representing different configurations of stimulus-response, but in the study of anxiety disorders the self-schemata which process information about the self are the most significant (Markus, 1977).
Beck's schema theory includes a superordinate organising principle or 'mode' consisting of different groups of rules and concepts arranged into general themes. In anxiety disorders the 'vulnerability' or 'danger' mode is said to be dominant. Beck and Clark (1997) also proposed that schema congruent processing proceeds through the influence of schemata directing processing resources to areas of the external/internal environment, which are associated with them. Consequently, anxious individuals will attend to physically or psychologically threatening stimuli, they will interpret ambiguous stimuli as threatening and threatening information will be readily retrieved from memory.

Individuals possessing dysfunctional schemata representing physical or psychological threat may not necessarily undergo schema congruent processing and the dysfunctional schema may remain latent until such time that it is precipitated by relevant life stressors. Furthermore, Beck and Clarke (1988) suggested that individuals who possess these latent dysfunctional schemata might display cognitive vulnerability to the development of anxiety or depression.

Beck and Emery (1985) made specific predictions regarding cognitive function in clinically anxious patients based on their own experimental findings and those of previous research. Firstly, anxious individuals selectively allocate processing resources to threatening as opposed to non-threatening stimuli (Broadbent and Broadbent, 1988; Eysenck et al., 1987; MacLeod et al., 1986). Secondly, anxious patients are more likely to interpret ambiguous stimuli as threatening compared to non-anxious individuals, (Eysenck et al., 1987; Mathews et al., 1989). Finally, Beck and Emery (1985) concluded that anxious individuals have a reduced information processing capacity due to constantly scanning the environment for threatening stimuli and so reducing the capacity available to deal with other cognitive demands. Although there is some evidence to support this notion (Eysenck, 1979, 1982, 1983, 1985), it is unclear whether environmental scanning causes the reduced capacity. It has also been suggested that the processing of worries or other relevant concerns reduces processing capacity on cognitive tasks in anxious individuals (Eysenck, 1979)

Beck's theory conceptualises three different levels of cognition involved in emotional disorders. These are cognitive memory structures (schemata) leading to cognitive processes or 'thinking errors' which produce 'negative automatic thoughts' (Beck et al., 1979). Different emotional disorders are distinguished by their own particular negative automatic thoughts (Beck, 1967). In anxiety, these negative automatic thoughts concern personal danger (Beck, 1976; Beck et al., 1993; Beck and Clarke, 1988). Automatic thoughts are considered to be cognitive products of emotional disorders because they are rapid, often abbreviated, plausible (at the time they occur) and the individual is unable to repress them (Beck, 1967). Schemata associated with these automatic thoughts influence their composition. Beck proposed that vulnerable individuals might possess more inflexible, rigid schemata than normal individuals which are latent until activated by the existence of similar conditions to those in which they were first formed. In anxiety disorders the latent schemata are likely to symbolise subjective, emotional threat to the individual and their reduced coping ability.

A central tenet of Beck's theory is that schema-congruent processing and consequent hypervigilance towards perceived threat is not a consciously mediated process and occurs without conscious awareness (pre-attentive). Another cognitive anxiety theory which follows this premise, is that of Bower (1981).

Beck's (1979, 1986) schema model of anxiety and pre-attentive/attentive bias has been questioned in terms of its explanatory power for patterns of cognitive biases observed in depression (Mogg and Bradley, 1998). According to this model, schemata representing emotions such as anxiety and depression should be activated when the appropriate emotion is felt, increasing vulnerability towards that threat. Mogg and Bradley (1998) argued that whilst research evidence had emerged in support of attentional biases towards threat in anxiety (e.g. McLeod et al., 1986, Mathews and Klug, 1993), research had failed to demonstrate attentional biases in depression (e.g. McLeod et al., 1986) but did demonstrate memory recall biases (Mogg et al., 1987).

1.6.2 Hypervigilance Theory (Eysenck, 1992)

Hypervigilance theory follows that premise that emotion of anxiety is considered part of an adaptive early-warning alarm system that originally developed to detect danger or threat (Oatley and Johnson-Laird, 1987; Öhman et al., 2001). Eysenck (1992) emphasised this as the most vital function of anxiety but suggested that anxious individuals become excessively aware of or hypervigilant to perceived threat and may exaggerate the importance of such situations.

Hypervigilance is characterised by the anxious individual constantly scanning the environment for threatening stimuli, with processing being prioritised towards the initial encoding of threat (Eysenck, 1992). In these cases, anxiety may become dysfunctional in that hypervigilance towards threat is believed to maintain anxiety (Cisler and Koster, 2010; Eysenck, 1992).

Eysenck (1992) believed that it was necessary to examine the pre-attentive and/or attentional processes involved in facilitated threat detection and proposed that anxious individuals are prone to several cognitive biases which may affect attentional processes. Firstly, anxious individuals are likely to display selective attentional bias to threat-related stimuli and secondly, they may be highly distractible because of their biased sensitivity to threat. Thirdly, they may exhibit a broadening of attention accompanied by excessive environmental scanning prior to detection of salient threat-related material, which is followed by a narrowing of attention when the threat-related material is being processed. In addition to these biases affecting attentional processing, anxious individuals may also display an interpretative bias where even viewing ambiguous situations and information is interpreted as threatening. Eysenck (1992) hypothesised that all of these elements will be more noticeable when highly anxious individuals have elevated levels of state anxiety or stress.

1.6.3 Mathews and MacLeod (1994) Prioritisation Model

Mathews and MacLeod (1994) proposed that a prioritisation model, developed from Oatley and Johnson-Laird's (1987) theory of emotions might be more generally applied to the phenomena of emotional Stroop interference. Oatley and Johnson-Laird (1987) propose that emotions have evolved to co-ordinate a modular nervous system and that they occur when goals are interrupted. Emotions indicate a point in the pursuit of goals or avoidance of undesired consequences. Emotional signals set the cognitive system into emotion-mode. According to Oatley and Johnson-Laird (1987: 33), emotions satisfy evolutionary priorities to take any action required to evade threat in that,

> "The functions of emotion modes are both to enable one priority to be exchanged for another in the system of multiple goals, and to maintain this priority until it is satisfied or abandoned".

Anxiety heralds a shift into hypervigilance mode whereby the individual constantly scans the environment for threat and those who have previously experienced threat exhibit increased hypervigilance. Hypervigilance mode elicits modifications to the cognitive system enabling it to prioritise early automatic encoding of threat stimuli, but not strategic rehearsal for explicit memory encoding (Mathews and Macleod, 1994). This hypothesised bias involving pre-attentive processes appears to have been detected in subliminal Stroop interference studies involving emotional stimuli (Phaf and Kan 2007; Lundh et al., 1999; MacLeod and Rutherford, 1992; MacLeod and Hagan, 1992; Mogg, Kentish and Bradley, 1993; Mogg et al., 1993).

1.6.4 Attentional Control Theory (Eysenck et al., 2007(

Attentional Control Theory (ACT; Eysenck et al., 2007) is a development of Processing Efficiency Theory (PET; Eysenck and Calvo, 1992). The central tenet of ACT, which is carried over from PET, is that anxiety impairs processing efficiency more than performance effectiveness. Processing efficiency being the relationship between task performance and the cognitive resources required to perform the task. Processing efficiency decreases when more cognitive resources are required to reach a certain performance level. Performance effectiveness is the quality of task performance for example, reaction time. Both PET and ACT claim that worry is the significant element of anxiety responsible for increasing resource requirements and reducing processing efficiency.

Another major assumption of ACT is that anxiety impairs efficiency of the goal-directed (top-down) attentional system which in turn increases the influence of the stimulus-driven (bottom-up) attentional system due to facilitated detection of threat-related stimuli. The assumption that anxiety facilitates detection of threat is reached following empirical evidence from various attentional bias studies (e.g. Bar Haim et al., 2007; Egloff and Hock, 2001; Mogg and Bradley, 1998) demonstrating preferential attention to threat-related stimuli.

In this way, because anxiety automatically directs attention to the source of threat (Fox et al., 2005; Power and Dalgleish, 1997), it disrupts the balance between the stimulus-driven and the goal-directed systems and reduces attentional control. These effects are magnified when anxiety is high (that is, when the individual is faced with a situational stressor) which further reduces goal- directed attention resulting in more attention being directed towards concern- related stimuli (Eysenck et al., 2007).

Following a latent variable analysis by Miyake et al. (2000) which identified three major functions of the central executive (inhibition, shifting and [1]updating), ACT suggests that the theorised decrease in processing efficiency depends on two of these central executive functions which relate to attentional control namely, inhibition and shifting. Inhibition is defined as, using attentional control to

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[1] Updating is defined as a memory function and not directly involved in attentional bias and therefore, will not be discussed further

deliberately inhibit automatic responses and shifting is referred to as using attentional control to shift attention and maintain focus on task-relevant stimuli (Miyake et al., 2000).

When attentional control is impaired by anxiety as outlined above, inhibition and shifting are also adversely affected. Accordingly, anxiety reduces individuals' ability to avoid directing attention towards external and internal, task-irrelevant stimuli in addition to reducing their ability to shift and maintain attention on task-relevant stimuli. Eysenck et al. (2007) acknowledge that whilst anxiety does not always impact on performance effectiveness (naming the correct ink colour on an emotional Stroop task), the additional resources required to maintain performance are likely to affect efficiency (e.g. speed of colour naming performance on an emotional Stroop task) particularly in the presence of situational stress (concern-related word stimuli). The ACT model's focus on goal-directed attentional processes in this relationship distinguishes it from other models and offers an explanatory framework for decreased attentional control in anxiety.

1.7 The Conceptual Overlap Between Stress and Anxiety

Although stress and anxiety are often used analogously in research, they are different concepts which overlap particularly in terms of physiological and psychological responses. Stress and anxiety are both fraught with difficulties when looking for absolute definitions but the following summarises the approaches to defining both concepts previously outlined in this Literature Review.

In Section 1.1. various difficulties in defining stress were outlined and it was acknowledged that the term ‘stress’ has several referents. Firstly, it is referred to as characteristics of a stimulus (stressor) which *causes* stress (e.g. Beehr, 1995; Griffin and Clarke, 2011). Secondly, stress can be referred to as an *effect* (response) which has specific physiological features involving the HPA axes and the release of catecholamines, which might be accompanied by affective states such as anxiety and worry (Selye, 1950).

Stress can also be defined as an interaction (e.g. French et al., 1974, 1982), or transaction (e.g. Lazarus and Folkman, 1984, Lazarus, 1991) between a person and the environment where an individual’s cognitive appraisal of decides the level of demand, the response to the demand and the adequacy of their coping resources to deal with the demand (Lazarus and Folkman, 1984).

This lack of conceptual clarity applies to all areas of psychological research on stress including organisational research. Jex et al., (1992) reviewed 51 research articles from the organisational literature and found that the term ‘stress’ was referred to as a cause in 41% of the research, whereas 22% described it as an effect (response) and 25% described it as both a cause and an effect.

Given this conceptual confusion, it might be useful for the purpose of this doctoral research to view stress as representing an interaction between certain environmental stimuli (stressors) and a specific stress response mainly involving the hypothalamic–pituitary–adrenal (HPA) axis and/or catecholamines (Chen et al, 2017). Alternatively, anxiety comprises characteristic cognitive, behavioural and physiological responses to threatening or ambiguous situations perceived as stressful. In contrast to stress, anxiety cannot always be directly associated with an external stimulus, might have no discernible origin and need not be accompanied by a distinct physiological response. Anxiety is frequently part of an individual's stress response and therefore, unlike stress, is always described as an outcome.

Anxiety is only one of the possible psychological outcomes of stress which, as previously cited, can also include affective states such as depression (Netterstrom et al, 2008), anger, reduced self-esteem and reduced self-efficacy (Cox et al., 2000; Leka and Jain, 2011; Nieuwenhuijsen et al., 2010; van der Doef and Maas, 1999; Tennant, 2001). Given it is acknowledged that anxiety is symptomatic of stress, many self-report stress questionnaires (including those measuring strains as outcomes of occupational stress) measure anxiety as an outcome of stress and include items asking respondents to report anxiety, whilst also considering individual differences in the perception of situations as stressful.

An interesting example of this relationship between stress and anxiety, can be seen in the case of post-traumatic stress disorder (PTSD) which was recently re-classified in the DSM – 5 (American Psychiatric Association, 2013) from the category of anxiety disorders to that of stress disorder (triggered or induced by trauma). Although PTSD is classified as a stress disorder, its clinical profile includes numerous manifestations that are observed in pathological anxiety (Chen et al., 2017). However, the DSM – 5 recognises that PTSD cannot be simply explained as an anxiety disorder but a disorder that links stress exposure, fear systems and symptoms of anxiety. Furthermore, research has shown that hormonal changes typically linked with the stress response have been observed in cases of PTSD (Chen et al., 2017)

As previously cited, various cognitive theories of anxiety have proposed that anxiety has effects on cognitive performance. This doctoral thesis is particularly concerned with the effects of anxiety on attention and the attentional bias towards threat-relate material that is said to be elicited by anxiety. Following the above premise that anxiety is symptomatic of stress, it seems reasonable to suggest that anxiety is likely be produced in response to occupational stress and that an attentional bias to occupational threat-related stimuli will result.

The following section briefly reviews the cognitive perspective of stress, attention and performance, which has many similarities with the effects of anxiety.

1.8 Cognitive Perspectives on Stress and Attention

As previously cited, research has suggested causal links between stress and adverse health outcomes (physiological and psychological) due to the numerous physiological responses that are activated when individuals perceive environmental threat (e.g. Kasl, 1984; Kivimäki et al., 2006; Selye, 1959). In terms of stress and attention, biases in attention are proposed to originate in the evolutionary response to environmental threat (Eysenck, 1992; Öhman et al., 2001) which acts as an adaptive early warning system to enable escape.

Previous research has found increased stress responsivity and attentional biases in both clinically and non-clinically anxious individuals as well as in other psychopathologies such as eating disorders, chronic pain, addiction (Bar Haim et al., 2007; Crombez et al., 1999; Mathews and McLeod, 1985; Williams et al., 1996).

There is also research showing that individuals with affective disorders, together with those exposed to a chronic life stressor, exhibit physiological changes (e.g. increased heart rate, elevated cortisol, and immune response) when exposed to a laboratory stressor (e.g. Dickerson and Kemeny, 2004; Kirschbaum et al., 1993).

Attentional processing is guided moment to moment by central executive networks but in accordance with evolutionary theories of anxiety and emotion (e.g. Eysenck, 1992, Öhman et al., 2001) attention can be captured by sudden, acute detection of threat with a subsequent increase in selective attention to facilitate escape or avoidance of harm. Consequently, interest has grown in terms of investigating possible links between acute physiological responses to stress and performance on controlled attention tasks. Chajut and Algom (2003) induced stress in healthy participants using various tasks (e.g. time pressure and difficult/insolvable word tasks) prior to administering the classic Stroop task (Stroop, 1935b) as a measure of selective and divided attention. They found facilitated performance (reduction of Stroop interference) indicating that stress induction improved attentional abilities. Booth and Sharma (2009) also found improvement in Stroop performance in stressed individuals. In this way, stress reduces the availability of attentional resources so that attention is directed to task relevant processing and consequently processing of salient information is relatively interference free, whereas peripheral processing is reduced or excluded.

Other research supports the findings that stress is associated with improvements in selective attention (e.g. Kofman et al., 2006; Rodrigues et al., 2009; Weerda et al., 2010). Findings from these studies are consistent with Easterbrook's (1959) early influential theory of attention and emotion which hypothesised that stress improves selective attention because it progressively excludes the range of cues involved in a given task so that only the most relevant are processed. Therefore, selective attention improves with stress due to a narrowing of attention towards task relevant processing. Wells and Matthews (1994: 187) concluded from Easterbrook's theoretical stance that, "one of the few consistent effects of arousing stressors which generalizes across different sources of stress is narrowing of attention".

In contrast to research that has found improvements in selective attention for individuals exhibiting stress, other research has found decrements in selective attention associated with stress (e.g. Arnsten, 2009; Plessow et al., 2012a; Sanger et al., 2014; Steinhauser et al., 2007) and an explanation for this is postulated by capacity-resource theories (e.g. Eysenck et al., 2007; Wells and Matthews. 1994). Where Easterbrook's (1959) theory specifies that attention will be preferentially directed towards relevant stimuli due to stress narrowing attention, capacity-resource theories of stress and attention offer an alternative explanation in terms of what decides the 'relevance' level of stimuli for attentional processing in stressed individuals. As the name suggests, the main focus here is on the concept of a limited information-processing capacity for the attentional system (Kahneman, 1973). Following this theory, efficient processing is limited to the most easily accessible, automatically activated dimensions of the environment. In a stressed individual, this might be thoughts and events associated with their current concerns irrespective of whether they are relevant to completion of a task. In this way, attention fails for other stimuli regardless of whether they are relevant and essential to the task demands. Therefore, if more readily accessible, automatically processed stimuli are irrelevant to the task, no attention is directed to completion of the task. The personal relevance of particular environmental information when under stress reduces the capacity to attend to other dimensions including those that are relevant for the task and which usually require effortful controlled attention. It is also commonly believed that stress and arousal use up information processing resources needed for controlled attention (Wells and Matthews. 1994).

Eysenck et al. (2007) proposed attentional control theory as an example of capacity-resource explanations of stress and attentional bias. They suggested that once a threat has been recognised and dealt with, automatic engagement of attention can be countermanded by top-down, controlled processes leading to disengagement of attention. However, as attentional control is said to decrease with situational stress exposure (Eysenck et al., 2007) these higher-level processes may not totally overrule attentional engagement with threat stimuli in some individuals due to the increased influence of bottom-up, stimulus-based processing. Past research suggests that attentional bias is characteristic of anxiety when anxious individuals are seen to be hypervigilant towards even ambiguous environmental stimuli that others perceive as harmless (Bar Haim et al., 2007; Eysenck, 1992; Eysenck et al., 2007; MacLeod et al., 1986; Matthews and MacLeod, 1994). This is in line with Attentional Control Theory (ACT: Eysenck et al., 2007) which was previously cited as an influential theory of anxiety and attentional bias where processing efficiency is particularly impaired by high anxiety in the presence of a stressor, which in turn disrupts the balance between the stimulus-driven and the goal-directed systems and reduces attentional control.

Accordingly, it seems feasible that acute stress influences automatic components of selective attention due to lack of attentional control. Furthermore, it is possible that when individuals experience chronic stress (with accompanying anxiety) and attentional control is reduced, they are more easily distracted by threat-related stimuli and/or less able to disengage from it resulting in attentional bias towards threatening stimuli that can lead to anxiety disorders or other psychopathologies (Eysenck et al., 2007). Capacity- resource theories attempt to explain increases in

Stroop interference on classic Stroop tasks as due to limited capacity for processing of less accessible, information requiring controlled processing. Eysenck's attentional control theory explains Stroop interference as being due to reduced attentional control in stress (or anxiety) and concomitant capacity limitations.

Capacity-resource theories appear to be in accordance with popular anxiety and attention theories although the counter arguments based on Easterbrook's theory require further consideration.

1.9 Attentional Bias

Many cognitive theories of anxiety propose that anxiety disorders are distinguished by an unconscious preoccupation with, and sensitivity to, threat-related stimuli (e.g. Beck et al., 1985; Eysenck et al., 2007) termed (selective) attentional bias (Eysenck, 1992; Mathews and MacLeod, 1985) which can be further defined as, "differential attentional allocation towards threatening stimuli relative to neutral stimuli" (Cisler and Koster, 2010: 203).

According to Williams et al., (1997: 73) attentional bias is said to have occurred,

> "…when there is a discrete change in the direction in which a person's attention is focussed so that he/she becomes aware of a particular part or aspect of his/her environment".

This discrete change may take place in any sense modality, is perceived to be dependent upon a distinct change in the individual's external or internal environment and is predominantly viewed as passive or involuntary but can also be voluntary (Williams et al., 1997).

Research has investigated the effects of attentional bias on performance for anxious individuals using a range of experimental paradigms including, the emotional Stroop (Bar Haim et al., 2007; Becker et al., 2001; Mathews and McCleod, 1985; Mogg et al., 1993), visual search (Hahn et al., 2006; Rinck et al., 2003), emotional spatial cueing (Fox et al., 2001; Koster et al., 2004; Mogg and Bradley, 2002) and the visual dot probe task (Koster et al., 2004, 2005; Mogg et al., 1997; Bradley et al., 1999) for visual attention, and the dichotic listening task for auditory attention (Foa and McNally, 1986; MacLeod and Mathews, 1988).

As previously cited, selective attentional bias has also been detected in individuals exhibiting stress, with research reporting both facilitation (e.g. Booth and Sharma, 2009; Chajut and Algom, 2003; Rodrigues et al., 2009) and impairment of performance (e.g. Arnsten, 2009; Plessow et al., 2012a; Sanger et al., 2014; Steinhauser et al., 2007) on various cognitive tasks including the classic Stroop (e.g. Kofman et al., 2006) the task switching paradigm (e.g. Kofman et al., 2006; Plessow et al., 2012a) and the explicit cueing paradigm (e.g. Steinhauser et al., 2007). In terms of the emotional Stroop task, some research has investigated the interaction between trait anxiety and induced stress (e.g. Mogg et al., 1990) whilst a few studies have considered naturally occurring stress for example, students prior to an exam (e.g. MacLeod and Rutherford, 1992).

Two main approaches have been employed in experimental designs investigating attentional bias in anxiety, the first being to investigate facilitation effects on performance as a consequence of attentional bias towards threat-related stimuli. Such research has frequently employed the visual dot probe task (e.g. Koster et al., 2004). The second approach investigates interference effects on performance as a consequence of attentional bias towards threat-related stimuli and this been dominated by the emotional Stroop task (e.g. Mathews and MacLeod. 1985).

The current research focusses on interference effects of attentional bias towards threat-related stimuli as observed in the emotional Stroop task. The following sections outline the investigation of attentional bias using the emotional Stroop paradigm, with specific reference to anxiety disorders and conditions, and reviews the extensive body of research conducted using this experimental paradigm.

1.10 The Classic Stroop Paradigm

Stroop's (1935b) original studies set out to explain the interference effect of colour-naming versus word reading found by Peterson et al. (1925) and involved two separate experiments. Experiment 1 considered the effect of incongruent ink colours on reading words aloud and comprised of five words (*red, blue, green, brown and purple*) printed in incongruent ink colours, for example the word 'red' would be shown in green ink and the participant had to read the word aloud. The stimuli were presented on a 10-inch x 10-inch card with a second card presenting the stimuli in reverse order. Control condition cards were identical to the experimental cards except that the words were printed in black ink only. The results showed no significant difference in reading times between the experimental and control conditions and therefore, no interference from incongruent ink colours on word-reading.

In Experiment 2, known as The Standard Stroop Colour-Word Test (1935) the task was switched so that the participant had to name the colour of the ink aloud rather than read the word. The control cards had ink colours in the same order as the experimental cards except that solid colour squares replaced the words. The results indicated a 74% increase in colour naming times of words incongruent to the colour ink than for solid colour squares and therefore highly significant interference from these words in naming ink colours.

Early variations on The Standard Stroop Colour-Word Test (1935b) used miscellaneous stimuli, for example meaningless data such as a series of X's (XXXXX), nonsense syllables (e.g. *bhdr, gsxrq*) semantically related words (e.g. '*sky'-blue, 'snow'-white*) unrelated words (e.g. *take, friend*), actual names of colours or simply colour patches. Subsequent studies suggested that interference occurs with most words (Klein, 1964) particularly if semantically related to a colour, for example, *blood* - red, *sky* - blue, *grass* - green (Scheibe et al., 1967). Priming the words' meaning by asking participants to learn a semantically related word (to the target word) also interferes with colour naming (Warren, 1972). Consequently, the robust finding is that participants take longer to name colours when the base items are incongruent colour names or connected to the concept of colour than when they are meaningless stimuli.

The basic Stroop effect demonstrates several phenomena; firstly, that word reading is faster than colour naming, typically by approximately 200ms (cf. Cattell, 1886; Dyer, 1973c; Glaser and Glaser, 1982); secondly, that word reading is not affected by ink colour even when the ink colour occurs before the word (e.g. Glaser and Glaser, 1982) unless the task is dramatically altered (Dunbar and MacLeod, 1984); and lastly, that the meaning of words can interfere with colour naming. The degree of interference can vary but generally is around 100ms (e.g. Dunbar and MacLeod, 1984; Glaser and Glaser, 1982).

Several early studies demonstrated Stroop interference and impaired performance but others showed Stroop facilitation. If the wrong word slows colour naming response times, then the right word ought to speed response times. A number of studies showed facilitation (depending on the chosen control condition) or reduced interference for a congruent condition (Regan, 1978, 20ms; Kahneman and Chajeczyk, 50ms, 1983). However, this was much weaker than corresponding interference shown in the incongruent conditions (e.g. Sichel and Chandler, 1969; Glaser and Glaser, 1982; Duncan-Johnson and Kopell, 1980,1981).

1.11 The Emotional Stroop Paradigm

The emotional Stroop paradigm (e.g. Mathews and MacLeod, 1985) has been one of the most popular methods of elicitation and measurement of attentional bias over the last thirty years or so and has provided a cumulative knowledge base across a wide range of emotional conditions and disorders including anxiety (Bar Haim et al., 2007; Williams et al., 1996) with the notable exception of occupational stress, which this study aims to address.

In the 1980's, with the resurgence of clinical research into emotional disorders modified versions of the Stroop colour-word test were developed to elicit and measure attentional bias in a range of emotional disorders including anxiety (e.g. Mathews and MacLeod, 1985; Watts et al., 1986). In a typical emotional Stroop task, words of varying emotional significance (threat-related and control) are presented and participants are asked to name the colours in which the words are presented while ignoring the word content. The assumption being that participants have to inhibit the automatic process of reading the word stimuli so that they can focus on colour naming (Algom et al., 2004; Williams et al., 1996). Stroop interference is said to occur when the word meaning captures the participant's attention despite their efforts to attend to the task demand that is, colour naming (Williams et al., 1996).

Stroop interference has been inferred when either or both of two effects are found: firstly, significantly longer colour naming times for threat-related stimuli compared to neutral stimuli in the experimental group, that is, a within-subjects effect; secondly significantly longer colour naming times for threat-related stimuli in the experimental group in comparison to the control group that is, a between-subjects effect (Bar Haim et al., 2007).

Cisler et al. (2009) proposed that attentional bias is more reliably demonstrated by the within-subjects Stroop effect because examination of this differential removes potential errors in correctly identifying a control group without a particular disorder (known as diagnostic specificity) for example, anxiety; and/or the degree of anxiety of the experimental group that are both included when comparing colour naming times to those of a control group. However, the meta-analysis by Bar Haim et al. (2007) found that significant Stroop effects were comparable for within-subjects and between-subjects effects

1.10.1 Emotional Stroop Research

Findings from emotional Stroop research with anxiety disordered patients and non-clinically anxious individuals frequently indicates that they exhibit Stroop interference for threat-related stimuli due to attentional bias for selective processing of threat-related information (Bar Haim et al., 2007; Williams et al. 1988, 1996; 1997). That is, when compared to non-anxious controls, anxious individuals take longer to colour-name threat-related words than neutral control words.

Mathews and McLeod (1985) carried out an early, influential study into selective processing of threat-related stimuli in anxiety states using an emotional Stroop colour naming test. They examined the tendency for non-anxious individuals and patients with general anxiety disorder (GAD) to overestimate personal danger (Beck et al., 1974; Beck and Clark, 1988; Beck et al., 1985). They assumed that variations in type, extent or ease of activation of schemata are linked with a bias in processing relevant threat-related information in anxiety states which may impair colour-naming performance in the Stroop task. Blocked, card presentation of colour-words was utilised by Mathews and MacLeod (1985) where 24 GAD and 24 non-anxious controls were required to name the ink colour of words related to physical or social threat and others with no considered threat value (neutral). Four sets of 12 words were written in random order, eight times on A4 card in either red, blue, green or yellow block capitals (approx. 0.5cm high). Consequently, four cards, each with 96 words were produced. One contained physical threat words (e.g. *disease, injury, mutilated*), a second contained social threat words (e.g. *pathetic, inadequate, failure*), and two control cards contained non-threatening, positive words (e.g. *playful, hobby, welcome, confident*). Words more frequent in everyday usage generate more colour naming interference (Klein, 1964). Therefore, experimental word stimuli were matched for frequency with control words in order to limit such effects in Mathews and MacLeod's (1985) study. The four stimulus cards were presented in the assigned order and participants were asked to name the ink colour that the words were printed in as quickly and accurately as possible whilst disregarding word content. Participants were also asked to recall any of the words from the cards in order to test recognition memory. The results of the recognition task showed no memory bias for threat words in anxious patients suggesting that anxiety-related interference occurs in early cognitive processes like attention but not in later memory processes. After both tasks, the GAD patients were asked whether their main concern was with physical (e.g. illness or assault) or social threat (e.g. what others thought of them or failure).

The main finding of Mathews and MacLeod’s (1985) study was that GAD patients were slower than the control group in colour naming all words but particularly threat-related words. The anxious participants who indicated that health concerns predominated showed more interference for physical threat words. This was interpreted as exhibiting an association between currently activated danger schemata and salient threat stimuli in the group whose chief concern was stated as physical threat. All anxious participants were slowed by social threat words; Mathews and McLeod (1985) suggested this could be because social worries were an inherent threat for all anxious individuals. The control group did not differ in colour naming times for any of the word sets indicating no Stroop interference.

The results of Mathews and MacLeod’s (1985) early influential study have been supported by an extensive range of emotional Stroop experiments using stimuli that are relevant to the real-life concerns of anxious participants. The majority of these experiments have investigated attentional bias in patients with an anxiety disorder (e.g. GAD, SAD, PTSD, PD, OCD, and specific phobias) although some have also considered non-clinically diagnosed anxious individuals. Examples of such research are outlined in the following sections.

1.10.1.1 Emotional Stroop Research in Anxiety Disordered Patients

In terms of GAD and SAD patients, various studies have reported Stroop interference for anxiety-related stimuli using words such as, *ridicule, failure, abandoned, shy* (Amir et al., 2002; Becker et al, 2001; Martin et al., 1991; Mathews and Klug, 1993; Mathews and MacLeod, 1985; Mattia et al., 1993; Mogg and Bradley, 2005).

Individuals diagnosed with PTSD have also displayed colour naming disruption in the emotional Stroop (Cisler et al., 2010; McNally et al. 1990; McNeil et al., 1999; Thrasher et al., 1994). McNally et al. (1990) observed greater disruption for words such as *nam, and medevac*, in Vietnam War veterans, whilst survivors of the 'Herald of Free Enterprise' ferry tragedy had significantly slower colour naming times for salient threat-related words like, *flooded, enterprise* and *sea* (Thrasher et al., 1994).

PD patients have exhibited Stroop interference for PD words. McNally et al. (1990) found that several categories of threat-related words disrupted colour naming performance for PD patients; catastrophe-related words (e.g., *death, collapse*), fear related words (e.g., *panic, terror*) and words relating to bodily sensations (e.g., *dizzy, faint*). However, some research has found that interference is not restricted to panic and fear-related words but has also been observed with other word types such as depression-related (Carter et al., 1992) and positive emotional words (McNally et al., 1992). Furthermore, other research has reported no interference for PD-related or other threat-related words in comparison to a control group (Kampman et al., 2002).

Foa et al. (1993) found that OCD patients with washing rituals were slower to colour-name contamination-related words such as, *dirty* and *mess* in comparison to neutral words and a control group. Other OCD research has reported similar findings (Lavy et al., 1994). However, the research on attentional bias in OCD patients is inconclusive with several studies finding no evidence of Stroop interference towards either general threat-related or OCD-related stimuli (Kampman et al., 2002; Moritz et al., 2008).

Patients with specific phobias have generally demonstrated slower colour naming latencies for words related to their particular fear. Stroop interference has been found in spider phobic patients towards spider-related words such as *web, crawl*, *hairy, spider*, in comparison to control words (Kindt et al. 1997; Lavy et at al., 1993; Thorpe and Salkovskis, 1997; Watts et al., 1986). Additionally, Constantine et al. (2001) found Stroop interference towards snake-related stimuli in intensely snake phobic participants using a pictorial version of the emotional Stroop.

Overall, Stroop interference in anxious patients seems to be a fairly robust feature of emotional Stroop research. In a systematic meta-analysis of attentional bias and anxiety research, Bar Haim et al. (2007) reviewed 172 attentional bias in anxiety studies published between February 1986 and May 2005 (N = 2,263 anxious, N = 1,768 non-anxious participants) using the dot probe, emotional Stroop or emotional spatial cueing task and reported significant Stroop interference for threat-related stimuli in clinically diagnosed anxious samples (d = 0.48) in comparison to non-anxious controls.

1.10.1.2 Emotional Stroop Research in Non-Clinical Anxiety

Attentional bias towards threat related words has also been observed in non-clinical populations with maladaptive anxiety states.

Various emotional Stroop research has reported that high trait anxious participants were slower to colour-name anxiety related words compared to neutrals (Egloff and Hock, 2001; Mogg et al., 1990, 1993; Richards et al., 1992; Richards and French, 1990; Richards and Millwood, 1989;).

The emotional Stroop effect has also been observed in anxious participants experiencing temporary stressful life events (producing elevated stress/state anxiety levels) with interference towards threat-related stimuli (Dresler et al., 2009; Egloff and Hock, 2001; MacLeod and Hagan, 1992; MacLeod and Rutherford, 1992; Mogg et al., 1990). Mogg et al. (1990) found that both high and low trait anxious students in an experimentally manipulated high stress condition (failure to complete difficult or unsolvable anagrams followed by negative feedback) showed more interference for achievement-related and general threat-related words than neutral words compared to the low stress condition. Conversely, MacLeod and Rutherford (1992) found delayed colour naming times for achievement-related words in high trait anxious but not low trait anxious students, immediately prior to an examination period when state anxiety was elevated, suggesting an interaction between trait anxiety and elevated state anxiety during a stressful event. Whilst MacLeod and Rutherford (1992) attributed the Stroop interference observed in their study to elevated state anxiety, Mogg et al. (1990) found no effect of trait anxiety on Stroop interference and proposed that delayed colour naming was due to priming of negative affect by the stress manipulation.

Emotional Stroop interference has also been found in other anxiety states. Ehlers et al. (1988) reported that non-clinical participants who suffered panic attacks showed greater interference than controls for threat words related to physical harm, separation or social embarrassment. MacLeod and Hagan (1992) investigated attentional bias in emotionally vulnerable women awaiting a gynaecological investigative procedure (colposcopy). Greater interference for colour naming threat related material was associated with high trait anxious participants prior to the procedure. Owens et al. (2004) found that participants with high levels of health anxiety demonstrated Stroop interference for illness-related stimuli in comparison to other emotional words and also in comparison to a low health anxiety group.

Bar Haim et al. (2007) reported significant Stroop interference towards threat-related material for studies using non-clinical samples with high self-reported anxiety (d = 0.51) which did not differ significantly across the various experimental paradigms (emotional Stroop, dot probe, emotional spatial cueing).

1.10.1.3 Other Emotional Stroop Research

The emotional Stroop paradigm has also been investigated in a range of other emotional disorders including, eating disorders (Dobson and Dozois, 2004; Faunce, 2002), depression (Epp et al., 2012; McNeil et al., 1999), and in recent years, various forms of addiction (Boyer and Dickerson, 2003; Field et al., 2006) frequently supporting the prediction of attentional bias towards threat-related stimuli in other affective conditions.

Early studies investigating expertise effects on Stroop performance found that contrary to expectations increased exposure to specific stimuli (e.g. bird-related stimuli and ornithologists) reduced Stroop interference on subsequent Stroop trials (e.g. Dalgleish et al., 1995; Mogg and Marden, 1990). In line with this, the emotional Stroop has been employed to monitor attentional bias before and after therapy (e.g. Mathews et al., 1995; Thorpe and Salkovskis, 1997) and as a form of cognitive therapy in itself (e.g. Lavy et al., 1993; Masia et al., 1999; Watts et al., 1986). Mathews et al. (1995) investigated Stroop performance in GAD patients prior to and following Anxiety Management Training and found that colour naming differences observed between GAD patients and non-anxious controls prior to treatment had disappeared immediately after treatment. Thorpe and Salkovskis (1997) assessed Stroop interference for individuals with spider phobia before and after they received treatment aimed at modifying maladaptive beliefs about spiders and found that interference was reduced after treatment. Masia et al. (1999) tested the effects on colour naming interference of an emotional Stroop adapted to present only social anxiety-related words repeatedly for 1,098 presentations with the thinking that this was a form of language-based exposure therapy. Findings demonstrated that Stroop interference for social anxiety words was reduced following this form of treatment and concluded that this could be investigated further with other anxiety disorders.

Research evidence from emotional Stroop research is generally consistent with cognitive models of anxiety previously outlined, which assume that attentional bias is not simply an artefact of anxiety but primarily involved in its development and maintenance (e.g. Beck and Clark, 1988; Beck et al., 1985; Eysenck, 1992; Eysenck et al., 2007; Mogg and Bradley, 1998). Attentional bias has been implicated in a vicious circle, whereby anxious individuals selectively attend to threat-related material making them more anxious, which in turn increases attentional bias towards threat-related material and adds to their anxiety and so on. Anxiety may therefore increase awareness of threatening situations, the frequency with which they are recalled, and their effect on cognitive functioning. However, various other operational and population-based factors have been implicated as moderators of the emotional Stroop effect. The following section considers the research evidence investigating these proposed moderators.

1.10.2 Moderators of the Emotional Stroop Effect

A range of operational and population-based differences in the emotional Stroop paradigm have been observed over time and it has been variously suggested that these variations could moderate or be responsible for observed differences in Stroop interference. *Operational variations* include but are not restricted to, differences in stimulus type (word vs. picture); Stroop design (blocked vs. single randomised); exposure time (subliminal vs. supraliminal) and experimental paradigm (e.g. emotional Stroop, visual dot-probe, emotional spatial-cueing). *Population-based variations* include, anxiety type (clinical or non-clinical), anxiety disorder (e.g. GAD, SAD, OCD, PTSD, phobias, PD); and the presence of state or trait anxiety. These variations will be considered in the following sections.

1.10.2.1 Stimulus Type (Word versus Picture Stimuli)

As previously stated a large body of emotional Stroop research has reported an attentional bias in anxious participants, demonstrated by slower colour naming responses to threat-related word stimuli in comparison to neutral word stimuli (Bar Haim et al., 2007). However, Bradley et al. (1997) argued that anxious individuals spend more time talking and thinking about anxiety-related words on a daily basis and as such slowed responses to threat words in an emotional Stroop task could be due to priming and the participant's familiarity with anxiety-related words in comparison to neutral words rather than an attentional bias.

Pictorial versions of the emotional Stroop displaying threat-related and neutral pictures have been used in research attempting to verify the Stroop effect observed with word stimuli using picture stimuli which is considered more ecologically valid and more representative of the threat stimuli. In a typical pictorial Stroop for GAD, pictures of anxious or angry faces have been used as threat-related stimuli and pictures of neutral or happy faces as control stimuli. As recognition of facial expressions is an automatic process that occurs without conscious awareness it should be a useful indicator of biased attention in anxious individuals (Dimberg et al., 2000). Pictures are either coloured or a transparent, coloured filter covers them and participants are asked to name the colour whilst ignoring the picture content. Research on other anxiety disorders has either used pictures relevant to general threat or pictures relevant to the specific threat, for example, snakes for snake phobic patients (e.g. Constantine et al., 2001).

Picture stimuli has been used in studies investigating various emotional disorders in children which suggests that the concreteness and ecological validity provided by this method is a useful way of assessing attentional biases in children, particularly if their reading skills are not developed (Kindt and Brosschott, 1999). However, whilst pictures appear to be effective in representing spiders, snakes or anxious faces, it is not always possible to adequately represent some other threat-related concepts with a picture (e.g. occupational stress) and this is where words might be more appropriate.

Generally, emotional Stroop research using pictures has found Stroop interference in anxious participants (Constantine et al., 2001; Kindt and Brosschott, 1997; Lavy and van den Hout, 1993) but some research has not (Benoit et al., 2007; Kindt and Brosschott, 1999). Bar Haim et al. (2007) found a significant medium effect size for word stimuli (d = 0.51) but a non-significant small effect size for pictures (d = 0.24) in the emotional Stroop suggesting that interference is stronger with word stimuli although this is still inconclusive.

1.10.2.2 Stroop Design: Blocked versus Mixed, Randomised Presentation

Two formats have been predominant in the presentation of Stroop word stimuli, namely, blocked card and mixed randomised presentation. Blocked presentation traditionally uses blocks of up to 100 words of the same stimulus type, for example, blocks of threat-related or neutral unrelated words written in different ink colours with verbal colour naming responses. Prior to the regular use of computers, each block would have been presented on cards (e.g. Mathews and Klug, 1993; Mathews and McLeod, 1985) but computerised block presentation has also been used where words of the same type (e.g. threat-related) appear together on the screen (Holle et al., 1997; Mattia et al., 1993). In both variations, the order of blocks of word types and order of colours would usually be randomly presented.

Randomised presentation involves words presented individually (or occasionally in groups) in random order in terms of threat value, on a computer screen with a keypad or voice key colour naming response (e.g. McNally et al., 1990; Mogg et al., 1993; Richards and French, 1990). Incorrect responses are also usually recorded in computerised versions. Randomisation is typically set to be pseudo-random so that the same words and/or colour do not appear consecutively. In this way participants are not able to predict what type or colour of word is presented in subsequent trials.

Richards et al. (1992) compared computer presented, blocked and single, randomised word presentation with a group of high and low trait anxious participants. Word stimuli included anxiety-related, happy and neutral words matched for frequency. Findings revealed delayed colour naming times for anxiety-related words in the high anxious group but not the low anxiety group. This was only observed with the blocked presentation suggesting that responding to anxiety-related words in a block might have lowered the mood of the anxious participants due to carry-over effects of a word's meaning and made them more receptive to the meaning of subsequent anxiety-related words in the block (Algom et al., 2004; McKenna and Sharma, 2004; Richards et al., 1992). Slowed colour naming was not observed for happy words with a possible explanation being that the negative, anxiety-related words have a stronger effect on mood than happy words (McKenna and Sharma, 2004; Richards et al., 1992).

The notion that there is a generic slowdown in colour naming due to carry over effects of threat-related stimuli is in line with various psychological perspectives (cognitive, physiological and social) which suggest that humans have an inherent disposition to preferentially direct resources towards threat to the detriment of current activity. Öhman et al. (2001) proposed that this evolutionary adaptive process facilitates unconscious allocation of attention towards threat via a *feature detection* system that is sensitive to biologically threatening stimuli and which influences physiological arousal in response.

Priming is also a possible explanation for the larger Stroop interference effects reported with blocked presentation but may also be implicated in the emotional Stroop effect generally. Priming occurs when one word facilitates the processing of a subsequently presented word of the same theme (Warren and Morton, 1982). Priming can occur over five intermediary items so individually presented stimuli can be still affected although not to the same extent as blocked presentation (Bar Haim et al., 2007; Dalgleish, 1995; Williams et al., 1996).

Studies using categorised neutral control words for example, household objects, have attempted to eliminate priming as an artefact of Stroop interference (e.g., Foa et al., 1991; Mathews and Sebastian, 1993; Mogg et al., 1993). These studies showed significant Stroop interference effects in anxious participants for threat- related words but not for the neutral categorised words thereby indicating that priming between same category words does not cause Stroop interference.

Generally, conclusions from emotional Stroop research indicate that blocking of word stimuli produces stronger emotional Stroop interference than randomised, mixed word stimuli. Furthermore, this is may be due a carry-over of negative affect from a block of threat-related words or priming rather than attentional bias (Holle et al., 1997; Richards et al., 1992; Williams et al., 1996). In line with this, the meta- analysis by Bar Haim et al. (2007) concluded that although both blocked and random, mixed presentations produced significant emotional Stroop interference in anxious participants, a significantly larger effect size was produced for blocked presentations (d = 0.69) which is in line with the aforementioned reservations for blocked presentation.

1.10.2.3 Repetition of the Same Words

Words are generally presented many times in the emotional Stroop and this may contribute to the colour naming differences observed (Williams et al., 1996). For example, Mathews and MacLeod (1985) presented 4 sets of 12 words, 8 times each whilst Mogg et al. (1990) presented 3 sets of 20 words, 5 times each. However, in a typical emotional Stroop task both threat-related and neutral stimuli are presented in equal number of times so this is unlikely to be a sufficient explanation for Stroop interference towards threat stimuli. Gotlib and Cane, (1987) and Gotlib and McCann, (1984) investigated the effect of word repetition by presenting 150 depression-related, manic-related and neutral words only once to depressed patients. They found slowed colour naming times for depression-related words in depressed patients but not controls. Therefore, word repetition appears not to be a critical element of emotional Stroop interference although research evidence is inconclusion.

1.10.2.4 Supraliminal vs Subliminal Computer Presentation

An alternative rationale for emotional Stroop interference is that participants consciously attend to threat-related stimuli and that this delays colour naming (Algom et al., 2004; McKenna and Sharma, 2004; Phaf and Kan, 2007). McKenna and Sharma (2004) suggested that evidence for a 'slow' Stroop effect comes from blocked presentation of threat words where emotional Stroop interference effects appear to be consistently larger (Holle et al., 1997; Richards et al., 1992). This is proposed to arise due to carry over of negative effect from one threat word to subsequent threat words on the same card and not due to an automatic attentional bias towards threat, but evidence from blocked presentations does not entirely preclude the existence of a 'fast' Stroop effect also in operation (Algom et al., 2004; McKenna and Sharma, 2004).

This is contrary to Beck's schema theory (Beck, 1976; Beck et al., 1979; Beck et al., 1985; Beck and Clark, 1988), Bower's semantic network theory (Bower, 1981,1983,1985, 1987) and Williams et al. (1988), who argue that anxiety related processing biases for threatening material occur automatically and are not mediated by conscious strategies.

Evidence to counter the ‘conscious attention’ or slow Stroop effect proposition has arisen from studies using subliminal presentation of stimuli, which have reported significant Stroop interference. This interference effect has been reported in clinically anxious individuals (e.g., Bradley et al., 1995; Mogg, Bradley et al., 1993; Lundh et al., 1999) and also in non-clinical, high anxious individuals with high state anxiety or elevated stress (MacLeod and Hagan, 1992; MacLeod and Rutherford, 1992; Mogg, Kentish et al., 1993).

A typical subliminal, emotional Stroop task often compares the two exposure modes, subliminal (outside conscious awareness) and supraliminal (accessible to conscious awareness). Subliminal mode typically displays the word stimuli on a coloured patch and employs a pattern mask (e.g., nonsense syllables or rows of XXXX’s) which covers the stimulus word (but not the coloured patch) after a limited exposure time, usually between 14-20 milliseconds, which is generally agreed to be below the conscious awareness threshold (e.g., MacLeod and Rutherford, 1992; Mogg, Bradley et al., 1993). This method of presenting stimuli subliminally is known as backward masking (c.f. Neisser, 1967).

To check that the masked presentation is preventing conscious awareness, various awareness checks are usually (but not always) conducted at intervals throughout the emotional Stroop task. For example, a lexical decision task may be used (e.g., MacLeod and Rutherford, 1992; Mogg, Bradley et al., 1993) where a letter string either a word or a non-word is shown during the masked presentation mode and participants have to decide which has been presented. Providing the accurate responses do not significantly differ from those expected by chance it may be concluded that the masking procedure prevented conscious awareness of stimuli content. In supraliminal or unmasked mode, the stimulus word remains on the screen until the participant gives a response (vocal or button press) and no pattern mask is used.

MacLeod and Rutherford (1992) found that high trait anxious students were significantly slower to colour-name threat related words (e.g., *failure, lonely*) presented subliminally compared to non-threat (e.g., *fortunate, button*). MacLeod and Hagan (1992) used subliminal presentation of threat words (e.g., *disease, pathetic*) in a prospective study involving women about to undergo a gynaecological diagnostic procedure (colposcopy). Levels of depression and anxiety experienced by the women after receiving a diagnosis of abnormality requiring treatment was predicted by the degree of Stroop interference for threat related words at the time of the colposcopy. Mogg, Bradley et al. (1993) found that anxious patients were significantly slower to colour-name negative emotional words (e.g., anxiety-related, *embarrassed, cancer* and depression-related, *misery, discouraged*) compared to neutral words (e.g., *carpet, domestic*) and positive words (e.g., *adorable, bliss*) when presented subliminally and supraliminally.

The findings from subliminal emotional Stroop research generally indicate that disruption of colour naming in anxious individuals is not necessarily mediated by conscious attentional strategies but is frequently associated with a pre-attentive bias for threat-related stimuli at the automatic stage of processing (Williams et al., 1988). Therefore, this attentional bias appears to be independent of conscious awareness of threat-related material. However, this is still under debate with various research citing arguments regarding fast versus slow Stroop effects (Algom et al., 2004; McKenna and Sharma, 2004).

Further considerations regarding subliminal emotional Stroop as evidence for a fast, automatic attentional bias was offered by Phaf and Kan (2007) who conducted a meta-analysis of 70 emotional Stroop studies carried out from the mid 1980's to 2005. They looked particularly for blocked and mixed designs presented supraliminally or subliminally and found the largest (significant) effect sizes (in terms of *r*) for blocked, supraliminal presentations with both clinical and non clinal anxious individuals. Effect sizes for studies using blocked presentations were generally larger than for mixed, single presentations. Furthermore, the effect sizes for Stroop interference in supraliminal studies were non-significant and all close to zero which puts doubt onto the evidence from subliminal studies which have provided support for the automaticity of the emotional Stroop effect (Phaf and Kan, 2007).

Conversely, Bar Haim et al., (2007) reported significant effect sizes in their meta-analysis for both subliminal and supraliminal exposures for anxious participants but not for controls, in the emotional Stroop studies reviewed. However, Stroop interference for threat-related stimuli was significantly larger for supraliminal (*d* = 0.57) than for subliminal presentation times (*d* = 0.23).

1.10.2.5 Experimental Paradigm

Description of the different experimental paradigms which have been employed to investigate attentional bias in anxiety (and other emotional disorders) is beyond the scope of the current research (See Bar Haim et al., 2007 for a review), and it is deemed more relevant to focus on the emotional Stroop. However, Bar Haim et al. (2017) found that attention bias was consistently demonstrated across the different experimental paradigms and types of anxious participants (clinical anxious, non-clinical anxious, adults and children) with a medium effect size (*d* = 0.45). Studies using the emotional Stroop paradigm, demonstrated a larger within-subjects effect size (*d* = 0.49) than either the dot probe (*d* = 0.37) or the emotional spatial cueing task (*d* = 0.43). Between-subjects comparisons displayed similar results with the emotional Stroop having an effect size of, *d* = 0.45, and the dot-probe, *d* = 0.38. The emotional spatial cueing task showed no significant between-subjects effects.

Whether the reported differences in effect sizes from Bar Haim et al. (2017) are entirely reflective of their respective reliability in demonstrating attentional bias is debateable given the possible moderators involved in attentional bias research. However, the emotional Stroop has generally demonstrated, over a substantial body of research, robust colour naming interference for anxious participants towards threat-related stimuli (Bar Haim et al., 2007; Williams et al., 1996).

1.10.2.6 Specificity of Stroop Stimuli and Current Concern

Although attentional bias in emotional Stroop research has regularly been demonstrated by slower colour naming times for emotionally negative threat-related stimuli (e.g. Dalgleish, 1995: MacLeod and Mathews, 1988; Macleod and Rutherford, 1992; Mansell et al., 2002; Mogg et al., 1993) questions have been raised regarding whether this bias is only exhibited for emotionally negative stimuli or also occurs with emotionally positive stimuli.

Various studies have discovered impaired colour naming in emotionally disordered individuals using both positive and negative emotional stimuli (e.g. Dalgleish, 1995; Martin et al., 1991; Mathews and Klug, 1993; Mogg and Marden, 1990; Rutherford et al., 2004). Martin et al. (1991) tested the hypothesis that emotionality was confounded with negativity in the emotional Stroop and found that clinically anxious participants showed colour naming interference for both positive (e.g., *joyful*) and negative words (e.g.*, lonely*) in comparison to neutral words. Mogg and Marden (1990) also reported that participants high in trait anxiety were slower to colour-name positive (e.g., *ecstasy*) and negative words (e.g., *assault*) matched for emotionality than neutral words (e.g., *teacup*).

The suggestion that emotional Stroop interference can occur for all emotional words irrespective of their valence throws doubt onto explanations such as Beck's 'danger' schemata theory (Beck et al., 1985) which propose that negative threat-related material is more accessible to emotionally disordered individuals.

An alternative explanation to the emotionality hypothesis may be that interference is not directly due to the emotional valence of the stimuli but rather the extent of semantic relatedness to the schemata of that particular individual (Williams et al., 1996). This concern-relatedness hypothesis concurs with the findings of many studies where specificity of the threat stimuli to the participant's current concerns has consistently shown greater Stroop interference in comparison to generally emotional stimuli. For example, more interference was displayed for concern-related stimuli in emotionally disordered individuals with spider phobia (Watts et al., 1986); suicide concerns (Williams and Broadbent, 1986b); panic disorder (McNally et al., 1992); social anxiety (Becker et al., 2001), physical anxiety (Mogg et al, 1989); rape PTSD (Foa et al., 1991); participants deprived of food (Lavy et al., 1993). Similarly, the same effect has been observed in non-clinical anxious groups for example, students prior to exams (Ray, 1979; Reiman and McNally, 1995) and gynaecological outpatients awaiting diagnostic colposcopy appointments (MacLeod and Hagan, 1992). In McNally et al.'s (1992) study, panic disordered patients showed slower colour naming times on catastrophe-related words regardless of previously rating the set of positive words as more emotional. Therefore, emotional valence of the experimental stimuli is not sufficient on its own to account for Stroop interference but rather the semantic-relatedness of the stimuli to participants' current concerns is also implicated (Williams et al., 1996). The following studies investigated the relative contributions of emotionality and concern-relatedness to emotional Stroop interference.

Mathews and Klug (1993) independently varied the concern-related specificity and the emotional valence of the word stimuli with clinically anxious (GAD, PD and socially phobic) patients and non-anxious controls. They employed positive-negative and related-unrelated (to anxiety concerns) stimuli. Therefore, stimuli comprised of words that were; emotionally negative and related (e.g., *shaking, nervous and frightened*); negative and unrelated (e.g., *sin, quarrel and destructive*); positive and related (e.g., *fearless, courage and confidence*) and positive unrelated (e.g., *beauty, romantic and delightful*) and neutral matched for length and frequency. Mathews and Klug (1993) found that specificity or extent of relatedness of the stimuli to anxiety and not the emotional valence was associated with slower colour naming times in anxious patients in comparison to controls. Therefore, if the word stimuli were specific to the participants concerns, interference occurred irrespective of emotional valence for example, with words related to anxiety symptoms (e.g., *shaking,* negative-related) or desired traits (e.g., *fearless*, positive-related).

Reiman and McNally (1995) also demonstrated that relatedness to current concern was significant in a study involving non-clinical participants (i.e. students). They utilised stimuli chosen for its particular personal relevance to the participants based on the responses to the Motivational Structure Questionnaire (MSQ; Cox and Klinger, 1988). Participants chose the two most positive and two most negative subject areas from fifteen, which included family and home; employment, job and money; mental and emotional health and hobbies and pastimes. This enabled Reiman and McNally (1995) to employ stimuli that varied in emotional valence (positive and negative) and relatedness (high and low). Words associated with high positive and high negative current concerns produced slower colour naming response times than positive and negative weakly concern-related or non-related words and neutral words.

However, as with emotionality, relatedness to current concern does not appear to be the sole explanation for Stroop interference, particularly in some types of emotionally disordered patients. Some patients have displayed disproportionately more attentional bias towards negatively-valenced, threat-related stimuli than would be expected from application of the concern-relatedness hypothesis alone. For example, Cassiday et al. (1992) found that PTSD patients who had been raped showed more interference on negative threat words than participants who had undergone the same trauma (i.e. rape) but had not been clinically diagnosed with PTSD. Similarly, McNally et al. (1994) concluded that Stroop colour naming was slower in panic patients towards negative panic-related words (e.g., *fear, dizzy, anxious*) than their positive near antonyms (e.g., *safe, steady, carefree*). However, McNally et al. (1994) used words that were not specifically chosen for their personal relevance. Lavy et al. (1994) in a replication of Mathews and Klug's (1993) study demonstrated that even when positive and negative words, chosen for their degree of personal relevance to OCD patients, were used, negative stimuli (e.g., related: *filthy*, unrelated: *hate)* produced more interference than positive related and unrelated stimuli (e.g., related: *clean,* unrelated: *love)*. Although colour naming interference was greater for negative words, relatedness to OCD patients' concerns did not further increase this interference.

It appears from a summary of the evidence that neither concern-relatedness (congruent or incongruent with current concerns) nor emotionality (negative and positive) of stimuli are wholly sufficient to explain emotional Stroop interference. In non-clinical populations concern-relatedness seems necessary to cause Stroop interference but the evidence from clinical populations suggests that concern-relatedness alone is not responsible for disruption in colour naming. In these patients, both relevance to personal 'danger' schemata and the negative valence of the stimuli is strongly associated with the degree of emotional Stroop interference (Williams et al., 1996).

The proposition that emotionally disordered patients exhibit more Stroop interference for negative current concerns due to greater associations with representations of personal danger schemata raises another issue. That is, the possibility that Stroop interference occurs as a result of the patients 'expertise' with the language characterising their own feared situations, symptoms or traits on which they constantly ruminate. Any observed Stroop interference may simply demonstrate increased associations between stimuli belonging to the same category or the increased frequency with which this material is used (Williams et al., 1996, 1997).

Mogg and Marden (1990) found no evidence to support this hypothesis in members of a college Boat Club who exhibited no interference effects in colour naming of rowing-related words. They proposed that this could be due to the insufficient expertise of the participants and that differences would be observed in true experts. Dalgleish et al. (1995) tested this theory by asking genuine experts (i.e. ardent ornithologists) to colour-name bird-related words and found that they showed greater disruption for bird-related words than non-ornithologist controls. However, there is a possibility that words relating to an area of immense personal interest are also emotionally relevant to these experts thereby devaluing the expertise explanation.

Studies carried out with recovered patients to assess the effects of therapy on anxiety disorders may help to distinguish between concern-relatedness and expertise effects. Watts et al. (1986) and Lavy et al. (1993) investigated Stroop interference in spider phobic patients prior to and after exposure therapy. During this therapy, patients were exposed to numerous spider-related stimuli and encouraged to familiarise themselves with the characteristics of spiders. According to the expertise hypothesis they would have been expected to exhibit greater interference for spider related words (e.g., *web, crawl*) after this exposure than before. However, Stroop interference for spider words was actually reduced following treatment. Similarly, Mathews et al. (1995) discovered that attentional bias towards anxiety-related words disappeared following Anxiety Management Training despite increased familiarity with anxiety terminology during therapy.

Unfortunately, practice effects cannot be ruled out in these ‘expertise’ studies with patients after receiving therapy. That is, practice on the first presentation of the emotional Stroop task prior to therapy may facilitate performance on a subsequent re-test. Mattia et al. (1993) compared colour naming performance for social threat-related words in participants with social phobia who responded to treatment against those who did not respond, to investigate whether recovery from emotional disorders was a mediating factor in Stroop interference following therapy. Following treatment non- responders exhibited increased Stroop interference whilst treatment responders exhibited reduced Stroop interference for social threat words. These results are inconsistent with the suggestion that practice effects caused by increased familiarity with concern-related stimuli might be responsible for reduced Stroop interference.

Overall, the results of studies investigating the emotionality hypothesis and the concern-relatedness hypothesis as moderators of Stroop interference appear to conclude that concern-relatedness of stimuli is an important factor in studies with non-clinical, anxious participants. However, emotionality alone does not fully explain Stroop interference in clinically anxious patients where it seems that negativity of the stimuli is also implicated (Williams et al., 1996). This is in line with various theories of anxiety which propose a hypervigilance towards ‘danger’ schemata in chronically anxious individuals (Beck, 1976; Beck et al., 1979; Bower, 1981; Eysenck, 1992; Williams et al., 1988). In addition, the effects of practice or expertise on emotional Stroop interference indicate that ‘expertise’ due to increased familiarity or word type relationship are not adequate explanations for emotional Stroop interference in chronically anxious individuals.

1.10.2.7 Context and Stroop Interference

The context in which the emotional Stroop task is performed may also influence differential colour naming times, in particular mood state including negative affect. Environmental stress, both internal and external has been associated with colour-naming disruption in various studies. For example, Mogg et al. (1990) found that students performing the emotional Stroop task after experiencing stress manipulation (via task failure for insoluble anagrams) and therefore increased stress were slower to name achievement-related words than controls. Likewise, Lavy et al. (1993) found that participants who had fasted for 24 hours prior to the test showed greater Stroop interference for food-related words than controls. These findings suggest that any environmental situation, which activates personal threat representations could lead to greater Stroop interference for salient threat-related words. An exception to this finding was a study by Mathews and Sebastian (1993) who varied the environmental context by having the participants concern-related object present or absent during the Stroop task. Snake-avoidant individuals (non-clinical) performed an emotional Stroop task comprising snake-related (e.g., *cobra*), general threat (e.g., *fail*) and neutral (e.g., *spoon*) stimuli in the presence of a boa constrictor. Unexpectedly, no colour naming interference occurred for snake-related words in the snake-avoidant group compared to controls. A further experiment with no snake present showed greater Stroop interference for snake words in the snake-avoidant group compared to controls. The third experiment used only snake-avoidant participants but this time environmental stress was manipulated by the presence of a large spider for half of the tests. When the spider was present no interference for snake words was displayed. However, in the absence of the spider snake-avoidant participants were slower to colour-name snake words compared to general threat and neutral words. Mathews and MacLeod (1994) suggest that this anomalous finding might be due to the capacity of non-clinical participants to override Stroop interference in certain situations. This ability has not been observed in clinical groups. Mathews and MacLeod (1994) further propose that 'breakdown' (the distinguishing point between non-clinical and clinical emotional disorders) occurs when individuals cannot break the vicious circle whereby anxiety causes attentional bias which leads to increased relevance of threat related information and more attentional bias thus increasing the likelihood of clinical disturbance. In this way breakdown occurs when the individual is unable to summon the effort required to override the inclination towards relevant threat related information.

Studies which manipulated environmental stress or state anxiety suggest that increased stress can slow colour naming performance for concern-related words in non-clinical samples (e.g. Dresler et al., 2009; Egloff and Hock, 2001; French et al., 1992). There is also some evidence to suggest that non-clinical samples possess the ability to override Stroop interference in certain situations (e.g. MacLeod and Mathews, 1988; Mathews and MacLeod, 1994; Mathews and Sebastian, 1993).

1.10.2.8 Clinical versus Non-Clinical Samples

Examples of both clinical and non-clinical emotional Stroop research have been previously outlined and discussed with the conclusion that attentional bias towards threat-related stimuli has been found in both clinically anxious and non-clinically anxious participants. In the meta-analysis by Bar Haim et al. (2017) significant emotional Stroop interference was found in clinically diagnosed anxious patients (d = 0.48) and in non-clinically anxious participants (d = 0.51) and these interference effects did not differ significantly as a function of anxiety status.

1.10.2.9 Type of Anxiety Disorder

Although the different disorders range widely in aetiology, diagnosis, symptoms and time course they are considered to belong to the same major category of anxiety disorders as detailed in the DSM-5 (American Psychiatric Association, 2013) and therefore, if emotional Stroop interference occurs across all the disorder types this lends further credibility to the hypothesis that anxiety is characterised by an attentional bias towards threat.

Examples of emotional Stroop research in different anxiety disorders have previously been reviewed with the conclusion that colour naming interference occurs generally across the different anxiety disorders including GAD, PTSD, SAD, OCD, PD or phobias. Furthermore, the meta-analysis by Bar Haim et al. (2017) found no significant difference in Stroop interference across the different anxiety disorders with Cohen's *d* effect sizes ranging from 0.36 to 0.59. Given that attentional bias appears to be a characteristic feature of different anxiety disorders as elicited by the emotional Stroop, this reinforces the hypothesis that attentional bias is a core element of anxiety.

1.10.2.10 Presence of State or Trait Anxiety

As previously discussed, state anxiety is the level of anxiety currently experienced, whereas trait anxiety is an enduring tendency to be anxious when threat is perceived (Spielberger, 1966). A small number of emotional Stroop studies have investigated direct comparisons between the effects of state and trait anxiety on attentional bias (e.g. Egloff and Hock, 2001; Rutherford et al., 2004) although some have only considered whether state and trait anxiety scale scores correlate with attentional bias in clinically anxious samples (e.g. Mathews and MacLeod, 1985; Mogg et al., 1989). Mathews and McLeod (1985) found a closer association between Stroop interference and state anxiety than Mogg et al. (1989) who suggested that Stroop interference was more closely linked to trait anxiety. Other research (e.g. Egloff and Hock, 2001; Richards et al., 1992; MacLeod and Rutherford, 1992) has experimentally manipulated stress (state anxiety) levels in non-clinical, trait anxious participants by for example, asking participants to solve in insoluble anagrams), or by administering the emotional Stroop prior to naturally occurring stressful events (e.g., examinations or medical procedures).

Studies employing state-trait self-report inventories such as the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1970) have frequently been used to allocate participants to comparison groups in studies evaluating the effects of state and/or trait anxiety on Stroop interference. Despite the STAI being validated against various behavioural and psychophysiological indicators, studies have shown inconclusive and sometimes conflicting evidence in support of either state or trait anxiety's individual influences or whether they interact to influence attentional bias. Richards and Millwood (1989) found that high trait anxious, non-clinical participants exhibited greater attentional bias towards negative emotional words compared to neutral or positive emotional words. Although the high and low trait anxious groups in this study differed in state anxiety, no account was given of any possible effects. Similarly, Dawkins and Furnham (1989) found that emotional words relevant to repressors (e.g. *cry, scream, blush*) disrupted colour naming more than neutral words in high trait anxious participants but again no consideration was given to the effects of state anxiety. Mogg et al. (1989) addressed his shortcoming by considering the effects of both trait and state anxiety on emotional Stroop performance. They found that GAD patients were slower to name negative emotional stimuli than matched controls. Furthermore, GAD patients with social worries were slower to name social threat words (e.g. *failure, inadequate*) and GAD patients with physical worries showed greater interference for physical threat words (e.g. *disease, mutilated*). Stroop interference was associated with trait but not state anxiety. This is in accordance with Mogg and Bradley's (1998) cognitive-motivational theory that trait anxiety interacts more closely with impaired colour-naming for negative emotional words than general emotional stimuli. Conversely, Martin et al. (1991) found no difference in colour naming between high and low trait anxious non-clinical participants. They also found that GAD patients with the same levels of trait anxiety as the non-clinical group were slower to name both negative and positive emotional stimuli compared to controls. This raises the question of whether it is clinical status, rather than high levels of trait anxiety, which correlates with disrupted performance on emotional Stroop tasks.

The findings of the study conducted by Martin et al. (1991) may be disputed when evidence from other studies is considered. Mogg and Marden (1990) and Mogg et al. (1990) reported that the performance of non-clinical high trait anxious participants was impaired for threat related stimuli. Likewise, Mogg et al. (1993) discovered that high trait anxiety was associated with greater colour naming disruption of subliminally presented emotional words in non-clinical anxious participants. The results of these studies indicate that non-clinical individuals with high trait anxiety have an ability to override the capture of attentional resources by emotional material (Mathews and MacLeod, 1994).

Individuals with high levels of trait anxiety may have an inherent tendency to exhibit greater emotional Stroop interference when state anxiety is increased (Egloff and Hock, 2001; Williams et al., 1996). This factor has been investigated by studies using measures of trait and state anxiety together with environmental manipulation of stress or by testing at the time of a naturally occurring stressful event. Mogg et al. (1990) manipulated state anxiety by asking students to solve insoluble anagrams prior to an emotional Stroop task containing achievement related, general threat and neutral stimuli. High trait anxious students were slower to colour name all threat words regardless of whether they had experienced the failure condition beforehand. No effects of state anxiety were found in this study and even the short-term stress of the failure experience did not correlate with increases in measured state anxiety afterwards.

MacLeod and Rutherford (1992) investigated emotional Stroop interference in high and low trait anxious students both when state anxiety was low and when state anxiety was high a week before end of term examinations. No difference was found in colour naming between groups when state anxiety was low. When state anxiety was raised (prior to examinations) the high trait anxiety group were slower to name negatively valenced examination related words compared to the low trait anxiety group.

Research investigating the effects of state and trait anxiety on emotional Stroop performance appears to indicate that individual differences in trait anxiety (evaluated by questionnaire) correlate with individual differences in attentional bias towards threat related stimuli. However, these differences seem to require activation by current emotion (state anxiety) or stressful conditions and are more likely to occur when the participant has had time to ruminate on the threatening circumstances (e.g. expected examinations or medical procedures) than after a short-term stressor (e.g. failure to solve an experimental problem). Research with clinically anxious patients following recovery lends support to this notion. Trait anxiety is assumed to be an inherent property of clinical anxiety states and therefore recovered patients are assumed to have continued high levels of trait anxiety although state anxiety levels should have decreased. However, when re-tested recovered patients show no interference for threat related words which have disrupted Stroop performance prior to treatment (e.g. Watts et al., 1986; Mathews et al. 1995).

Consequently, whilst high trait anxious patients always display colour naming disruption on the emotional Stroop, non-clinical, high trait anxious participants do not. Studies of this effect on emotionally disordered patients have consistently found disruption, but this is not the prevalent finding for non-clinical individuals differing in trait anxiety (Martin et al., 1991; Mogg et al., 1993). This indicates an ability to override attentional bias towards threatening material in non-clinical groups and as such requires further investigation.

A further possibility is that experimental stimuli are not considered sufficiently threatening to cause interference in non-clinical groups. Emotional Stroop studies have utilised word stimuli (e.g. *illness, stupid*) which may represent only mild threat compared to pictorial stimuli such as that used by Mogg et al. (2000) in a visual dot probe task. Unfortunately, it is difficult to obtain highly threatening pictorial stimuli to represent adequately every distress syndrome and this may limit the usefulness of pictorial stimuli in such experiments.

To summarise, research indicates that individual differences in trait anxiety (evaluated by questionnaire) are frequently identified with individual differences in Stroop interference (Williams et al., 1996). Current emotion or situation interacts with trait anxiety to produce this interference and the effect is more pronounced when the threat is protracted (e.g. anticipated exam) in comparison to a short-term threat (failure to solve anagram). Therefore, the longer and more often high trait anxious individuals dwell on the threat, the greater the effect of threat-related representations (e.g. *failure, pathetic*). The larger interference effects shown when high trait anxious individuals incubate threats and by the specificity of threat-related interference to emotional disorder imply that Stroop interference may be a function of practice or expertise with salient threat-related stimuli although this has largely been cast doubt on by expertise studies and research following more exposure to concern-related words following therapy as previously cited.

1.10.3 Mechanisms Underlying Emotional Stroop Interference

The emotional Stroop research previously cited demonstrates that anxious individuals (clinical and non-clinical) exhibit disruption in colour naming of threat-related words but not neutral words in comparison to non-anxious controls. Possible moderators and sources of variance associated with emotional Stroop interference have also been considered. However, although these go some way to explain individual differences in colour naming performance as well as the circumstances under which emotional Stroop interference occurs, they do not reveal what part of the cognitive system is acted upon to produce attentional biases towards emotional material.

In line with Beck's schema theory (Beck, 1976; Beck et al., 1979; Beck et al., 1985; Beck and Clark, 1988;); Eysenck's (1992) hypervigilance theory; Eysenck's attentional control theory (Eysenck et al., 2007) and Mathews and McLeod's (1994) prioritisation theory, most research investigating attentional bias and anxiety has taken the standpoint that emotional Stroop interference occurs because it disrupts the allocation of attentional resources. The following section considers the connectionist model of emotional Stroop interference proposed by Cohen et al. (1990) which attempts to explain the underlying cognitive mechanisms of classic Stroop interference which it is suggested, can also be applied to the emotional Stroop paradigm.

1.10.3.1 Explanatory Frameworks

In terms of the emotional Stroop task, emotional stimuli are hypothesised to capture more attentional resources because they activate personal representations of threat (Mogg et al., 1989). Various other suggestions are that task irrelevant processes using up attentional capacity distract participants (Dawkins and Furnham, 1989); that interference is due to the greater cognitive effort required in order to repress or avoid threatening information (De Ruiter and Brosschot, 1994); or that high trait anxious individuals and clinical anxiety patients find it harder to maintain attentional focus (cf. Eysenck, 1992). However, none of these explanations completely explain the robust colour naming interference observed in a substantial body of emotional Stroop research. Several alternative explanatory frameworks for both the classic Stroop and the emotional Stroop effects have been offered over time but one that is of particular interest to the emotional Stroop is the Parallel Distributed Processing Model (Cohen et al., 1990).

1.10.3.2 Parallel Distributed Processing (PDP) Model

Explanations offered for the original Stroop effect (Stroop, 1935b) do not account for attentional bias in the emotional Stroop, as there is no competition (either as interference or in relative speed of processing) between ink colour and word meaning in the emotional versions. Accordingly, there is a need for an explanatory model, which can account for emotional Stroop interference in terms of pre-attentive processes.

Cohen et al. (1990) proposed a connectionist, parallel-distributed processing (PDP) model with which they simulated the effects of attention in order to explain the mechanisms underlying Stroop interference (See Figure 1).

The PDP model (Cohen et al., 1990) comprises two processing pathways, one for colour and another for word information which meet at a mutual response mechanism. Each pathway has a set of Input Units, Intermediate Units and Output Units and in any individual pathway the Input Units feed forward to the Output Units. Processing is performed within this system of interconnected modules. A stimulus activates units at input level, which spreads to Intermediate Units, and eventually to the Output Units. When activation from one of the Output Units exceeds a given threshold a response occurs.

Cohen et al. (1990) propose that speed of processing and interference effects are associated with 'strength of processing' in a pathway. The strength of a pathway depends on the set of connections within it therefore, speed and accuracy of both the spreading activation and the eventual response differs depending on the pathway taken by the required task. Each module sends information to and receives information from other modules in different pathways. Pathways intersect facilitating and interfering with each other. If two pathways are activated at the same time and they meet at their intersection point interference occurs when the pathway activation levels are different and facilitation occurs when activation levels are the same.

There are also two Task Demand (or attention) Units, one pertaining to colour-naming and one to word reading, which are connected to Intermediate Units in the individual processing pathways. These Task Demand Units are used to allocate attention to one of the tasks. Activation of either one of the Task Demand Units triggers processing in that particular pathway. An Input Unit, which is task specific in its own processing pathway, represents each colour and word and each Output Unit represents one potential response. Attention acts a neuromodulator in this model being described as an extra source of input within a processing pathway, which may change the responsiveness of units in competing pathways.

Cohen et al. (1990) gave an extremely detailed account of PDP modelling of attentional processes, which is too extensive to cover here. However, Williams et al. (1996) summarised the PDP model and suggested various ways in which the PDP model may be applied to the emotional Stroop task.

One possibility is that Input Units representing current concerns may cause greater interference at Output modules for naming a concern-related word because of the amount of practice associated with them (e.g., *web and crawl,* for spider phobics). However, practice effects have been undermined by studies looking at patients before and after exposure therapy which increases practice but actually reduces the interference effect of the concern-related stimuli (e.g., Watts et al. 1986 and Lavy et al., 1993).

Williams et al. (1996) proposed two alternative methods of modelling emotional Stroop interference within the PDP model. Firstly, that threat-related words may have Input Units with a higher resting level requiring more activation and secondly that this type of Input Unit if threat-associated might differ in responsiveness due to neuromodulatory control. In the case of the emotional Stroop, the Task Demand Unit for colour naming is functioning giving the Intermediate Units high response priority.

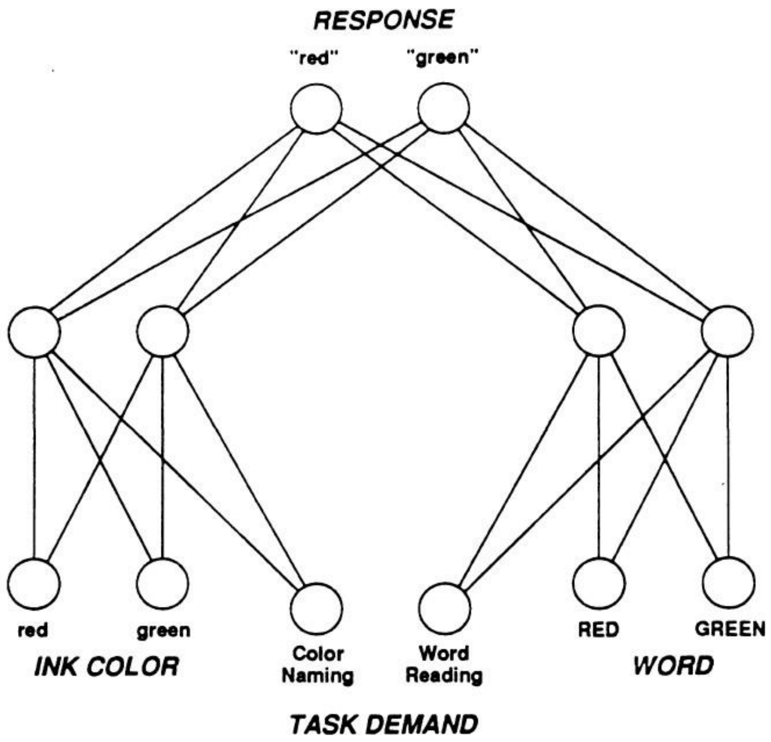

Figure 1. Diagram of the PDP network adapted from Cohen et al. (1990) showing connections between input, intermediate and response units.

The reason that some emotional words interfere with this responsiveness is because concern-related words have greater input activation or stronger connections in the 'word' processing pathway resulting in raised activation levels clustering at Intermediate Units. Therefore, although the participant is trying to ignore the word it is still being processed along this pathway. This interference occurs without strategic attentional processes as attention is consciously allocated to task demand (colour naming) not word reading. Following this proposition, the idea of a pre-attentive bias or one occurring outside conscious awareness is justified.

MacLeod (1991: 193) in his review of the Stroop effect commented that the PDP model, "…amalgamates the speed-of-processing and continuum-of-automaticity ideas.". It follows parallel processing principles but emphasises strength of processing dependent on strength of connections in a pathway. This strength decides the degree of automaticity in a particular process. Furthermore, the model does not assume a limited capacity response mechanism. In this way, it is able to offer an account of the mechanisms underlying attentional bias in the emotional Stroop which is compatible with research findings including concern-relatedness, threat-relatedness (danger schemata) and expertise effects.

Williams et al. (1996) have suggested that attentional bias towards personal concern-related material is due to differences in resting activation level of input units. They also propose that additional interference from negative concern-related material might be due to neuromodulatory control of input units previously associated with threat. Expertise effects may be explained by the existence of processing pathways for material that has been extensively practised. These pathways become progressively stronger with increased practice.

The ability of non-clinical groups to override attentional bias by increasing effort to perform a given task is explained by the PDP model in terms of increased activation of the Task Demand Unit (due to increased effort for colour naming). Although this override ability has been found in non-clinical groups (Martin et al., 1991; Mathews and Sebastian, 1993) it has not been demonstrated in clinically disordered groups.

Following Williams et al. (1996), this might be because ‘breakdown’ occurs when the individual can no longer expend the extra effort that is required to override hypervigilance towards concern-related material. Within the PDP model ‘breakdown’ occurs when the Task Demand Unit’s increased activation surrenders to the increased strength of connections in a competing pathway. The strength of processing may have been increasing over some time as concern-related material is ruminated upon but the sudden removal of the Task Demand Unit’s control causes an abrupt increase in input units from concern-related processing pathways leading to ‘breakdown’ (increased likelihood of clinical disorder). The abruptness of this switch may account for studies which have shown misinterpretation of all negative stimuli as opposed to personal concern-related stimuli (McNally et al., 1994).

Subliminal studies may be more sensitive indicators of current concern as they are not responsive to override strategies. MacLeod and Hagan (1992) found that the degree of attentional bias (for health-related words) found in colposcopy patients on a subliminal Stroop task was predictive of the degree of dysphoria (anxiety and depression) observed when later results indicated pathology. The supraliminal version did not predict the degree of dysphoria.

In conclusion, the PDP model (Cohen et al., 1990) accounts for attentional bias towards emotional material in terms of; variations between activation levels of concern-related input units; increased practice causing stronger connections in a pathway processing the demands of a given task and neuromodulatory control of input units associated with previous concerns.

The PDP model requires only minor modifications to be generalisable to other selective attention tasks such as the visual dot probe task (MacLeod et al., 1986) and dichotic listening task (Mathews and MacLeod, 1986) which is seen as one of its main advantages (Cohen et al., 1990; Williams et al., 1996).

1.10.4 Attentional Bias as an Indicator of Occupational Stress

Despite the existence of individual differences in emotional, physiological and behavioural responses to stress and anxiety, research has demonstrated that attentional bias towards threat-related material is a consistent cognitive response to a wide range of anxiety disorders (Bar Haim et al., 2007; Foa et al., 1993; Mathews and MacLeod, 1985; Watts et al., 1986; McNally et al., 1990; Williams et al., 1996).

Anxiety is frequently symptomatic of stress and arousal of the physiological system is present in both (McEwan, 2007). It is not surprising then that similar descriptions are often given of emotional, physiological and behavioural responses to both anxiety and stress. There is also evidence of stress leading to impaired performance on tasks of attention including the emotional Stroop (Bar Haim et al., 2007: Williams et al., 1996). Therefore, it is reasonable to hypothesise that an anxiety-producing syndrome such as stress is susceptible to attentional bias which could be evaluated utilising a suitably modified version of the emotional Stroop task containing relevant threat- related stimuli. At this current time, although research has investigated attentional bias using the emotional Stroop paradigm in a range of different emotional psychopathologies and emotional states, there is little research on attentional bias as a response to occupational stress.

One published attempt to relate the emotional Stroop paradigm to occupational stress is Woodfield et al. (1995) who asked 40 managers in a large industrial company to complete a modified Stroop task containing five negative occupational threat-related words (*overload, deadline, failure, exhaustion, redundancy*) obtained from an article on occupational stress (Cooper and Marshall, 1976), and five neutral words (*fairness, admittance, balance, sanctity and estimation*) in addition to a set of control stimuli (*rows of letter 0's*). All stimuli were matched for number of letters, syllables and word frequency using the Kucera and Francis (1967) American-English frequency list. Each of the three-word sets were block presented on card so that each word or letter string appeared 10 times each in 5 colours (red, blue, green, orange and brown) totalling 50 presentations for each stimuli type. Each participant completed the Stress Arousal Check List (SACL; Cox and Mackay, 1978; Mackay et al., 1978) followed by the emotional Stroop task where they were asked to name the colour each word was printed in as quickly as possible. Participants who reported high stress levels (as assessed by scores on the SACL) were slower to colour-name occupational stress-related stimuli in comparison to neutral or control stimuli. The mean interference index (colour naming latencies for occupational stress-related words minus neutral) was also significantly larger in comparison to the low-stress group.

Woodfield et al. (1995) concluded that raised levels of stress contributed to the differences found amongst individuals in their patterns of cognitive performance towards concern-related stimuli on the emotional Stroop task. However, this study had several weaknesses. One of these was the lack of adequate control word sets with the stress-related words being the only negative emotional stimuli presented. Therefore, it is not possible to confirm whether general emotionality or concern-relatedness was responsible for the colour naming interference. In addition, the negative valence of half of the words used in the SACL (e.g. *dejected, fearful, nervous, worried*) completed prior to the Stroop task could have primed attentional bias towards the negative stress-related stimuli.

If priming is implicated in emotional Stroop interference, then it is feasible to suggest that priming from questionnaires used prior to emotional Stroop research could influence the amount of colour naming interference observed. Lundh and Czyzykov-Czarnocka (2001) investigated this hypothesis using the Abandonment Fears subscale from Young's (1990) Schema Questionnaire (SQ). The items in this subscale centre on basic human concerns representing significant negative life events specific to separation and abandonment. Twenty students first completed the SQ and then an emotional Stroop task containing abandonment-related words and neutral words, whilst the other twenty first completed the emotional Stroop task and then the SQ. The results revealed significantly slower colour naming latencies for abandonment words when the SQ was presented before the Stroop task than when the AQ was presented after the Stroop task however, there was no significant difference for neutral words. This finding supports the suggestion that priming effects are implicated in Stroop interference (and attention bias) and therefore require serious methodological consideration to control for priming effects prior to emotional Stroop or other attentional bias tasks (Lundh and Czyzykov-Czarnocka, 2001).

Another limitation of the study conducted by Woodfield et al. (1995) was that used card presentation of blocks of stimuli, which has frequently resulted in greater Stroop interference for all emotional material regardless of valence (Martin et al., 1991; Mogg and Marden, 1993) Various suggestions have been offered to explain why this might happen including differences in priming effects of threat words carrying over to subsequent words on the same card when block presented leading to slowing down of attentional processing (Algom et al., 2004). With respect to balancing words for frequency, the British-English Kucera and Francis frequency list was used which research suggests is unsuitable for participants whose first language is British-English (Fillmore et al., 1998).

Finally, Woodfield et al. (1995) only five words for each of the threat, neutral and control stimuli which meant that each word was presented ten times in each of the five colours leading to more repetition than would perhaps be advisable given that this has been cited as a possible mediating factor (Williams et al., 1996).

The current research aims to produce an occupational stress-related Stroop task which reduces the limitations outlined in Woodfield et al. (1995) in addition to considering the characteristics inherent to emotional Stroop research that were identified in this chapter.

1.10.5 Summary of Research Using the Emotional Stroop Paradigm

Overall the findings from emotional Stroop paradigm research have been interpreted as evidence of attentional bias towards personally relevant, threat-related-related material in clinically disordered individuals. Colour naming interference has been found in studies across a range of clinical conditions (e.g. GAD, PTSD, OCD) which have variously shown that cognitive disruption and attentional bias is greater when threat-related stimuli are specific to the participants' current concern rather than of a more general nature, but that the emotional valence (positive or negative) of that stimuli is also an important consideration (Gotlib and McCann, 1984; Mathews and McLeod, 1985; Watts et al., 1986b; Williams and Broadbent, 1986).

Research with non-clinical groups has not been as conclusive, nevertheless there is evidence to suggest that stimuli related to personal concerns captures attentional processes more than general threat or neutral stimuli particularly if trait or state anxiety is elevated or the individual has been subject to prolonged stress (Mogg et al. 1990; MacLeod and Rutherford, 1992; MacLeod and Hagan, 1992).

A range of variables might moderate emotional Stroop interference and must be considered when conducting and interpreting such research (Bar Haim et al., 2007; Williams et al., 1996).

Another important consideration when evaluating the emotional Stroop effect is that of the test-retest reliability of scores. Kindt et al. (1996), Eide et al. (2002) and Strauss et al. (2004) all found high test-retest reliabilities when colour naming response latencies were used but unacceptably low reliabilities when the interference scores (threat-related minus neutral response times) were used. There is little research investigating the psychometric properties of emotional Stroop tasks which is something that needs to be addressed if they are to be used in monitoring of the effectiveness of therapeutic interventions.

1.11 Rationale for the Occupational Stress-Related Stroop Task

This doctoral thesis focusses upon the development and piloting of an occupational stress-related Stroop task as an objective indicator of occupational stress. As previously cited stress is frequently reported as one of the major causes of work-related ill health and is responsible for 45% of all working days lost to ill health in the UK (HSE, 2016). Employers in the UK have a responsibility or 'duty of care' to identify and protect employees from aspects of the work environment detrimental to their health and safety and as such routine organisational risk assessment is important. However, conventional measurement methods such as self-report questionnaires have been frequently criticised casting doubt on their effectiveness in the risk management process (e.g. Rick et al., 2000).

It is hypothesised that occupational stress may exert highly specific effects upon cognitive processing, and in particular upon performance in an occupation stress-related Stroop task (MacLeod, 1991) which is a modification of the original Stroop colour naming task (Stroop, 1935b) and based upon the emotional Stroop paradigm.

There is a wealth of research on the emotional Stroop and anxiety (with both clinical and non-clinical samples), which has generally concluded that anxiety is associated with impaired colour naming performance for threat-related stimuli. Anxiety is often symptomatic of (occupational) stress (e.g. Cooper and Robertson, 1995; Eysenck, 1992; Eysenck et al., 2007) and the terms ‘anxiety’ and ‘stress’ are frequently used analogously to describe an individual’s response when faced with environmental threat, therefore it seems feasible to extend the emotional Stroop paradigm to investigate attentional bias in occupationally stressed individuals.

The primary aim of this research was to develop an objective indicator of occupational stress, in the sense that the individual’s conscious appraisal does not directly lead to perceptions of stress. The utility of this instrument will then be investigated across three different occupational groups to explore whether this generic occupational stress-related Stroop task could be used to identify the existence of occupational stress across occupational settings. It is proposed that the occupational stress-related Stroop could be used in conjunction with other assessment methods (e.g. self-report questionnaires, interviews, physiological indicators) to provide a broad-based risk analysis. Its main benefits would be to reduce the conscious or unconscious biases which may affect self-reports and the intrusive element of physiological and observational indicators which are also subject to contextual and situational biases. The Stroop is relatively quick and easy to administer and does not involve the collection of personal or intrusive data. The data collected can be easily analysed and the word stimuli can be updated to include additional or occupation specific stressors if required. Consequently, it should be possible to identify individuals who are occupationally stressed by looking at patterns of Stroop interference produced by this modified Stroop task.

Chapter Two (Study One) outlines the development of an occupational stress-related Stroop task containing appropriate word sets after consideration of factors inherent to emotional Stroop research, including specificity of stimuli for use in an occupational stress-related Stroop task, and lexical characteristics thought to affect colour naming times in Stroop research particularly frequency of occurrence, emotional valence and word length.

Chapter Two (Study One): The Development of Stimuli for an Occupational Stress-Related Stroop

2.1 Study One: Introduction

This Introduction begins by outlining characteristics inherent to emotional Stroop research and provides a rationale for the generation and inclusion of word pools containing occupational stress-related, neutral-unrelated, general threat-related and negative emotional words. Concerns are then raised regarding confounding of the lexical characteristics of the word stimuli used in emotional Stroop tasks with the emotional aspects of the words such that the interference effects observed in the emotional Stroop may be partly caused by these lexical characteristics (Larsen et al., 2006; Kahan and Hely, 2008). A British-English word frequency corpus is identified as a more reliable research tool for balancing the frequency of word sets in preference to the outdated American-English frequency lists used in the majority of emotional Stroop research using British-English speaking samples.

2.1.1 Characteristics Inherent to Emotional Stroop Research

Williams et al. (1996, 1997) concluded from a review of emotional Stroop research that the word stimuli typically used should include at least one set of concern-related words, one set of neutral-unrelated control words and at least one set of general threat-related control words in order to distinguish between attentional bias relevant to current concerns and attentional bias for any negative threatening material. It is also advisable to have an experimental group of participants shown to have elevated concerns regarding the topic under investigation (e.g. anxiety) and a control group without those concerns (Williams et al., 1997).

Typically, colour naming latencies for concern-related and neutral words are compared between the experimental and control groups (between-subjects) and usually within the experimental group (within-subjects). Longer latencies between the experimental and control groups for concern-related words in comparison to neutral words and also within the experimental group are said to indicate Stroop interference. This is interpreted as disruption of performance in the experimental group due to an automatic attentional bias towards stimuli that is semantically-related to their current concerns (Williams et al.1996).

A large body of emotional Stroop research has reported attentional bias toward concern-related material by individuals diagnosed with anxiety disorders (e.g. Bar Haim et al., 2007; Becker et al., 2001; Cisler et al., 2009; Mathews et al., 1995;

Williams et al., 1996) and also for non-clinically anxious participants (e.g. Bar Haim et al., 2007; Egloff and Hock, 2001; Mogg et al., 1990, 1993; Richards et al., 1992). Attentional bias towards specific concern-related stimuli in emotional Stroop tasks has also been observed in individuals with eating disorders (Cooper and Fairburn, 1994; Faunce, 2002; Johansson et al., 2005); where there is addiction to particular substances for example, smoking (Munafo et al., 2003); alcohol (Cox, Blount et al., 2000; Sharma et al., 2001); marijuana (Field, 2005) and addictive behaviours for example, gambling (Boyer and Dickerson, 2003). In the aforementioned research, words specifically related to the disorder or behaviour being studied have been used as the experimental, concern-related stimuli along with at least a set of neutral words and often other word sets to control for general threat. However, emotional Stroop research has also found Stroop interference when the stimuli used is generally threatening and not specifically related to current concerns (e.g. Mathews and MacLeod, 1985; Mathews and Klug, 1993; McNally et al., 1994).

Despite the extensive body of emotional Stroop research in the area of attentional bias, there is a paucity of published research related to attentional bias in stress and specifically in occupationally stressed individuals. Woodfield et al. (1995) conducted an emotional Stroop study using occupational stress-related words as well as neutral control words in their research investigating attentional bias in a sample of industrial managers. As previously noted their study had a number of methodological limitations including the use of inadequate experimental and control word sets, which reduces the credibility of the claim that the occupational stress-related words elicited attentional bias in the high stress group.

Given the lack of previous attentional bias research investigating the effects of occupational stress, it was not possible to use any existing occupational stress-related words from past research as is common practice with word sets used in attentional bias and anxiety research (e.g. Mathews and MacLeod, 1985; Martin et al., 1991). Therefore, a priority of the current research was to construct a set of occupational stress-related words that adequately represented the dominant sources of perceived stress reported by employees in contemporary UK workplaces. Appropriate control word sets were also required to compare colour naming times and reduce the confounding effects of word characteristics on Stroop interference as identified in past research (Balota et al., 2004; Burt, 1999, 2002; Larsen et al., 2006).

Since early emotional Stroop research in the 1980's, various hypotheses have developed concerning the appropriateness of experimental and control word stimuli used to investigate attentional bias in emotional disorders with emotional Stroop tasks. These will be outlined in the following sections.

2.1.1.1 Threat-relatedness Hypothesis

The *threat-relatedness hypothesis* proposes that any threat-related stimuli will lead to Stroop interference in anxious individuals. This is consistent with several influential cognitive theories of anxiety such as Bower's (1981, 1987) associative network theory, Beck's (1976) schema theory and Eysenck's (1991b) hypervigilance theory which generally agree that anxious individuals are more aware and attentive to threat-related stimuli.

The threat-relatedness hypothesis was endorsed by many early emotional Stroop researchers in that colour naming latencies for generally threatening words were compared to colour naming latencies for non-threatening words. Slower responses to threatening words in the emotionally distressed group were seen as indicative of attentional bias caused by the threat-relatedness of these stimuli. Various emotional Stroop studies with both clinical and non-clinical anxious participants reported findings in line with this hypothesis (Fox et al., 1993; Mathews and Macleod, 1985; Mathews and Klug, 1993; McNally et al., 1994; Mogg et al., 1989;).

Mathews and Macleod (1985) found that GAD patients took longer to name the colour of social threat-related (e.g. lonely, stupid, failure) and physical threat- related (e.g. disease, mutilated, cancer) words in comparison to neutral control words, despite reporting no concern with physical threat prior to the research. Likewise, McNally et al. (1994) found that panic disorder (PD) patients demonstrated attentional bias to both panic-related threat and general threat words as indicated by slower colour naming latencies in comparison to neutral words.

This defines the need for at least one set of threat-related control stimuli in the occupational stress-related Stroop task to differentiate between Stroop interference from general threat-related words and specifically occupational stress- related words.

2.1.1.2 Emotionality hypothesis

The *emotionality hypothesis* proposes that threat-related words are not only more threatening than neutral words but also more emotional (Martin et al., 1991) and therefore observed Stroop effects could be due to emotionality being confounded with threat value.

Martin et al. (1991) used blocked card presentation of physical threat (e.g. mutilated, diseased, violent) social threat (e.g. pathetic, lonely, criticised) neutral (e.g. adhesive, folded, functional) and positive emotional words (e.g. appreciated, carefree, peaceful) which were rated to be as emotional as the threat words. Findings indicated that anxious individuals demonstrated an attentional bias towards both negative (threatening) and positive emotional words supporting the emotionality hypothesis.

Mathews and Klug (1993) suggested that the emotionality hypothesis needed further clarification as Martin et al. (1991) used some positive emotional words that could be considered direct antonyms of anxiety symptoms (e.g. peaceful, carefree, appreciated) and may have acted as primes for their opposites such as panicky, anxious or criticised (Small and Robbins, 1988). Another explanation is that anxious participants elaborate on the meaning of the positive emotional words because they describe characteristics or emotional states that they would like to have but fear they will never achieve. Therefore, Stroop interference in anxious participants could be due to semantic relatedness of the positive words to the threatening words and not their emotional valence.

Mathews and Klug (1993) extended the study by Martin et al., (1991) using two sets of positive words and two sets of negative words which were either related or unrelated to the participants' current concerns and found that words highly related to the participants' concerns caused greater interference than unrelated words irrespective of emotional valence. Similar findings were reported by Maidenberg et al. (1996) and McNally et al. (1994) amongst others, so defining the need to re-examine the emotionality hypothesis and consider whether concern-relatedness of stimuli is more important. To control for the emotionality hypothesis, the occupational stress-related words will be balanced so that they are significantly less emotional than either the social or physical threat-related words.

2.1.1.3 Concern-Relatedness Hypothesis

Consequently, the *concern-relatedness hypothesis* (Mathews and Klug, 1993) proposes that words semantically related to the individual's immediate concerns elicit more Stroop interference than words that are not, irrespective of their emotional valence or general threat value.

Support for the concern-relatedness hypothesis, sometimes referred to as the content specificity hypothesis, has been extensive, for example, Watts et al. (1986) found colour naming interference for spider related words (e.g. hairy, crawl) in spider phobic participants. Likewise, Foa et al. (1991) reported that rape victims with PTSD had significantly longer colour naming latencies for rape-related words than for neutral control words.

Pergamin-Height et al. (2015) conducted a meta-analysis investigating content specificity of attentional bias in 37 samples (N = 866) across a range of anxiety disorders including GAD, OCD and PTSD, and found significantly more attentional bias to disorder congruent threat stimuli than disorder incongruent threat stimuli (irrespective of emotional valence) albeit with a relatively small effect size (d = 0.28, $p < .001$).

In view of the empirical evidence supporting the concern-relatedness hypotheses a set of occupational stress-related words were required which were specifically related to occupational stress concerns irrespective of emotional valence. Therefore, both positive and negative occupational stress-related words were to be included if they were deemed relevant to occupational stress.

Consequently, to account for the threat-relatedness hypothesis and the research evidence in support of attentional bias towards any threatening stimuli, it was decided to include a set of physical threat words and a set of social threat words to represent general threat in the occupational stress-related Stroop task. Similar word sets have been used in previous emotional Stroop research and also served to distinguish occupational stress-related responses from similar cognitive responses in anxiety states (e.g. Becker et al., 2001; Chen et al., 2013; Kaspi et al., 1995; Mathews and MacLeod, 1985).

Including both social and physical threat-related words addresses the frequently reported concerns of anxious individuals so might also assist in differentiating between a general anxious response to threat and occupational stress. In addition to the above word types and in line with previous emotional Stroop research a set of neutral (non-emotional), unrelated (to occupational stress) words was also required to enable comparison with colour naming latencies for the occupational stress-related words (Williams et al. 1997)

Therefore, appropriate word set stimuli required for the occupational stress-related emotional Stroop task are:

1. Occupational stress-related words (OS)
2. Neutral unrelated words (NU)
3. Social threat-related words (ST)
4. Physical threat-related words (PT)

2.1.2 Lexical Characteristics of Words in Emotional Stroop Research

The lexical characteristics of words (e.g. word frequency, emotional valence and word length) have frequently been found to influence performance on word recognition tasks as well as the emotional Stroop (e.g. Balota et al., 2004; Burt, 1999, 2002; Kahan and Hely, 2008; Larsen et al., 2006).

Word recognition research has mainly focussed on two tasks; the lexical decision task and the word-naming task, to study the influence of lexical characteristics on word recognition as they are believed to demonstrate the effects of word features efficiently (Balota et al., 2004). In a lexical decision task, participants are presented with a string of letters and asked to decide as quickly as possible if that letter string is a word or non-word. In a word-naming task, participants are presented with a word and asked to read the word aloud as quickly as possible. These tasks have manipulated lexical properties of words and generally found that those which affect word recognition will consequently influence lexical decision speed and word-naming speed on these tasks (Balota et al., 2004).

Consequently, the length of a word has been shown to affect performance on word recognition tasks in that shorter words are recognised more easily than long ones. The number of letters in a word has been found to have an inhibitory effect in both lexical decision tasks and word naming tasks for words with more letters (Larsen et al., 2006; New et al., 2006).

Research has also demonstrated that word stimuli with more syllables take longer to recognise and name (Balota et al., 2004; Ferrand and New, 2003; New et al., 2006). In contrast to these findings some studies have found that syllabic length has little or no effect on word naming (e.g. Forster and Chambers, 1973; Frederiksen and Kroll, 1976). However, Jared and Seidenberg (1990) suggested that this may be due to such studies not considering the interaction between syllabic length and word frequency. Subsequently, Jared and Seidenberg (1990) found that words with more syllables took longer to name but only for low frequency words. Ferrand (2000) and Ferrand and New (2003) also looked at syllabic length and word frequency and found that these two lexical characteristics interacted in that words with more syllables produced slower times on both word naming and lexical decision tasks but again only for lower frequency words and non-words.

With respect to emotional valence, Kousta et al. (2009) found that emotional valence of words, irrespective of polarity, facilitates performance producing shorter response times in lexical decision tasks. However, Estes and Verges (2008) found that relative to positive words; negative words interfered with performance on a lexical decision task and suggested this was due to selective attention towards the negative words as a threat detection mechanism interfering with demands of the task (lexical decision). This latter research finding is in concordance with the emotionality hypothesis for emotional Stroop stimuli previously reviewed in this Chapter however, evidence in not conclusive in either direction.

Evidence generally suggests that the frequency with which a word occurs in the language exerts a powerful influence on performance in word recognition tasks. In visual lexical decision tasks the usual observation has been that word recognition times have been faster for higher frequency words, that is, for words that are used more in the language (Balota and Spieler, 1998; Balota et al., 2004; Monsell, 1991). Burt (2002) showed that word frequency also influences colour naming latencies on emotional Stroop tasks with words that have lower frequency counts (and are therefore, less familiar) producing slower colour naming latencies than higher frequency words. This is explained as a function of the capacity model whereby less familiar words use up more processing capacity and cause a general response slowdown in colour naming (Burt, 2002).

The majority of past emotional Stroop research has often used frequency lists derived from American-English word databases even when the participants first language has been British-English (e.g. Jessop et al., 2004; McKenna and Sharma, 1995, 2004: Newman et al., 2008) or in some cases not acknowledged that words were balanced for any word characteristics (e.g. Ryan, 2002). Larsen et al. (2006) analysed 1,033 words often used in emotional Stroop research, across 32 studies and found that negative (threat) and disorder-specific words were significantly longer and had significantly lower frequencies than neutral control words using frequencies from both the Kucera and Francis (1967) and the Hyperspace Analogue to Language (HAL; Lund and Burgess, 1996) frequency databases. Therefore, it is possible that these lexical differences between the word types that provide the Stroop interference index (threat minus neutral word colour naming times) contribute to the effect that is claimed to be due to attentional bias towards threat-related material.

It could be argued that if the Stroop interference index correlates with an external index of individual difference in participants (e.g. stress scores or anxiety scores) then this in itself demonstrates that lexical differences are merely an artefact. However, Larsen et al., (2006) countered that if the Stroop interference index contains real variance due to emotionality or concern-relatedness and also error variance due to the lexical characteristics of the words then it is impossible to distinguish which of these factors correlate with the index of individual differences.

It is also important to note that interference in emotional Stroop tasks has also been regularly found where frequency and length have been balanced across the different word types (e.g. McKenna and Sharma, 1995; Williams and Nulty, 1986) so frequency cannot be entirely responsible for Stroop interference. Other factors such as emotional valence or the language that the frequency lists are derived from could play a role in this. Interestingly, Kahan and Hely (2008) found that emotional valence and frequency interacted for colour naming reaction times on an emotional Stroop that investigated these factors across conditions so it seems important to consider at least emotional valence, length and frequency when balancing emotional Stroop word stimuli.

Taking all these considerations into account, the occupational stress-related Stroop task will therefore contain two sets of negative threat-related words (representing social and physical threat), a set of neutral words and a set of occupational stress-related words. The occupational stress-related word set will not be controlled for emotional valence as concern-relatedness to perceived work stressors is the determining factor for these words.

2.1.2.1 Corpus Linguistics and Word Frequency Lists

Several indices of word frequency are available although it is suggested there are substantial differences between their ability to predict lexical decision times (Larsen, 2006; Zevin and Seidenberg, 2002). For example, Balota et al. (2004) found that the Kucera and Francis (1967) word frequency list, which is one of the oldest and most commonly used word frequency indices, had the smallest correlations with lexical decision speed than other word frequency indices they examined.

Many emotional Stroop task studies have used word frequency lists provided by Thorndike and Logue (1944), Kucera and Francis (1967) or Carroll et al. (1971) to match experimental word sets. However, these lists are relatively old, limited in size and they were created using word frequency data obtained from primarily American-English language corpora. For the purpose of this study it was decided to search for a more contemporary, preferably larger, frequency list extracted from a British corpus of English language in order to improve the reliability of balancing for word frequency and thus control for some of the concerns raised regarding the possible confounding of the lexical characteristics of word stimuli with the interference effect observed in the emotional Stroop.

Word frequency lists often used in attentional bias research were initially considered for their suitability to assist the balancing process in this study. As previously stated these word frequency lists have mainly been extracted from American-English corpora. For example, Kucera and Francis (1967) obtained from The Brown Corpus (Francis and Kucera, 1964; Francis and Kucera, 1982) or from American-English publications, such as, 'The Teacher's Word Book of 30,000 Words' (Thorndike and Logue, 1944) and 'The American Heritage Word Frequency Book' (Carroll et al., 1971). In terms of size, the Kucera and Francis (1967) list is based upon one million words, Thorndike and Logue (1944) upon 13 million words and Carroll et al. (1971) upon 5 million words of text. However, with numerous applications of contemporary, large-scale psycholinguistic and other language research, the availability of a larger, easily accessible, computerised and searchable language corpus would be a distinct advantage. Ideally it should also be based upon British-English written and spoken texts if it is primarily for research with British-English speaking participants.

A language corpus may be described as a large body of words useful for a variety of research purposes such as studies of artificial intelligence, speech recognition and synthesis, lexicography and all fields of linguistics. It is traditionally intended to be, "…a collection of naturally occurring language texts, chosen to characterize a state or variety of a language" (Sinclair, 1991, cited in Fillmore et al., 1998: Unfortunately, the corpora often used to produce popular word frequency lists do not fulfil these criteria when applied to British-English psycholinguistic research.

The Brown Corpus (The Standard Corpus of Present-Day Edited American-English, 1964), developed by Kucera and Francis (1964), is a body of over one million words derived from written American-English prose. It was made available for use in 1964, becoming the first computerised and subsequently the most analysed corpus to date. It comprises 500 American-English texts, representing diverse genres of written American. Texts include newspaper reports, press editorials, memoirs, religion, science fiction, detective fiction and romantic novels. Selection of material for inclusion involved initial subjective classification and decision regarding sample sizes, followed by random selection of actual samples in each category. The corpus was then tagged[2] to reflect parts of speech (POS) and later lemmatised (a process which separates a word stem from its inflected forms).

Fillmore et al. (1998) highlighted the fact that the Brown Corpus contains no spoken samples of American-English and is considered too small for contemporary large-scale application. They also emphasised the significant lexical and syntactic differences between British and American-English. There are considerable semantic differences between British-English (BE) and American-English (AE), for example, *pavement* (BE) - *sidewalk* (AE), *lift* (BE) - *elevator* (AE), *tap* (BE) - *faucet* (AE), *autumn* (BE) - *fall* (AE). The distribution of semantic classes will also distort

[2] Computerised corpora may be analysed by means of tagging. Tagging is the addition of identifying and classifying tags to words and other formations

British-English and American-English corpora differently, for instance the names of their respective national institutions such as ‘The House of Lords’ and ‘The Royal Family’ for BE, in comparison to ‘The Senate’ and ‘The President’ for the AE.

These factors of size and language idiosyncrasies impose limitations on the Brown Corpus usage in British psycholinguistic research. The overall effect is that frequency and distribution lists derived from American-English corpora may be skewed in favour of these distinctions, and as such are totally inappropriate to British psycholinguistic research defining the need for a frequency list derived from contemporary British-English.

Frequency lists have been constructed for different mediums of language and there are lists relating to both spoken and written words. Given that the standard emotional Stroop task uses written words, the next step was to search for a ‘written word’ frequency list derived from a British-English corpus. Another important consideration was accessibility of a British-English frequency list and the ease of which it could be searched. Previously, the majority of language corpora were only available pre-electronically (e.g. Thorndike and Logue, 1944), but with the emergence of large computerised English corpora it is possible to easily search large, electronic databases to determine word frequency.

As previously stated, the Brown Corpus is available electronically and there are several other computerised American-English corpora including Collins Bank of

English, (Cobuild) containing 329 million words, the Cambridge International Corpus (CIC) which currently contains 300 million words and the International Corpus of English (ICE) containing 1 million words.

The MRC Psycholinguistic Database Version 2.0 (Coltheart, 1981a) is a 150,837-word searchable dictionary based on American-English, which enables the user to enter various parameters to extract word lists with different psycholinguistic properties. It contains not only syntactic information but also, psychological material for the entries and is therefore useful to researchers in selecting stimuli for testing. The MRC Version 2.0 does not contain original material but was compiled by merging a number of smaller databases of limited availability. It provides lists selected for written frequency (Kucera and Francis, 1967; Thorndike and Logue, 1944), meaningfulness (Paivio et al, 1968) and concreteness (merged norms from Paivio et al., 1968 and Gilhoolie and Logie, 1980) along with other linguistic properties. However, the MRC in common with several of the aforementioned corpora either exclusively uses American-English samples or uses a large percentage of American-English samples and not British-English written and spoken samples, therefore does not fully satisfy the criteria for the current research.

Many language corpora impose restrictions and/or conditions regarding usage. For example, the Cambridge International Corpus is only available to authors and writers working on books for Cambridge University Press, whilst others require registration (fee payable) before they can be fully accessed.

2.1.2.2 The British National Corpus

The search for an accessible computerised corpus revealed the British National Corpus (The BNC World Edition, 1995), which is a database of over 100 million words taken solely from samples of spoken and written British-English. It was produced by a consortium of leading dictionary publishers (Oxford University Press, Longman Group UK Limited, and W. & R. Chambers Limited) and academic research centres (the University of Oxford, the University of Lancaster and the British Library) and represents a considerable range of modern British-English language with 90 million words from written English and 10 million from spoken English. The written samples include text from regional and national newspapers, specialist periodicals and journals (all ages and interests), academic books and popular fiction along with published and unpublished letters. The spoken part draws on unscripted informal conversation recorded from a range of social classes, regions, and ages as well as spoken language recorded in a range of different contexts from formal business meetings to radio shows and phone-ins. In total, the BNC comprises words from 4,124 texts (863 from spoken conversation or monologues).

In order for segmentation and word classification to take place, each text was split into orthographic sentence units (6.25 million in the whole corpus) and each word within these units automatically encoded according to the part of speech that it represents. This was performed by the computerised CLAWS stochastic part-of-speech tagger, which is able to distinguish 65 different parts of speech and was originally developed at The University of Lancaster (Leech et al., 1994). The BNC was encoded following the Guidelines of the Text Encoding Initiative (TEI) to ISO standard 8879 (SGML: Standard Generalized Mark-up Language) which represented the CLAWS output along with other structural properties of texts such as paragraphs, headings, and lists. Classification, contextual and bibliographical information is provided with each text.

The BNC hosted by Oxford University Computing Services, is available to search online and can be downloaded under licence (fee payable). Since the current research was undertaken a more recent version of the BNC (BNC, 2007) has been released and is now available to download under a ten-year licence (without payment) providing various copyright terms and conditions are acknowledged and complied with.

2.1.2.2 Word Frequency Lists Extracted from the BNC

Although it is possible to search and extract word frequency information from the BNC online database, it was not necessary to do so as a word frequency database drawn from the BNC World Edition (BNC, 1995) and developed by Kilgarriff (1997) for research use was found. This frequency list was originally created to mark all words in the top 3,000 items (in terms of occurrence in either written or spoken English) in ‘The Longman Dictionary of Contemporary English’.

The Kilgarriff (1997) frequency list used to balance words for the occupational stress-related Stroop task was extracted solely from the whole written BNC corpus and therefore reflects only British-English, not American-English written word frequencies. This was viewed as an advantage as the occupational stress-related Stroop task created for use in this research was developed as an objective indicator of occupational stress in British work settings where participants primarily speak British-English.

The full word frequency list containing 100,106,029 tokens[3] and 938,972 types[4] is available by anonymous file transfer protocol, along with a shorter version containing only those items occurring over five times. All files are available sorted either alphabetically or by frequency. There is also a lemmatised frequency list (that is, only the stem of the word and not the inflections are counted) for the 6,318 words with more than 800 occurrences in the whole BNC corpus. As an example, for the verb form of '*aim',* the count considered all citations of *aim, aims, aiming, aimed;* but excluded all non-verbal citations so that nominal (noun forms) *aim* and *aims* were not counted. The lemmatised list is also available from the same source. For the purpose of frequency-matching the word sets for the occupational stress-related Stroop task, the unlemmatised, alphabetically sorted, written word list was imported into Microsoft ® Word for Windows where it was possible to use the

[3] Number of tokens refers to the arithmetical count of the items in the list
[4] 'Types' refers to classification in the particular scheme, for example, a classification scheme may be set up for four major parts of speech: noun, verb, adjective and adverb.

program's search facilities to access word frequency information. This list provides the frequency of every word's occurrence in the 89.7 million BNC written word database. For example, the noun 'work' has 57,401 occurrences per 89.7 million in the written word list. The comprehensiveness and accessibility of the Kilgarriff British-English word frequency list makes it appropriate for use in construction of the word sets for the Occupational Stress-Related Stroop task.

Study One had two overarching aims:

1. To develop appropriate word sets for use as stimuli in an occupational stress-related Stroop task to be piloted as an objective indicator of occupational stress in the current research. A lack of previous emotional Stroop studies on occupational stress meant that a suitable word list of generic occupational stressors had to be derived for use in the current research.

2. To identify a contemporary British-English word corpus categorising words according to frequency of use in order to balance for frequency of use. This was to reduce the possible confounding effects of word familiarity on colour naming latencies in the emotional Stroop as suggested by research on word characteristics in lexical tasks. The majority of emotional Stroop tasks have been previously conducted using word stimuli balanced for frequency using comparatively old American-English frequency lists with participants whose first language is British-English and this was deemed unsatisfactory.

2.2 Study One Method

Study One utilised three different data collection methods and samples in an attempt to achieve methodological triangulation and capture different dimensions of the occupational stress phenomenon (Patton, 1999) in order to produce appropriate word sets for use as stimuli in an occupational stress-related Stroop task.

In the first stage, semi-structured interviews (n=10) were conducted with participants from different occupational settings to elicit prevailing issues and perceived stressors in the workplace. In the second stage, participants (n=7) from an opportunity sample took part in a focus group on occupational stress using free elicitation to draw out phrases and/or words and finally, four popular self-report occupational stress inventories were reviewed to establish common questionnaire-based sources of occupational stress.

2.2.1 Stage 1: Interviews

2.2.1.1 Design

Semi-structured interviews were used not only to identify sources of occupational stress, but also, to identify what the interviewees believed constituted stress, how it manifested itself and their perception of what caused stress in others.

2.2.1.2 Participants

Participants were obtained through a system of networking with contacts in various local organisations. A total of 10 participants comprising five male and five female interviewees with a mean age of 35.50 years (*SD* = 6.00) subsequently completed interviews. All participants were in full-time employment in various white-collar occupations at different organisations.

The male interviewees were employed as, an Accounts Manager with a distribution company, an Administration Account Manager for a C.C.T.V. company, a Business Leader with a Human Factors company, an airport Operations Manager and a Business Consultant to a textile manufacturer. The female interviewees were employed as, a Finance Administrator in the Sales and Marketing Division of a large food manufacturer, a Customer Service Representative in a credit card company, a Sales Executive in a large bank, a Legal Executive, and a Solicitor.

A Participant Information sheet (Appendix 1) and Consent form (Appendix 2) was drafted following BPS Ethical Guidelines (2009) outlining the research aims, the researcher's contact details and requesting the interviewee's permission to tape and transcribe the interview. It also advised participants of their anonymity via generation of a unique identifier code, their rights to view and agree the transcript and to withdraw from the interview and their data. All participants were debriefed following the interviews and thanked for their assistance (Appendix 3).

2.2.1.3 Materials and Data Collection

A semi-structured interview format was chosen because, although questions were decided beforehand, it was still a flexible and adaptable way of investigating issues salient to this particular research question. Interviews have been described as, "*…conversations with a purpose."* (Burgess, 1984:20). The main purpose of an interview is determined by the question content, which may be concerned with factual information and behaviour or with beliefs and attitudes. The questions can therefore differentiate between things that individuals know or do and what they think or feel. Care was taken to ensure that the interview format used in this research contained both types of questions and that no leading or biased questions were included, in an attempt to obtain the interviewees full opinions about their experience of work.

Participants were asked about elements of satisfaction and enjoyment at work and what they thought their organisation could do to improve employee satisfaction or reduce occupational stress. Interview items were informed by previous literature on occupational stress and included, '*What aspects of your work do you most/least enjoy*?', '*Can you think of a particular time or situation at work when you felt stressed or pressured?'.* The full interview schedule can be found in Appendix 4. Interviews ran for approximately 45-50 minutes on average, as conversation was allowed to flow naturally with the interviewer using probes where appropriate. A recording device was used to capture the interviews for further analysis.

Stage 2: Focus Group

2.2.2.1 Design

The second method of enquiry used a focus group to obtain opinions and beliefs about occupational stress. Focus groups can be defined as, "…a group of individuals selected and assembled by researchers to discuss and comment on, from personal experience, the topic that is the subject of the research." (Powell, 1996: 499). Unlike interviews they rely on the group members interacting to discuss topics provided by the researcher (Morgan, 1998). Focus groups are useful at the exploratory stages of a study and can be used either as a stand-alone method or as a complement to other methods, especially to achieve triangulation (Morgan 1998).

Kitzinger (1996) argues that interaction is the essential feature of focus groups because the interaction between participants allows their views, including the language they use, and their values and beliefs about a given topic to be highlighted (Kitzinger, 1996). Interaction enables participants to ask questions of each other, as well as to re-examine their own understandings of specific topics and experiences.

2.2.2.2 Participants

Seven participants were opportunity sampled from a population of post graduate students attending a university conference and asked to participate in a focus group discussion on occupational stress. They consisted of four females and three males with a mean age of 38 years (*SD* = 7.00). All participants were in full-time employment and worked an average of 35 hours per week.

A Participant Brief and Consent form was drafted following BPS Ethical Guidelines (2009) giving the research aims, the researcher's contact details and requesting the participants to create a unique identifier code to ensure anonymity (Appendix 5 and Appendix 7). It also advised them of their rights to withdraw from the focus group as well as their right to withdraw their data.

2.2.2.3 Materials and Data Collection

A free elicitation task was employed as a means of tapping into participants' perceptions and attitudes towards occupational stress. This method of data collection is widely used in marketing and consumer research (e.g. Bech-Larsen and Neilsen, 1999; Steenkamp and van Trijp, 1997) and is considered an effective way to gather responses about the perceived attributes of products and services.

Free elicitation is based on cognitive theories of spreading activation (Anderson, 1983a; Collins and Loftus, 1975) and aims to activate all nodes associated with the product (in this case occupational stress) in the participant's memory. Participants are given words or phrases (sometimes photographs) relating to a product or service and asked to respond with words or phrases that come to mind.

Responses can be recorded and transcribed for analysis or written responses can be obtained. Typically, participants' first responses are recorded. However, the method used in this research was an adapted version of free elicitation which included some discussion time (ten minutes) between focus group members during the task as it was felt that eliciting attributes of an abstract concept such as occupational stress would be aided by brief discussion with others.

To elicit occupational stress-related words and/or phrases for Study One, participants were presented with a response sheet and a written question (‘*What do you think causes stress in the workplace?’),* which they were asked to discuss with the group. (Appendix 6). Participants were given ten minutes to discuss the question and were encouraged to write down words and phrases that came to mind on the response sheet as the discussion ensued.

The researcher facilitated the group discussion to encourage everyone to participate and keep the conversation on the defined topic. Responses were collected and retained for analysis and participants were thanked for their assistance, debriefed and given an opportunity to ask questions (Appendix 3).

2.2.3 Stage 3: Self-Report Occupational Stress Inventories

2.2.3.1 Design

Following a review of the literature discussing self-report measures of occupational stress, four self-report questionnaires, frequently used in occupational stress research were chosen for content analysis.

2.2.3.2 Materials and Data Collection

Following a review of the research employing self-report scales to investigate occupational stress, four established questionnaires were chosen for their relative frequency of use in measurement of occupational stress. These questionnaires are described briefly here with reference to their content but fuller descriptions together with discussion of their psychometric properties is provided in the section on self-report measurement of occupational stress in this thesis. In the case of the Pressure Management Indicator, further details are provided in the Method section of Study Two as this questionnaire is used as a self-report indicator of stress status. the questionnaires used for content analysis in this research are copyright instruments and as such cannot be reproduced in the Appendices.

The Occupational Stress Indicator (OSI)

Developed by Cooper et al. (1988), the Occupational Stress Indicator (OSI) measures stressors, strains and moderator variables and is based on the Cooper and Marshall (1976) stress model. The OSI has been used extensively in occupational stress studies and during the period 1991 to 1996 the OSI was cited, in the research literature more frequently than any other measure of work stress. It also has normative data for over 20,000 people from a diverse array of organisations (Vagg and Spielberger, 1998).

The OSI comprises 167 items within 28 sub-scales across 6 domains: Job Satisfaction, Health, Type A Behaviour, Locus of Control, Sources of Pressure and

Coping Strategies. The Sources of Pressure domain was chosen for content analysis in this research because it was considered most pertinent to the aim of identifying occupational stress-related stimuli for the occupational Stroop task. It comprises 61 items across six sub-scales measuring Factors Intrinsic to the Job (9 items), Managerial Role (11 items), Relationships with Other People (10 items), Career and Achievement (9 items), Organisational Structure and Climate (11 items) and The Home-Work Interface (11 items).

Examples items include, '*Having too much work to do*', '*Morale and organisational climate*' and '*Lack of consultation and communication'*. Participants are asked to indicate to what degree each item is a source of pressure using a six-point scale where 1 = Very definitely is not a source and 6 = Very definitely is a source.

Previous Cronbach's alphas for internal consistency reliability of the Sources of Pressure subscales range from .71 to .87 (Davis, 1996).

The Job Content Questionnaire

The Job Content Questionnaire (JCQ; Karasek, 1985) is based on the Job Decision Latitude theory (Karasek, 1979) and has been widely employed in occupational stress research (Hurrell et al., 1998). It was originally developed for use in the Framingham Coronary Heart Disease Study (1948-ongoing) and contained 27 items based on The U.S. Quality of Employment Survey carried out in the late 1960's through to the early 1970's.

A longer version of the JCQ (Karasek et al., 1995; Karasek et al, 1998) comprising 49 items and containing five sub-scales (Decision Latitude, Psychological Demands and Workload, Social Support, Physical Demands, Job Security) is available, along with an even longer 112-item version. The recommended 49-item version of the JCQ was chosen for content analysis, as this is reported as the most valid and reliable (Karasek et al., 1998). Example items include, '*My job requires working very hard*' (psychological demands) and '*On my job, I have very little freedom to decide how I do my work'* (decision latitude). The JCQ is a copyright instrument and as such cannot be reproduced in the Appendices.

The Job Stress Survey

The Job Stress Survey (JSS) is a 30-item self-report questionnaire designed by Spielberger (1994) to evaluate the perceived severity and frequency of occurrence of psychologically damaging working conditions. It is based on Person-Environment Fit theory (PE-Fit; French et al., 1992) and the transactional model of stress (Lazarus and Folkman, 1984).

The JSS design followed recommendations by Jackson and Schuler (1985) who suggested that work stress measures should focus on aspects of work situations that frequently result in psychological pressure and Dewe (1989) who theorised that the intensity and frequency of workplace stressors should be considered. Each of the thirty JSS items describes generic, job-related stressors and includes items relating to poorly motivated co-workers, lack of recognition for good work, working overtime and meeting deadlines. Example items include, ‘*Working overtime*’ and ‘*Excessive paperwork’* and participants are asked to respond to each item in terms of severity (1 – 9) and frequency of occurrence during the last six months (1 – 9+). The JSS is a copyright instrument and therefore cannot be reproduced in the Appendices.

The Pressure Management Indicator (PMI; Williams and Cooper, 1998)

The PMI measures stressors, outcomes and moderator variables frequently cited in occupational research and is a revised version of the OSI (Cooper et al., 1988) which attempts to overcome the reliability problems previously identified within some of the OSI sub-scales (Davis, 1996).

Several modifications were made during the development of the PMI following suggestions for improvements on the OSI. The word ‘stress’ was removed from the title because it could imply that stress was a problem in the organisation and also to remove the chance that respondents may report more stress than if a neutral word was used. ‘Pressure’ was deemed to be a more neutral word and hence the questionnaire was renamed the Pressure Management Indicator.

Amongst other things the OSI was also criticised for being too long so the authors of the PMI reduced the original 167 items to 90 items assembled into 22 sub-scales. The 22 subscales are allocated as follows, Job satisfaction (2 subscales); Mental and physical health (five subscales); Sources of Pressure (eight subscales); Individual differences (four subscales); Coping (two subscales); and Social Support (separate construct).

Only the Sources of Pressure domain was selected for content analysis in the current study as it appeared the most relevant to identifying generic work stressors for the occupational stress-related Stroop task. It contains 40 items across eight subscales: Workload (six items), Relationships (eight items), Home-Work Balance (six items), Managerial Role (four items), Personal Responsibility (four items), Daily Hassles (four items), Recognition (four items) and Organisational Climate (four items). Example items include, '*Managing or supervising the work of others*', '*Being undervalued*', and '*Keeping up with new techniques, ideas, technology or innovations*'. Participants are asked to indicate to what degree each item is a source of pressure on a six-point scale (1 = very definitely is not a source and 6 = very definitely is a source). Cronbach's alphas for the eight subscales ranged from .64 to .88 (Williams and Cooper, 1998).

The authors of the PMI also took steps to ensure that the PMI was applicable across cultural boundaries and that the items reflected changing work demands, job insecurity and changes involved in the use of modern technology. The PMI is a copyright instrument and therefore cannot be reproduced in the Appendices.

2.3 Analysis

Content analysis was employed to determine the presence of particular words, concepts or themes within the texts obtained from the three methods of enquiry. Content analysis is an empirical method of text analysis to quantify the absolute and relative occurrence of words per text (Titscher et al., 2000). Berelson (1971:18) defined content analysis as, "…a research technique for the objective, systematic, and quantitative description of the manifest content of communication". It may be applied to a variety of communications such as books, speeches, interviews, and discussions, to quantify and analyse the presence, meanings and relationships of words or concepts and subsequently to draw conclusions about the text, the writer or respondents (Titscher et al., 2000).

Prior to content analysis, recorded narratives from the interviews and written texts from the focus group and self-report questionnaires were skimmed through to assist formation of analysis rules. Primarily, the level of analysis was decided upon, that is whether to code for words, sentences or paragraphs. It was resolved to code for words or sets of words that appeared to be related to sources of occupational stress or dissatisfaction at work, for example, "out of my control" and "when I'm on a deadline" (from interview texts).

The next step was to decide from the initial skimming of the texts, how many different pre-defined themes to code for although some flexibility was allowed so that those relevant categories not included at the outset could be added if found to be significant when the texts were analysed further. This allowed new material to be incorporated into the analysis if required. A set of 21 pre-defined themes was initially identified for coding of theme occurrences (Table 2.1).

Table 2.1

Pre-Defined Themes for Content Analysis

Pre-Defined Themes N = 21	
Accountability/Personal Responsibility	Lack of Guidance
Bureaucracy/Organisational Procedures	Perceived Lack of Success
Deadlines	Lack of Support
Workload	Lack of decision latitude
Factors Outside Personal Control	Management Conflicts
Home/Work Balance	Overwork/Long Hours
Inadequate Training	Supervising/Managing others
Job Insecurity	Unclear Definition of Work Role
Keeping Up With/Dislike of New Technology	Feeling Undervalued/Unappreciated
Poor Communication/Consultation	Difficult Work Relationships
Work Demands	

The texts were primarily coded for singular theme or word occurrence per individual text and not for how many times this theme occurred in each text as this was more indicative of how widely the theme was distributed throughout the sample rather than a concern of any particular individual. Coding was performed at the level of word meaning and subtle differences in tense etc. were ignored thus allowing coding of words and concepts that indicated the same meaning as the pre-defined words and concepts. Therefore, jargon and euphemisms could be put into existing categories when these were consistent with the theme. From the interviews, for example, *"I want someone to say, 'you've done a good job there'… which they don't"*, was coded under the pre-defined theme of, 'feeling undervalued/unappreciated'.

Once a set of words or phrases was categorised under a particular theme this rule was applied consistently throughout the texts. Following the establishment of these analysis rules the interview, focus group and questionnaire texts were re-read and theme occurrences noted manually.

Content analysis of the data collected from the interviews, focus group and self-report questionnaires produced the results shown in Table 2.2. Fourteen additional themes were identified and coded in the final content analysis: *Customer Demands, Achieving Targets, Others' Incompetence, Tedious/Repetitive tasks, Organisational Climate, Understaffing, Lack of Information, Business Travelling, Isolation, Organisational Change, Lack of Resources, Organisational Culture (Macho), Time Management and Bullying/Discrimination.*

Although complete triangulation may not have been achieved using three methods of data collection, it was felt that a broader picture emerged of the contemporary issues concerning occupational stress than if only one method had been utilised.

Table 2.2

Content Analysis Showing Number of Occurrences of Pre-Defined Themes Found in Each Type of Text

Pre-Defined Occupational Stress Themes *N* = 35	Interview Texts *n* = 10	Word Elicitation Texts *n* = 7	Questionnaire Texts *n* = 4	Total Texts	% of Texts in which Theme Occurs
Workload (Over/Under)	10	5	4	19	90
Work Relationships	9	1	4	14	66
Inadequate Training	8	2	3	13	62
Overwork/Long Hours	7	1	4	12	57
Lack of Support	5	2	4	11	52
Management Conflicts	8	1	2	11	52
Work Demands	6	1	4	11	52
Accountability	6	-	4	10	48
Achieving Deadlines	7	2	1	10	48
Home/Work Balance	5	1	3	9	43
Lack of Decision Latitude	5	1	3	9	43
Lack of Guidance	5	1	3	9	43
Lack of Perceived Success	4	1	4	9	43
Organisational Climate	6	-	3	9	43
Customer demands	8	-	-	8	38
Job Insecurity	4	-	3	7	33
Lack of Information	5	-	2	7	33
Achieving Targets	6	-	-	6	29
Others Incompetence	6	-	-	6	29
Bureaucracy/Procedures	6	-	2	8	38
Factors Outside Control	6	-	3	9	43
Keeping Up Technology	4	-	2	6	29
Communication/Consultation	7	-	4	11	52
Managing Others	4	-	4	8	38
Unclear Work Roles	6	5	3	14	66
Undervalued/ Unappreciated	4	2	4	10	48
Themes occurring in less than 25% of the texts					
Tedious/repetitive Tasks	1	-	3	4	19
Understaffing	3	-		3	14
Business Travel	3	-	-	3	14
Organisational Change	3	-	-	3	14
Organisational Culture	3	-	-	3	14
Lack of Resources	2	-	-	2	9
Time Management	1	1	-	2	9
Bullying/Discrimination	1	1	-	2	9
Isolation	1	-	-	1	5

2.3.1 Occupational Stress-Related Word Designation

Themes that occurred in less than 25% of the total texts were excluded from the next stage of the occupational stress-related word set generation. This resulted in the following 9 themes being disregarded for the purpose of the current study, Tedious/Repetitive Tasks, Understaffing, Business Travel, Isolation, Organisational Change, Lack of Resources, Organisational Culture, Time Management and Bullying/Discrimination.

Finally, a word was designated to depict each of these remaining themes. In some instances, similar themes were combined where overlap of meaning occurred and one word appeared to characterise both of them. Themes combined were:

- 'Factors Outside Personal Control' and 'Lack of Empowerment' expressed by 'Powerless'
- 'Management Conflicts' and 'Supervising/Managing Others' expressed by 'Management'
- 'Work Relationships' and 'Others Incompetence' expressed as 'Colleagues'
- 'Workload', 'Work Demands' and 'Customer Demands' expressed by 'Workload'

It was not possible to assign a single word that adequately typified the theme 'Organisational Climate' but otherwise all the significant themes were adequately represented. The resulting 'occupational stress-related' words are shown in Table 2.3 together with the themes that they were considered to represent.

Table 2.3

Occupational Stress-Related Words Designated to Themes Identified from Content Analysis (N = 20)

Word Designated	Themes Identified from Content Analysis
Accountable	Accountability
Bureaucracy	Bureaucracy
Deadlines	Achieving Deadlines
Powerless	Factors outside personal control – Lack of Empowerment
Family	Home/Work Balance
Untrained	Inadequate Training
Redundancy	Job Insecurity
Technology	Keeping Up with/Dislike of New Technology
Unconsulted	Lack of/Poor Communication/Consultation
Unguided	Lack of Guidance
Unsupported	Lack of Support
Management	Management Conflicts-Supervising/Managing Others
Workrole	Unclear Definition of Work Role
Undervalued	Undervalued/Unappreciated
Colleagues	Work Relationships – Others Incompetence
Workload	Workload-Work Demands-Customer demands
Targets	Achieving Targets
Unpromoted	Lack of Perceived Success / Lack of Promotion
Uninformed	Lack of Information
Overworked	Overworked/Long Hours

2.3.2 Development of Control Word Sets

The next step was to develop word sets to control for the various theoretical considerations inherent to emotional Stroop research and to distinguish responses to occupational stress from other anxiety disorders. As outlined in the Introduction to Study One in order to control for alternative hypotheses explaining attentional bias to threat-related stimuli in emotional Stroop tasks, four, word pools containing social threat-related, physical threat-related, occupational stress-related and neutral unrelated words were created which could then be balanced for word length, emotion valence and frequency of use in written British-English language.

Suitable word pools for each of the control sets were mostly obtained from lists of words used in previous emotional Stroop research on anxiety disorders. Initially pools of around 50 words of each type were collated to enable the construction of three sets of twenty control words (neutral unrelated, social threat-related and physical threat-related) that were balanced for word length, emotional valence and frequency of use with the twenty, occupational stress-related words. The following section explains this process in more detail.

A pool of emotionally neutral, unrelated (to occupational stress) words was obtained from various sources. John's (1988) list, which assigned emotionality ratings to 240 emotional (happiness, sadness, anxiety and anger) and neutral words based on the opinions of 300 Reading University graduates, provided the main body of words for the neutral word set. The remaining neutral words originated from those used in previous attentional bias studies (e.g. Mathews et al., 1990; Martin et al., 1991; Golombock et al., 1991). Care was taken to ensure that none of the final set of twenty words were semantically related to occupational stress (Table 2.4).

Table 2.4

Neutral Unrelated Words (NU)

bracelet	acquaint	sausage	voltage	tennis
package	adhesive	majestic	pianist	gigantic
yesterday	already	gesticulate	watercolours	panoramic
moderator	monastery	civilian	academy	generally

Words rated as social threat-related by previous emotional Stroop studies formed the initial pool of social threat-related words (Mathews and McLeod, 1985; MacLeod et al., 1986; Mathews et al., 1990; Mogg et al., 1989). The final twenty words can be seen in Table 2.5.

Table 2.5

Social Threat-Related Words (ST)

inept	disgraced	despised	ashamed	opposed
afraid	ridiculed	ominous	pitiful	pathetic
embarrassed	rejected	mortifying	inferior	idiotic
indecisive	inhibited	inadequate	isolated	abandoned

A pool of physical threat-related words was created from those generated for emotional Stroop studies conducted by Mathews and McLeod (1985), MacLeod et al., (1986) and Golombock et al., (1991). The final twenty words can be seen in Table 2.6.

Table 2.6

Physical Threat-Related Words (PT)

scalpel	deathbed	fracture	inquest	collapse
disease	cancerous	infectious	haemorrhage	paralysed
injury	violence	disfigurement	anaesthetic	malignancy
mutilated	coronary	casualty	cemetery	emergency

The first step of the process of balancing words from their respective pools for frequency with the occupational stress-related word set involved an initial search of Kilgarriff's (1997) electronic 89.7 million token written word frequency list to obtain the frequency for every occupational stress-related word. Secondly, the frequency counts were obtained for the neutral, unrelated words matched on syllabic length with the occupational stress-related words. This was repeated for words from the social threat-related and from the physical threat-related word pools until the best possible matches were obtained for both syllabic length and word frequency. See Appendix 8 for a table showing raw word frequency counts and syllabic length for each word in the final word sets. The syllabic lengths were matched exactly across the four, word types so there was no need to analyse for differences.

Emotional valence values for the occupational stress-related words, social threat-related and physical threat-related words were obtained from a database comprising affective norms established by Warriner et al. (2013). Valence, arousal and dominance norms for 13,915 words were gathered using words from Bradley and Lang's (1999) Affective Norms for English Words (ANEW), Van Overschelde et al's (2004) Category Norms, and the SUBTLEX-US corpus (Brysbaert and New, 2009).

Words in the Warriner et al. (2013) database were independently rated (n = 723) as emotional using a 9-point scale where 1 = negative, 9 = positive and 5 = neutral and mean valences for all the words are available as a searchable csv. list.

2.3.2.1 Analysis of Word Frequency and Emotional Valence

Word frequencies were analysed for differences across the four, word types using a one-way repeated measures ANOVA. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(5) = 144.65$, $p < .001$. Given that $\varepsilon = .34$, Greenhouse-Geisser corrected tests are reported (Field, 2013). There was no significant effect of frequency of occurrence, $F(1.02, 19.41) = 2.26$, $p = .149$, $\eta_p^2 = .106$ indicating that none of the word sets differed significantly in terms of frequency of occurrence in B-E. Means and standard deviations for frequency, syllabic length and emotional valence are displayed in Table 2.8.

Table 2.8

Means and Standard Deviations for Frequency of Use, Syllabic Length and Emotional Valence by Word Type

	Frequency		Syllables		Valence	
Word Type	*M*	*SD*	*M*	*SD*	*M*	*SD*
Occupational Stress	4087.60	8290.14	3.10	0.85	4.40	1.43
Neutral	4018.25	8603.46	3.10	0.85	5.49	0.51
Social Threat	1351.45	1617.77	3.10	0.85	2.95	0.66
Physical Threat	1558.45	2390.95	3.10	0.85	2.93	1.08

Emotional valence values for the occupational stress-related, social threat-related and physical threat-related words were analysed using a one-way ANOVA with repeated measures on word type. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(2) = 0.67$, $p = .001$. Given that $\varepsilon = .94$, Hyunh-Feldt corrected tests are reported (Field, 2013). There was a significant effect of emotional valence, $F(2, 24) = 9.92$, $p = .001$, $\eta_p = .453$. Post hoc analyses using six paired t-tests with a Bonferroni corrected alpha (.05/6 = .008) revealed that the ST words, $t(19) = 3.86$, $p = .002$, and PT words, $t(19) = 3.52$, $p = .004$ were significantly more negative than the OS words indicating their higher general threat value. The ST words, $t(19) = 10.80$, $p < .001$ and the PT words, $t(19) = 9.28$, $p < .001$ were also significantly more negative than the NU words. The ST and PT words did not differ significantly from each other in terms of valence, $t(19) = .177$, $p = .862$ and nor did the OS and NU words, $t(19) = 2.28$, $p = .041$ emphasising the concern-relatedness rather than general threat properties of the OS words.

2.4 Summary of Results

Study One was primarily a methodology study detailing the construction of appropriate stimuli for the emotional Stroop task to be used in Studies Two, Three and Four. The primary aim of this study was to create appropriate word lists for use as stimuli in an occupational stress-related Stroop task.

This aim was successfully met in that appropriate word stimuli consisting of four sets of words (20 occupational stress-related; 20 neutral unrelated; 20 social threat-related and 20 physical threat-related) were created, taking into account the following: the occupational stress-related words were representative of commonly perceived sources of pressure in the workplace; the characteristics inherent to emotional Stroop research such as threat-relatedness and emotionality were controlled for by including appropriate control word types. Word length, emotional valence and frequency were also controlled for in line with concerns raised in previous research (Balota et al., 2004; Kahan and Hely, 2008; Larsen et al., 2004) so that social and physical threat words were significantly more negative than occupational stress-related words and neutral words ($p < .008$). Results also showed no difference in emotional valence between neutral and occupational stress-related words ($p > .008$) thus emphasising the concern-relatedness of occupational stress words rather than threat-relatedness.

The secondary aim was to identify an easily accessible, British-English word frequency database in preference to the American-English lists or databases typically used in emotional Stroop research to assist matching of control word sets to the occupational stress-related words so that there were no significant differences in lexical characteristics which have been implicated in confounding with interference from threat words. Study One balanced the four, word types for frequency using a frequency list (Kilgarriff, 1996) derived from a large, British-English word corpora, the BNC (BNC, 1997) so that there were no significant differences between word types ($p > 05$). Therefore, this second aim was successfully met.

The following chapter outlines Study Two, the purpose of which was to test the occupational stress-related Stroop task in a sample of white-collar workers. White-collar workers comprise a large proportion of the UK working population and it is suggested that their working context possesses several core characteristics (e.g. working with paper/people/money rather than objects, working in an office environment rather than factory floor) and so were considered a representative sample on which to initially test the occupational stress-related Stroop task to elicit attentional bias to the generic set of occupational stress-related word stimuli.

Chapter Three (Study Two): Occupational Stress and Attentional Bias in White-Collar Workers

3.1 Introduction

The purpose of Study Two was to employ the occupational stress-related Stroop task constructed for this doctoral research, as an alternative measure of occupational stress through elicitation of attentional bias towards a set of generic, occupational stress-related word stimuli. Study Two employed a homogenous sample of white-collar workers from a large science and engineering safety management consultancy in the north west of England as they were considered fairly representative of a large proportion of working adults in the UK.

The Literature Review previously defined and reviewed the concept of occupational stress and outlined and evaluated methods commonly used to measure work-related stressors and strains. Conclusions reached were that monitoring and identification of work- related stressors through organisational risk assessment is fundamental to the health of the individual and the organisation. Currently, self-report questionnaires are the most frequently used measurement method in the UK and elsewhere however, given the limitations previously outlined, researchers have proposed that multiple measurement methods might improve reliability of stress measurement typically performed during risk management interventions.

3.1.1 White-Collar Workers and Occupational Stress

White-collar workers have been defined as, "…managerial, professional, associate professional and technical, sales, and clerical and secretarial occupations." (Almeida-Santos et al., 2010: 5). White-collar work is fundamentally considered to be work primarily consisting of cognitive work rather than physical work with an emphasis on formal education in comparison to blue-collar work.

Designating workers to occupational groups using collar colour initially referred to the fashion for 19th and 20th century office workers in Western countries to wear white collars as opposed to manual workers known as blue-collar workers, who typically wore more serviceable blue denim or cambric shirts (Sinclair, 1919 cited in Van Horn and Schaffner, 2003).

Many working roles identified as white-collar could also be viewed as service work for example, customer service and sales. Furthermore, various types of white-collar work are described as having several core characteristics making them distinctive from blue-collar work and some professions, such as, working environment (office, not factory floor), type of clothing worn for work (everyday clothes, not a uniform), and type of work (dealing with paper, money and people as opposed to objects). White-collar workers in the UK, represent what is a large and increasing section of employed adults in the UK (Whysall and Ellwood, 2006). Whilst there is a paucity of recent reliable statistics on the proportion of white-collar workers in the working population of 32.15 million in December 2017, a recent report by the National

Office for Statistics (2018) reported an increase of 150,000 more UK workforce jobs (between the period September 2016 and September 2017) in the 'Administrative and Support Services' sector (typically white-collar), which was the largest increase across the workforce classifications (for example, manufacturing jobs increased by only 48,000). This increase might be explained by changes in the structure of employment towards service industries over past years which has favoured white-collar workers in non-manual occupations. However, there is also some uncertainty attached to white-collar jobs, mostly for administrative clerical and secretarial jobs where the growing use of information and communications technology (ICT) has led to job losses (UK Commission for Employment and Skills: UKCES, 2014). In addition, deskilling, automatization and the reduction of jobs to routine processes have been accused of transforming the nature of white-collar work so that it has more similarities with blue-collar work (Van Horn and Schaffner, 2003.

In contemporary times, with the growth in types of occupations it might be too simplistic to categorise workers simply as white or blue- collar and a range of other descriptions could apply, however for the purpose of this study it provides a useful description of the characteristics and types of work carried out by the population which provided the participants for the research conducted in Study Two.
For the purposes of this research, given that white-collar workers are said to make up a substantial proportion of the 32.15 million people working in the UK (Office for National Statistics, 2018), they were viewed as being representative of a wide range of occupational roles and therefore an appropriate population on which to initially

test the occupational stress-related Stroop task containing a set of generic work-stress related word stimuli.

As previously cited in the Literature Review, stress and anxiety are amongst the most frequently reported work-related health problems in the UK accounting for 37% of all work-related ill health and representing approximately 11.7 million working days lost to ill-health in 2015-16. Furthermore, the scale of this problem has remained fairly static over the last ten years. (HSE, 2016).

Numerous organisational research has investigated psychosocial factors, moderating variables and health outcomes in the workplace. With reference to white-collar workers, the Whitehall II studies are a series of large-scale studies reporting on the association between psychosocial stressors, and health outcomes in white collar workers in the UK. These studies involved large numbers of male and female civil servants aged between 35-55 who took part in prospective studies with baseline measures during the first stage (1985-88) and varying in average number of years for follow-up measures. In one of the Whitehall II studies, Bosma et al. (1997) investigated the link between psychosocial factors in the workplace namely, job control, job demands and social support from colleagues (as identified by self-report scales) and the onset of coronary heart disease (CHD) in a sample of 10,308 civil servants. They found that perceptions of lower job control were significantly associated with newly reported CHD over an average of 5.3 years to follow-up. In another Whitehall II study with the same participants (N = 10,308), Stansfeld et al.

(1999) investigated relationships between job demands, decision authority (control), effort-reward and social support at work, and psychiatric disorder outcomes. They found that high job demands, low social support, low decision authority and a high effort to reward ratio in phase 1 (baseline 1985-88) predicted the incidence of psychiatric disorder at follow-up (1991-93).

Kuper et al. (2002) used the Effort-Reward Imbalance model (Siegrist, 1996, 2002) and found that a higher effort to rewards ratio predicted risk of CHD and poor physical and mental health over an average of 11 years from baseline to follow-up of the Whitehall II cohort. Head et al. (2002) conducted a further Whitehall II investigation, and found that high demands, low control and an imbalance between effort and reward in the workplace were all associated with increased incidence of CHD even when typical predictors such as smoking and high blood pressure were accounted for.

Head et al. (2006) investigated the effect of perceived change in psychosocial work factors (decision latitude, work demands and social support at work) on health status and subsequent sickness absence in a sample from the Whitehall cohort (*N* = 3817). Baseline measures were taken in 1985-88 with two follow-ups in 1994-95 and 1996-98). Findings indicated that decreases in decision latitude increase the risk of long spells of sickness absence, increasing levels of job demands predicted risk of protracted sickness absence and improvements in social support from colleagues reduced the risk of protracted sickness absence.

The above are examples of the prospective Whitehall II studies which when taken together, account for a substantial body of research on white-collar workers showing that stressful working conditions, such as, high job demands, low decision latitude (control) and lack of social support at work, are associated with subsequent ill health including psychiatric morbidity (Stansfeld et al., 1991), poor mental health functioning (Kuper et al., 2002), sickness absence (Head, 2006), and coronary heart disease (Bosma et al., 1997; Kivimaki et al., 2002; Kuper et al., 2002) amongst other physiological and psychological health outcomes.

Other research has reported similar results for white-collar workers in terms of psychosocial work factors such as high work demands (e.g. excessive workload), low decision latitude (e.g. control over work role), social support at work, and a high ratio of effort to reward, predicting health outcomes including psychological distress (Bourbonnais et al., 1996); increased blood pressure (Guimont et al., 2011); CHD (Kivimaki et al., 2006; McEwan, 2007); job insecurity (Ferrie et al., 2001) and mental health

As outlined, there is considerable evidence suggesting associations between psychosocial work hazards, perceived stress and subsequent adverse outcomes not only in white-collar workers but in the global work force in general. The majority of this evidence comes from correlational studies using self-report measures and therefore no causal relationships can be claimed. In addition, the dominant measurement instruments used in organisational risk assessment are self- report questionnaires, which are open to response biases for example, social desirability (Paulhus and Vazire, 2007) and issues related to poor psychometric reliability and validity (Briner, 2000) as well as common method variance that may confound the results (Lindell and Whitney, 2001). Other occupational stress measurement methods using what might be considered more objective physiological measures, could be deemed intrusive, are often time-sensitive (Kirschbaum and Hellhammer, 1994) and can also be affected by a range of extraneous factors such as, ingestion of alcohol, nicotine, or some types of medication (Kirschbaum and Hellhammer, 1994), physical and mental exertion (Semmer et al., 2004) and participants' non-compliance with sample collection instructions (Kudielka et al., 2003). This reinforces the requirement for a novel measure of psychosocial work hazards such as an occupational stress- related Stroop task, to be used as an adjunct to self-report or other methods.

3.1.2 Occupational Stress, Anxiety and Attentional Bias

In the Literature Review, an argument was advanced that anxiety and stress (as conceptually similar states) are characterised by an attentional bias towards threat-related environmental stimuli. Various cognitive theories support this argument and propose explanations for why this might be including, activation of threat schemata when anxious or aroused (Beck and Clark, 1997); hypervigilance towards threat as an evolutionary response (Eysenck, 1992); and lack of attentional control in anxiety and stress (Eysenck et al., 2007). Furthermore, there is evidence to endorse the proposal that acute levels of stress can facilitate selective attention and performance on attentional tasks such as the classic Stroop (e.g. Booth and Sharma 2009; Chajut and Algom, 2003) which is in line with Easterbrook's (1959) evolutionary theory of attention and emotion where attention narrows in the face of threat so that only task relevant processing (naming the ink colour) takes place.

Additionally, there is a wealth of evidence for impaired attentional processing by anxious individuals on the emotional Stroop (for reviews see Bar Haim et al., 2007; Williams et al., 1996) which is in line with several cognitive theories of anxiety including attentional control theory (Eysenck et al., 2007). The main thrust of attentional control theory is that stress uses up processing resources so that efficient processing is limited to only the most easily accessible, automatically activated dimensions of the environment, which is likely to be thoughts and events related to current concerns (the meaning of the threat or concern-related words in an emotional Stroop), irrespective of whether they are relevant to completion of the task (e.g. colour naming).

A considerable body of research has reported attentional bias towards negative threat- related stimuli in emotional Stroop tasks for a range of affective psychopathologies and states including anxiety (e.g. Bar Haim et al., 2007; MacLeod and Mathews, 1988; Mansell et al., 2002; Williams et al., 1996) However, researchers have questioned the notion that this attentional bias only occurs with emotionally negative, threat words and have found Stroop interference in studies using both positive and negative emotional stimuli (e.g. Dalgleish, 1995; Rutherford et al., 2004). Following on from this, it was proposed that it is the specificity of stimuli to the participants current concerns rather than the emotional tone which elicits attentional bias. A range of research has demonstrated emotional Stroop interference for a large range of both clinical and non-clinical affective conditions including, eating disorders (e.g. Dobson and Dozois, 2004) depression (e.g. Epp et al., 2012), addiction (e.g. Field et al., 2009b), prospective colposcopy patients (MacLeod and Hayes, 1992) and students with examination stress (Reimann and McNally, 1995).

Although there is an extensive body of research investigating attentional bias in anxiety and other affective states, to date there is a lack of research investigating attentional bias in occupational stress. A comprehensive literature search found only one previous study using the emotional Stroop paradigm that was specifically related to workers or occupational stress. As previously cited, Woodfield et al. (1995) employed a blocked, card version of the emotional Stroop which contained occupational threat-related words, neutral and control (rows of letter O's) to investigate attentional bias in forty managers at a large industrial company in the UK and found that those with higher stress (indicated by scores on a stress adjective checklist) took significantly longer to colour-name occupational threat words in comparison to both neutral and control stimuli and in comparison to a low stress group. However, this study had a range of limitations (previously cited in the Literature Review) that could have confounded the results so the current research took these limitations into account and controlled for them where possible. These controls are outlined in the Method section of this chapter.

Therefore, the current study aims to use an occupational stress-related Stroop task to investigate attentional bias towards concern-related stimuli (occupational stress-related) and control words (including social threat, physical threat and neutral) in white collar workers who indicate high levels of perceived stress on an established self-report measure of occupational stress, namely the PMI (Williams and Cooper, 1998). The PMI has been used in occupational stress research with a range of different occupational groups (e.g. Bellmann et al., 2003; Cottrell, 2001; Kirkcaldy and Shephard, 2011; Laschinger and Finnegan, 2005). Examples of research populations include, Cottrell (2000) who used the PMI with a sample of UK community nurses; and Bellmann et al. (2003) who used the PMI with a group of Australian managers (N = 204).

Hypothesis One

Participants in the high occupational stress group will take significantly longer to colour-name occupational stress-related words in comparison to neutral unrelated words (within-subjects Hypothesis). This emotional Stroop effect will be specific to occupational stress-related words and no differences will be found between other threat-related word sets (social threat, physical threat) and neutral words.

Hypothesis Two

Participants in the high occupational stress group will take significantly longer to colour-name occupational stress-related words than neutral unrelated words in comparison to the low occupational stress group (between-subjects Hypothesis).

3.2 Study Two Method

3.2.1 Design

Study Two employed a 2 x 4 mixed factorial design with stress status (high vs. low stress) as the between-subjects independent variable and word type (occupational stress-related, neutral unrelated, social threat-related and physical threat-related) as the within subjects independent variable. The dependent variable was the colour naming latencies (in milliseconds) recorded for each word type on the modified Stroop task.

3.2.2 Participants

Eighty participants were initially recruited from a large science and engineering safety management consultancy in the north west of England. The target population were white-collar administrative and professional staff. This occupational setting was chosen because it enabled an opportunity sample of a reasonable size to be drawn from a relatively large homogenous population.

Initial contact and liaison with the organisation was through a senior manager, who advised all employees of the general nature of the study without revealing procedural details. Employees were encouraged to take part in the study but no coercion was used and attendance was not compulsory.

Three participants were removed from the study due to colour vision deficiency and a further 11 were later removed due to incomplete or unreturned questionnaires. The remaining 66 participants consisted of males (*n* = 42) and females (*n* = 24) all of whom had normal or corrected to normal vision. The participants' ages were classified by group as follows: 15-30 years (*n* = 5); 31-50 years (*n* = 52); and 51 years and over (*n* = 9).

3.2.3 Ethical Considerations

This research adhered to the BPS Code of Human Research Ethics (2010) and also followed University ethical procedures for research. Prior to taking part in the study, participants were asked to read a Participant Brief detailing the stages of the study and what was required of them (Appendix 9). It was not possible to detail the full aims of the study as this could have primed participants to the stimuli in the modified Stroop task and confounded the results. Participants were advised of this prior to giving consent and told that the full research aims would be explained on completion of both stages of the study. They were then asked to read and sign a Consent Form (Appendix 10) to indicate their agreement to participate and also to provide the unique identifier code used in the Stroop task to maintain anonymity. Participants were advised that they were free to withdraw their data at any point up to the proposed data aggregation date and they were reminded of this during the debrief at the end of their participation.

3.2.4 Materials

3.2.4.1 Measure 1. Occupational Stress-Related Modified Stroop Task.

i) Word stimuli

Study Two used the word set stimuli described in Study One which comprised 80 words consisting of 20 occupational stress-related (OS), 20 physical threat-related (PT), 20 social threat-related (ST) and 20 neutral unrelated (NU) words (Table 3.1).

The OS, NU, ST and PT word sets were matched for frequency of occurrence using Kilgariff's (1996) word frequency list based on the British National Corpus (BNC) and also for syllabic length to control for confounding of Stroop interference with word characteristics (Ferrand and New, 2003; Kahan and Healy, 2008; Larsen et al., 2006; Monsell et al., 1989; New et al., 2006).

Table 3.1

Word Stimuli for the Occupational Stress-Related Stroop Task

Word Type			
Occupational Threat $N = 20$	Neutral Unrelated $N = 20$	Social Threat $N = 20$	Physical Threat $N = 20$
Untrained	Bracelet	Inept	Scalpel
Workrole	Acquaint	Disgraced	Deathbed
Workload	Sausage	Despised	Fracture
Deadlines	Voltage	Ashamed	Inquest
Targets	Tennis	Opposed	Collapse
Colleagues	Package	Afraid	Disease
Unguided	Adhesive	Ridiculed	Cancerous
Uninformed	Majestic	Ominous	Infectious
Overworked	Pianist	Pitiful	Haemorrhage
Powerless	Gigantic	Pathetic	Paralysed
Management	Yesterday	Embarrassed	Injury
Family	Already	Rejected	Violence
Unconsulted	Gesticulate	Mortifying	Disfigurement
Unpromoted	Watercolours	Inferior	Anaesthetic
Unsupported	Panoramic	Idiotic	Malignancy
Undervalued	Moderator	Indecisive	Mutilated
Accountable	Monastery	Inhibited	Coronary
Redundancy	Civilian	Inadequate	Casualty
Bureaucracy	Academy	Isolated	Cemetery
Technology	Generally	Abandoned	Emergency

ii) Presentation Software and Hardware

The computerised Stroop program used in this research was written by technicians working in the Psychology Department of Manchester Metropolitan University. The program incorporated a timer requiring a computer with a Pentium processor in order to record response times. It also enabled different sets of word stimuli to be entered and edited if required. An additional feature of the program allowed participants to enter a unique identification code, their gender and age group prior to each trial. These details were automatically recorded to a Microsoft Excel (Microsoft Office 2000 Full Edition) results file which was produced on completion of each participant's trial. The results file provided individual word presentation colour naming latencies, mean colour naming latencies for each word across four presentations and aggregated word type means for every participant (all latencies were in milliseconds). The emotional Stroop program registered errors if a participant pressed an incorrect colour key for example, pressing the *'green'* key when the stimulus word colour presented was *'red'* and provided a mean percentage error rate for each individual by word type.

A computerised, single, coloured-word presentation was used in preference to blocked, card presentation following concerns raised by previous research that Stroop interference observed for threat-related stimuli in blocked card studies might be due to other factors such as priming from blocks of negative emotional stimuli and not entirely reflective of an attentional bias towards threat (e.g. Algom et al., 2004; McNally, 1994; Williams et al.,1997).

The modified Stroop program presented each word stimuli in lower case letters one centimetre high in the centre of a black screen. Every word was semi-randomly presented once in each colour (*red, blue, green and yellow*) totalling 320 word presentations per participant, with the restrictions that the same word or colour could not appear twice in succession. The number of presentations and the randomisation was effected to reduce possible confounding variables such as priming (Algom et al., 2004; McKenna and Sharma, 2004) and practice or repetition effects (Neale and Liebert, 1986; Williams et al., 1996). Standardised instructions appeared on-screen to guide participants through the Stroop task (See Procedure).

iii) Experimental Hardware

A Samsung laptop computer with a 12” SVGA colour screen and standard QWERTY keyboard were used to present the task. The keys numbered 5, 6, 7, and 8 were each covered by a coloured sticker so that they appeared as red, blue, green and yellow respectively to allow manual response. These keys were chosen as they are located at the top centre of a QWERTY keyboard so do not favour either right or left handedness in responses. The Stroop effect can diminish with a manual as opposed to vocal response however, colour naming interference has still been found in the majority of manual response studies and a complete absence of interference has seldom been reported (MacLeod et al., 1991).

3.2.4.2 Measure 2. Pressure Management Indicator (PMI)

The Pressure Management Indicator (PMI; Williams and Cooper, 1998) is a 120-item, 24-scale, self-report questionnaire developed from the Occupational Stress Indicator (OSI; Cooper et al., 1988). It aims to measure the major dimensions of occupational stress outlined in Cooper and Williams’ (1998) transactional model of work stress, namely stressors (e.g. workload, career development and home-work balance) and strains (e.g. job satisfaction); outcomes (e.g. physical symptoms including exhaustion, depression) and moderating variables (e.g. social support, coping strategies).

Responses from the Sources of Pressure (SOP) scale of the Pressure Management Indicator (PMI; Williams and Cooper, 1998) were used as a means of categorising participants into high and low occupational stress groups (relative to the sample) for analysis in this study. The SOP scale was chosen to indicate the level of perceived occupational stress and to allocate participants into groups because it is the scale that directly measures the amount of pressure perceived from a range of commonly reported workplace stressors.

The SOP scale measures the amount of pressure the participant perceives each item in the scale has placed on them in the last 3 months and constitutes the largest scale of the PMI comprising 40 items with eight subscales: Workload (six items) measuring 'The amount or difficulty of work they have to deal with' e.g. *'Having to work very long hours'*; Relationships (eight items) measuring 'How well they get on with the people around them' e.g. *'Discrimination and favouritism'*; Recognition (four items) measuring 'The extent to which people feel they need to have their achievements recognised' e.g. *'Unclear promotional prospects'*; Organisational Climate (four items) measuring 'The 'feel' or 'atmosphere' within the place of work' *e.g. 'Characteristics of the organisation's structure and design'*; Personal Responsibility (four items) measuring 'Taking responsibility for their actions and decisions' e.g. *'Implications of the mistakes you make'*; Managerial Role (four items) measuring ‘Being responsible for managing and supervising other people’ e.g. *‘Having to adopt a negative role such as sacking someone’*; Home-Work Balance (four items) measuring ‘’Switching off’ from the pressures of work when at home, and vice versa’ e.g. *‘Absence of emotional support from others outside work’*; and Daily Hassles (four items) measuring ‘The day to day irritants and aggravations in the workplace’ e.g. *‘Keeping up with new techniques, ideas, technology or innovations’* (Williams and Cooper 1998).

Participants’ responses are measured on a six-point rating scale with 1 being *‘very definitely is not a source’* and 6 being *‘very definitely is a source’* of pressure. Participants are asked to respond to each question even where a particular question does not apply. For example, if a question asks about pressure from managing staff and the participant does not manage any staff they should respond by circling ‘1 - *very definitely is not a source’*. The subscales may be analysed individually or the 40 items in the SOP may be summed to create a total SOP score. The maximum total score on the SOP scale is 240 and is calculated by summing the response to each item in the scale, and the minimum score is 40. The higher the score for the individual subscales, the more pressure is perceived from that particular source and the higher the total SOP score, the more pressure is perceived overall (Williams and Cooper, 1998). No cut-off scores are provided for high and low stress as the instrument is not intended for clinical use, although there is a set of norm data (N = 20, 981) with reference points for each of the subscales (Resource Systems, 1999).

The PMI total SOP scale and subscales have previously established internal consistency reliabilities with alpha coefficients of between .73 and .88 (Williams and Cooper, 1998) with only the Daily Hassles subscale (α = .64) falling below the conventionally acceptable alpha level of .70 (Nunnally and Bernstein, 1994). Although it is acknowledged that all facets of the transactional model of stress (stressors, strains and moderator variables) might interact in the work stress process, participants' perceptions of sources of stress (stressors) in the workplace were considered most relevant to enable categorisation of participants into high and low stress groups. This is in line with questionnaires generally used to allocate groups in emotional Stroop research where the focus is on quantifying the level of general anxiety for example, the State-Trait Anxiety Inventory (Spielberger et al., 1970, 1983) or other emotional disorder including phobias for example, fear of snakes using the Snake Questionnaire (SNAQ: Klorman et al., 1974).

The PMI is a copyright instrument and not available in the public domain therefore, it cannot be reproduced in the Appendix of this research but permission to use it was obtained from the publishers, Resource Systems with the provisos that the entire PMI was used to collect data and a copy of the anonymised data set was forwarded to them on completion of the analysis.

In addition to the PMI questions, participants were asked to indicate their gender, age group and to provide their work email address. To reduce unnecessary invasiveness and possible reticence regarding provision of their exact age, participants were simply asked to indicate which age group they belonged to (15-30 years, 31-50 years, or 51 years and over). There was also a space to write the participant's unique identification code from the Stroop task to enable matching of individual questionnaire responses to the Stroop task results.

3.2.5 Procedure

Initial written contact was made with a senior manager in the organisation outlining the aims and procedure of the research and permission was given to collect data. Data collection took place over a 4-week period by prior arrangement with the organisation. Every employee who agreed to participate after reading the Participant Brief and Consent was given an appointment day and time and requested to attend a designated office at their organisation.

Data collection was implemented in two phases; Phase 1 was completion of the occupational stress-related Stroop task; Phase 2 was completion of the PMI self-report questionnaire.

3.2.4.2 Phase 1. The Occupational Stress-Related Stroop Task

Stage 1 of the study was conducted in a small, private office at the participants' workplace. Participants were asked if they had read the Participant Brief and were requested to sign the Consent Form and create a unique identifier code if they were willing to take part. They then completed the computerised Occupational Stress-Related Stroop task administered by the researcher.

Participants were seated approximately 30cm away from the computer screen and advised to take up a comfortable position as the task would take approximately five minutes to complete. The participant's attention was drawn to the four coloured keys (*red, blue, green and yellow*) on the computer keyboard which would be used in the task and s/he was asked to read and follow the instructions as they appeared on the computer screen thus standardising the task instructions. Prior to the Stroop task, on-screen instructions asked the participant to indicate their age group and to enter their unique identification (ID) code into the respective boxes provided on the screen. The researcher stayed in the room up to this point to ensure that the participants details were completed correctly given that the ID code would also be used in the second phase of Study Two to marry up Stroop and questionnaire responses. Once they had completed their details, the researcher reminded the participant to follow the on-screen instructions and withdrew from the room. After entering their age and ID code into the program the following instructions appeared on screen:

*"In this task, you will be presented with words written in different colours.
Press 'Space Bar' to continue."*

Having pressed the 'Space Bar' the next set of instructions appeared:

"Your task is to press the coloured key which corresponds to the colour of the word on the screen. You should do this as quickly and as accurately as possible. There is no need to read the word; you need only identify the colour it is written in. Press 'Space Bar' to continue."

Once the participant had pressed the ‘Space Bar’ the following instructions were revealed:

“After you have provided your response by pressing the appropriately coloured key you should press ‘Space Bar’ to reveal the next word. You will now be given a short practice test to familiarise you with the procedure. Press ‘Space Bar’ to begin the practice test.”

Prior to the main task four neutral practice words (*inexpensive, surface, lit or spherical*) were presented once in each of red, blue, green and yellow ink (16 presentations). One of the four practice words appeared in the centre of the screen printed in either red, blue, green or yellow on a black background. The word remained on the screen until the participant pressed a coloured key and the next word appeared on the screen. This was repeated until all practice words had been presented (a total of 16 individual word presentations). The aim of this practice test was to familiarise participants with the apparatus and the task and to reduce participant apprehension. It also served to show whether participants could easily distinguish between the four colours used in the task. Three participants reported difficulties so were thanked for their assistance and did not take any further part in the study.

On completion of the practice trials, the following instructions appeared on the screen.

“Now you have the idea, the actual task can begin. Press the ‘Space Bar’ to begin the experiment”

A stimulus word appeared in the centre of the screen printed in one of the four colours and remained on the screen until one of the four colour keys was pressed. This procedure was repeated for a total of 320 semi-random presentations (4 sets of

20 stimulus words, individually displayed once in each of the four colours). At the end of the task the following instructions appeared on the screen.

"Thank you for taking part in this task. Please tell the researcher you have finished"

Once the participants had completed the Stroop task, they were thanked for their time and assistance and asked if they were willing to continue with Phase 2 of the study by completing a questionnaire. The Stroop program produced a Microsoft Excel © results output file for every participant which was retained for subsequent statistical analysis.

3.2.4.2 Phase 2. The Pressure Management Indicator (PMI)

Each participant was given the PMI (Williams and Cooper,1996) questionnaire booklet and an envelope. They were asked to read the instructions and return their completed questionnaires in the sealed envelope to a sealed ballot-type box on the desk of a designated member of administrative staff by a specified date.

Participants were given 3 weeks to complete the PMI and were emailed a reminder at the two-week point. Upon receipt of the completed questionnaires the researcher contacted the participants, thanked them for their involvement and fully debriefed them as to the aims of the study. Participants were also reminded to contact the researcher if they wished to withdraw their data prior to data aggregation or request a summary of the results once completed and given a date by which this should be done (Appendix 11).

Following this, participants' questionnaires were matched with their Stroop task output using the unique identification codes and all contact details initially provided were destroyed to maintain anonymity.

3.3 Study Two Results

Participants responses from the PMI and colour naming latencies from the occupational stress-related Stroop were entered into SPSS for analysis.

3.3.1 The Pressure Management Indicator (PMI)

The Sources of Pressure (SOP) scale of the PMI was scored following the procedure recommended by the authors (Williams and Cooper, 1998) and supplied by the publishers, Resource Systems. A total SOP scale score was calculated by summing the scores from all 40 items for each participant and scores were also calculated for every participant on each of the eight subscales.

Internal consistency reliabilities for the total SOP scale were calculated for the whole sample and for each of the eight subscales. Table 3.2 shows Cronbach's alpha reliabilities for all subscales and the total SOP scale. Subscale alpha reliabilities ranged between .64 and .86 which is generally considered acceptable for psychometric tests in the social sciences (Nunnally and Bernstein, 1994). The total SOP scale reliability which was used as an index to allocate participants to comparison groups, had an alpha reliability of .93, 95% CI [.91, .95] which was significantly above .7 ($p < .001$).

Table 3.2

Cronbach's Alpha for Sources of Pressure Scales on the Pressure Management Indicator (N = 66)

Pressure Management Indicator Scale	Number of items	Cronbach's alpha	95% Confidence interval for alpha	
			Lower	Upper
PW	6	.86**	.80	.91
PR	8	.86**	.80	.91
PC	4	.82*	.74	.88
PO	4	.73	.60	.82
PP	4	.84*	.76	.89
PM	4	.78	.68	.86
PH	6	.85**	.79	.90
PD	4	.64	.47	.76
TOT SOP	40	.93**	.91	.95

Note. PW = workload; PR = relationships; PC = recognition; PO = organisational climate; PP = personal responsibility; PM = managerial role; PH = home/work balance; PD = daily hassles; TOT SOP = total sources of pressure; *F* test with true value = 0.7, **p* < .01. ***p* < .001

3.3.2 Participant Characteristics

Unlike attentional bias research on anxiety, which typically uses either clinically diagnosed anxious participants or non-clinically anxious participants pre-screened for anxiety levels, participants in this study were not pre-screened for occupational stress status in order to categorise them into high and low occupational stress groups. This is meant to ensure that there are an adequate number of participants with concerns related to the research area (the experimental group) to compare with a control group However, as previously cited, pre-screening using an occupational stress questionnaire containing words semantically related to or the same as those used in the occupational stress-related Stroop task could prime participants to the topic and content of the task and confound the results (Dalgleish, 1995; Williams et al., 1996).

Another issue related to the order that questionnaires and the emotional Stroop task are administered in, is that concern-related material which generally appears in self-report scales used for pre-screening (e.g. the State-Trait Anxiety scale, STAI: Spielberger et al., 1970 or the Beck Anxiety Inventory, BAI; Beck et al., 1998) might produce negative affect in participants. It has been proposed that this negative affect carries over to the Stroop task and can confound Stroop interference with a generic slowdown in processing due to negative affect (Algom et al., 2004; Lundh and Czyzykov-Czarnocka, 2001). The PMI used in studies One, Two and Three of this thesis contains reference to occupational words such as '*workload*', '*deadlines*', and '*pressure*' which could prime responses to the emotional Stroop task either through semantic similarity or emotional tone so it was particularly necessary to control the order of delivery in that Phase 1 was completion of the emotional Stroop and Phase 2 was PMI completion. Therefore, following the design typically employed in attentional bias and anxiety research where either clinically anxious or high trait or state anxious participants are compared with non-anxious controls, two comparison groups (high and low stress) were categorised based on occupational stress scores as determined by the PMI total SOP scores obtained after administration of the Stroop task. For the current study, 25th and 75th percentile total SOP mean scores were used to create high and low stress comparison groups. Using a percentile, median or other split of participants' questionnaire mean scores to establish comparison groups follows several other attentional bias studies mostly within non-clinical samples where participants were not pre-screened or diagnosed for emotional disorder or there were no established cut-off points on the scale used (e.g. Boyer and Dickerson, 2002; Woodfield et al., 1995). Consequently, participants with a total SOP score equal to or lower than the 25th percentile (≤ 108.00) were assigned to a *'low stress'* (LS) group and participants with a total SOP score equal to or higher than the 75th percentile score (≥ 145.00) were assigned to a *'high stress'* (HS) group. The LS group (n = 17) consisted of 10 males and 7 females with a modal age group of 31-50 years and a PMI total SOP mean of 92.12 (SD = 17.15). The HS group (n = 18) consisted of 14 males and 4 females with a modal age group of 31-50 years and a PMI total SOP mean of 156.00 (SD = 12.52).

A series of independent t-tests revealed that the HS group had a significantly higher total SOP mean score than the LS group (p < .001). This was also the case for each of the eight subscales of the SOP scale indicating that the HS group perceived significantly more occupational pressure from the sources measured than the LS group (p < .001). Table 3.3 shows means, standard deviations, t values, and effect sizes using Cohen's *d*[5] (with 95% confidence intervals) indicating very large effect

[5] Cohen's *d* effect sizes (adjusted for sample size) are used throughout the results section and Cohen's 'rules of thumb' used for interpreting values of *d* where 0.2 – 0.49 is considered a 'small' effect size, 0.5 – 0.79 represents a 'medium' effect size and 0.8 and above is a 'large' effect size (Cohen, 1992)

sizes for differences in scores between low and high stress groups on all SOP subscales and total SOP.

3.3.3 Analysis of Stroop Colour Naming Latencies

Individual trials with colour naming latencies of three standard deviations above or below participants' individual means were considered outliers (Tabachnick and Fidell, 2013) and were excluded from the analysis. Individual trials with errors (e.g. pressing an incorrect colour key) were also excluded from the analysis. Outliers and errors accounted for less than 2% of the data so were not analysed further. Means and standard deviations of colour naming latencies for each word type (OS, NU, ST, PT) were determined for the HS group and the LS group and are presented in Table 3.4.

Table 3.4

Stroop Colour Naming Latencies (milliseconds) by Word Type for High and Low Stress Groups

	Stroop Colour Naming Latencies (ms)			
	Low Stress *n* = 17		High Stress *n* = 18	
Word Type	*M*	*SD*	*M*	*SD*
Occupational (OS)	766.76	89.58	811.50	140.40
Neutral (NU)	762.53	87.86	783.72	125.84
Social Threat (ST)	769.29	93.04	790.94	122.62
Physical Threat (PT)	766.47	89.46	720.48	89.46

Table 3.3

Means, Standard Deviations and t-tests (with effect sizes) for Sources of Pressure Scores on the Pressure Management Indicator (PMI) by Stress Group Status

Measure									
PMI Sources of Pressure	Low Stress n = 17		High Stress n = 18					Effect Size CI (95%)	
	M	*SD*	*M*	*SD*	*t*	*df*	*d*	Lower	Upper
PW	13.29	4.55	26.06	4.84	8.02	33.00	2.66	1.73	3.58
PR	19.94	6.44	31.44	3.19	6.64	23.09	2.21	1.29	3.14
PC	11.47	4.43	16.39	3.43	3.68	33.00	1.21	0.48	1.95
PO	11.53	3.54	17.56	2.33	5.98	33.00	1.97	1.12	2.81
PP	10.71	2.64	16.39	1.54	7.84	33.00	2.57	1.60	3.54
PM	5.71	1.90	13.22	4.34	6.66	23.45	2.18	1.27	3.09
PH	9.71	4.43	20.33	4.16	7.32	33.00	2.41	1.53	3.30
PD	9.76	3.40	14.61	2.03	5.08	25.85	1.69	0.88	2.51
TOT SOP	92.12	17.15	156.00	12.52	12.64	33.00	4.16	2.90	5.41

Note. PW = workload; PR = relationships; PC = recognition; PO = organisational climate; PP = personal responsibility; PM = managerial role; PH = home/work balance; PD = daily hassles; TOT SOP = total sources of pressure
All t-tests significant at p < .000

To investigate differences in colour naming performance a 2 x 4 mixed factorial ANOVA was conducted with occupational stress status (low and high) as the between-subjects variable and threat word type (OS, NU, ST, PT) as the within-subjects variable. Colour-naming latencies (in milliseconds) for each word type were the dependent variable. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(5) = 12.96$, $p = .024$. Given that $\varepsilon = .83$, Huynh-Feldt corrected tests are reported (Field, 2013). The results revealed a significant main effect of word type, $F(2.80, 92.48) = 8.14$, $p < .001$, $\eta_p^2 = .198$ and a non-significant main effect of stress status, $F(1,33) = 0.56$, $p = .459$, $\eta_p^2 = .017$. These were qualified by a significant interaction between word type and stress status, $F(2.80, 92.48) = 5.80$, $p = .001$, $\eta_p^2 = .149$.

To investigate the significant interaction, one-way ANOVAs were conducted on each of the LS and HS groups separately with repeated measures on word type (OS, NU, ST, PT). Colour naming latencies differed significantly between word types for the HS group, $F(2.35, 39.96) = 8.67$, $p < .001$, $\eta_p^2 = .338$. However, there were no significant differences in colour naming latencies between word types for the LS group, $F(2.08, 33.27) = 1.79$, $p = .181$, $\eta_p^2 = .101$.

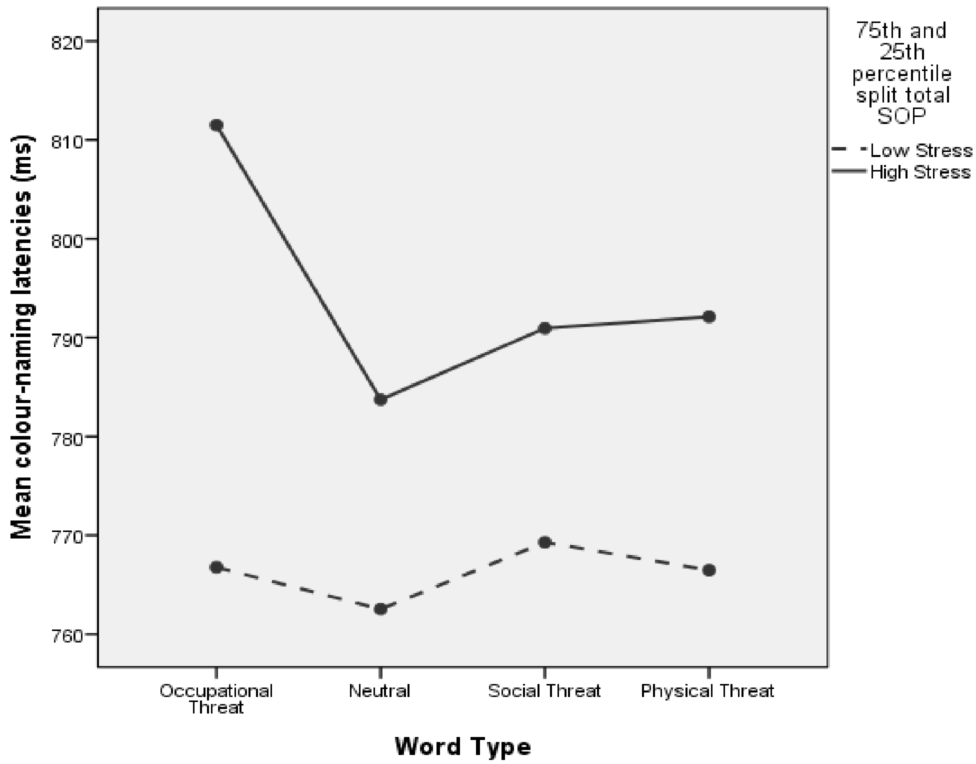

Figure 3.1. Means plot showing colour naming latencies as a function of word type and occupational stress group.

To interpret the significant differences observed in the one-way ANOVA, simple effects analyses were conducted using three paired t-tests on just the HS group, between colour naming latencies for each of the threat word types (occupational, social and physical) and neutral unrelated words. A Bonferroni correction was applied to control for familywise Type 1 error giving a new alpha significance of .016 (.05/3).

The results indicated that the colour naming latencies for OS words (*M* = 811.50, *SD* = 28.74) were significantly slower than for NU words (*M* = 783.72, *SD* = 25.71) with a mean difference of 27.78 (*SD* = 21.33) milliseconds and a small effect size, $t(17) = 5.53$, $p < .001$, $d = 0.20$, 95% CI [0.08, 0.32]. This difference was specific to OS words and NU as there were no significant differences in colour naming latencies between the other threat words (ST, PT) and neutral words, ($p > .016$) within the high stress group. Effect sizes were negligible. Table 3.5 shows mean differences, t-test statistics and Cohen's *d* effect sizes with confidence intervals (95%).

Table 3.5

Paired Sample t-tests on Colour Naming Latencies by Word Type for the High Stress Group with Effect Sizes and Confidence Intervals

Colour Naming Latencies (ms)							
						CI (95%)	
Word Pair	Mean Difference	*SD*	*t*(17)	*p*	*d*	Lower	Upper
OS-NU	27.78	21.33	5.53	< .001*	0.20	0.08	0.32
ST-NU	7.22	19.54	1.57	.135	0.06	- 0.02	0.13
PT-NU	8.39	18.92	1.88	.077	0.06	- 0.01	0.14

Note: OS = Occupational Stress, NU = Neutral Unrelated, ST = Social Threat, PT = Physical Threat; *Significant at Bonferroni corrected alpha, p < .016

Analysis of Interference Scores

To investigate differences in the pattern of colour naming responses between the high and low stress groups, interference scores were calculated by subtracting the colour naming latencies for NU words from each of the threat word colour naming latencies (OS, ST, PT) for both high and low stress groups. Larger positive interference scores indicate more interference from threat words on colour naming latencies. Table 3.6 shows means and standard deviations for interference scores by word types and stress group.

A 2 x 3 mixed factorial ANOVA was conducted with occupational stress status (low and high) as the between-subjects factor with repeated measures on word type interference (OS-NU, ST-NU, PT-NU) and interference scores as the dependent variable. There were significant main effects for word type interference, $F(2,66) = 4.30$, $p = .018$, $\eta_p^2 = .115$ and stress group, $F(1,33) = 7.82$, $p = .009$, $\eta_p^2 = .192$. These were qualified by a significant interaction between word type interference and stress group, $F(2,66) = 5.49$, $p = .006$, $\eta_p^2 = .143$.

To interpret the interaction and investigate whether any of the interference scores were significantly higher in the HS group than the LS group (Hypothesis Two), three independent t-tests were conducted with a Bonferroni correction (.05/3) and a new significance level of $\alpha = .016$.

Table 3.6

Colour Naming Interference Scores by Word Type and Stress Group

	Stroop Interference Scores (ms)			
	Low Stress *n* = 17		High Stress *n* = 18	
Word Type	*M*	*SD*	*M*	*SD*
OS - NU	4.24	6.52	27.78	21.33
ST - NU	6.76	11.92	7.22	19.54
PT - NU	3.94	12.98	8.39	18.92

Note. OS = Occupational Stress-Related; ST = Social Threat-Related; PT = Physical Threat- Related

The high stress group had significantly higher interference scores for OS-NU (M = 27.78, SD = 21.33) than the low stress group (M = 4.24, SD = 6.52) with a mean difference of 23.52 milliseconds and a large effect size, $t(20.32) = 4.47$, $p < .001$, d = 1.45, 95% CI [.066 – 2.26]. No other significant differences were found between HS and LS groups for ST-NU or PT-NU interference scores ($p > .016$). Table 3.7 shows mean differences, t-test values and effect sizes and Figure 3.2 depicts the interference scores (with error bars) for each word type by stress group.

Table 3.7

Mean Differences, Independent t-Test Values and Effect Sizes for Interference Scores between HS and LS groups

Colour Naming Interference (ms)							
						CI (95%)	
Interference Word Type	Mean Difference	*SE*	*t*	*p*	*d*	Lower	Upper
OS-NU	23.54	5.40	4.47	< .001*	1.45	0.66	2.26
ST-NU	0.46	5.51	0.08	.934	-0.24	-0.90	0.43
PT-NU	4.45	5.46	0.82	.422	0.27	-0.40	0.93

Note. OS = Occupational Stress-Related; ST = Social Threat-Related; PT = Physical Threat- Related. *Significant at Bonferroni corrected alpha, p < 016.

3.4 Summary of Results

Analyses of mean colour naming latencies showed that the high stress group took significantly longer to colour-name occupational stress-related words in comparison to neutral unrelated words with a small effect size (*d* = 0.20). This Stroop interference was specific to the occupational stress-related words within the high stress group. No significant differences in colour naming latencies were found for either social threat or physical threat words in comparison to neutral unrelated words in either the HS or LS group. These results support Hypothesis One (within-subjects)

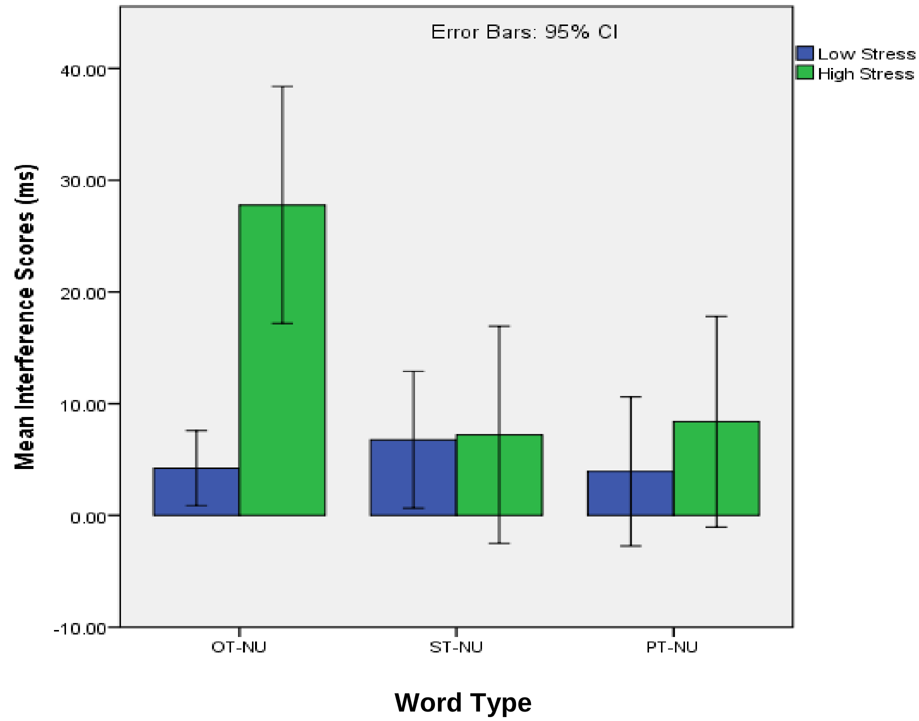

Figure 3.2. Mean interference scores with error bars by word types and stress group. Summary of Results

Examination of interference scores revealed a significantly larger interference score for occupational stress-related words and neutral unrelated words (OS – NU) in the high stress group in comparison to the low stress group with a large effect size (d = 1.45). This supports Hypothesis Two (between -subjects). This difference was specific to the occupational stress-related words as there were no significant differences in interference scores between the low stress and high stress group for any of the other threat word interference scores.

The above is intended only as a summary of the analyses in terms of the Hypotheses, the findings of Study Two are considered further in Chapter 6, the Discussion.

The next chapter (Chapter Four – Study Three) is concerned with extending the testing of the occupational stress-related Stroop task to a more specific occupational group, namely teachers working in a Further Education college. The main aim was to discover if the attentional bias towards occupational stress-related words which was exhibited by white-collar workers with higher stress in Study Two, will also be observed in teachers who might be expected to report an occupation-specific set of stressors rather than the generic set represented in the occupational stress-related Stroop constructed for this doctoral research.

The phenomenon of 'teacher stress' will be outlined and examples of psychosocial hazards reported in teacher stress research will be considered. Popular measurement tools used in investigating teacher stress will also be reviewed and a rationale advanced for this research.

Chapter Four (Study Three): Attentional Bias and Occupational Stress in Further Education Teachers

4.1 Introduction

The purpose of Study Three was to extend the use of the occupational stress-related Stroop task, the development of which was described in detail in Study One, to elicit and measure attentional bias towards occupational stress-related stimuli in Further Education (FE) teachers.

The main aim was to discover if the set of generic occupational threat-related words used in the Stroop task and found to elicit attentional bias in a homogenous sample of white-collar workers in Study Two was applicable to across occupational groups, in this instance, teaching. Given that teachers as a profession are generally shown to perceive higher levels of occupational stress (Kyriacou, 2001) and that sources of this stress may be specific to the role of teaching, Study Three uses a sample of FE teachers.

The Introduction defines and outlines the problem of occupational stress in teachers, identifies the main sources of teacher stress and discusses measures frequently used to assess occupational stress in teachers before proposing that the occupational stress-related Stroop could be used as an alternative or additional measure of occupational stress.

4.1.1 Teacher Stress

Previous research generally supports the notion that teaching is a stressful profession with low levels of psychological and physical well-being and job satisfaction (e.g. Johnson et al., 2005; Kyriacou, 2001; Lambert and McCarthy, 2006; Travers and Cooper, 1993, 1996). A study conducted by Smith et al., (2000) for the Health and Safety Executive (HSE) found that teaching was the most stressful profession in the UK with 42% of teachers describing themselves as 'highly stressed'. This was more than double the average for other professions. More recently the HSE Labour Force Survey (HSE, 2016) reported an average prevalence (for the 3-year period 2013-2016) of 1780 per 100,000 for self-reported teacher stress, anxiety and depression caused or worsened by their job.

Johnson et al. (2005) surveyed workers' experiences of occupational stress using three stress-related factors (psychological well-being, physical health and job satisfaction) across 26 different occupations and found that not only did teachers report higher levels of occupational stress than average but also that teaching was one of the most highly stressed professions in the UK. In terms of lower than average levels of physical health and psychological well-being, teachers were rated second only to ambulance drivers. Reported levels of job satisfaction were also lower than average with 20 out of the 26 professions sampled reporting more satisfaction at work than teachers.

Teacher stress may be defined as, "…the experience by a teacher of unpleasant, negative emotions, such as anger, anxiety, tension, frustration or depression, resulting from some aspect of their work as a teacher." (Kyriacou, 2001: 28). Other definitions suggest that teacher stress pertains to the amount of work pressure and demands (stressors) for example, excessive workload, perceived by the individual and the consequent 'strain' reaction to those stressors for example, low job satisfaction and poor psychological health. It has also been suggested that teacher stress is the result of an imbalance between the amount of work stressors the individual perceives and the resources they believe they have to cope with them (e.g. Travers and Cooper, 1993).

4.1.2 Sources of Teacher Stress

Sources of teacher stress often identified in research are; disruptive students, time pressures and heavy workload, role conflict and ambiguity (Kyriacou, 2001), having to cope with change (Cox et al., 1988) maintaining discipline, having to teach disinterested students, relationships with work colleagues, low self-esteem linked to occupational status, being evaluated by others, dealing with administration and management and having a poor physical working environment (Kyriacou, 2001; Montgomery and Rupp, 2005; Travers and Cooper, 1996). McCarthy et al. (2009) noted that stressors identified by primary school teachers have included, large class sizes (French, 1993); having to complete unnecessary paperwork; excessive workload and time pressures; teaching children with difficult behaviours (Pratt, 1978); administrative or educational policy- related processes, and pressure to comply with educational changes and curriculum initiatives especially if they were counter to their own values or pedagogical beliefs (Moriarty et al., 2001).

Naturally, sources of stress will not be the same for every teacher and individual differences such as personality, coping resources, social support, stage of teaching career and the type of teaching they do may affect the individual's experience of stress (Kyriacou, 2001).

4.1.3 Individual and Organisational Consequences of Teacher Stress

In addition to the physical, psychological and behavioural responses to occupational stress previously outlined in Chapter One, research on teacher stress has examined responses believed to be more specific to teaching such as burnout.

Burnout (Maslach and Jackson, 1981) is often linked with the teacher stress experience and focuses primarily on the, "…physical, emotional and attitudinal exhaustion..." of individuals resulting from prolonged teacher stress (Kyriacou, 1987: 146). As cited in Chapter One, burnout is characterised by feelings of emotional exhaustion, depersonalisation, and lack of perception of personal achievement (Maslach and Jackson, 1981, Maslach et al., 1996, Maslach et al., 2001). In addition to these adverse emotional effects, burnout has also been associated across a range of occupations with depression, cardiovascular disease and sleep disruption (Ahola and Hakanen, 2007; Honkonen, 2006) as well as muscular-skeletal disorders (Ahola and Hakanen, 2007).

In teachers, burnout has been associated with absenteeism, reduced job satisfaction, lower quality of life, impaired job performance and intention to leave (Burke and Greenglass, 1989; 1995). However, the relationship is thought to be moderated by pre-existing vulnerability factors such as neuroticism, and poor coping mechanisms (Reichl et al., 2014) so care is needed when claiming definitive causal relationships with burnout.

Burke and Greenglass (1995) conducted a longitudinal study over a year investigating the relationships between teacher stressors and burnout together with the effects of burnout on a range of psychological, physical and organisational outcomes. Severity and frequency of stressors at Time 1 significantly predicted burnout 12 months later (Time 2). Furthermore, burnout (in particular the emotional exhaustion component) significantly predicted lower job satisfaction, lower life satisfaction, more psychosomatic problems (e.g. headaches, poor appetite) and increased use of medication (e.g. tranquillisers, pain relief).

de Heus and Diekstra (1999) investigated whether burnout was experienced more by teachers than other public service professions by conducting a large-scale, questionnaire study (N = 13,555) consisting of teachers and a range of other professions including, nurses, mental and physical health professionals and care workers. They concluded that teachers reported more psychological strains and higher rates of burnout than the other caring professions surveyed in the study.

In terms of other psychological outcomes, Ferguson et al. (2012) found that heavy workload and poor student behaviour were significant predictors of both anxiety and depression in teachers with poor employment conditions also being predictive of anxiety.

Other reported outcomes include, lowered job satisfaction and intention to leave (Chaplain, 1995; Klassen and Chiu, 2010; Travers and Cooper, 1993) and self-efficacy (Klassen and Chiu, 2010).

4.1.4 Measurement of Teacher Stress

Teacher stress is most commonly measured using self-report inventories and as such examples of these will be outlined here. Some research has employed generic work stress inventories that are non-specific to teaching, for example, the ASSET questionnaire (Faragher et al., 2005) which was used in the Johnson et al. (2005) study investigating occupational stress across 26 UK professions. Other research has argued

that scales specific to stressors related to the teaching occupation are required to obtain an accurate picture of the workplace issues triggering stress in teachers.
One example, of a teacher-specific stress measure is The Teacher Stress Inventory (TSI; Fimian, 1984) which is a self-report measure identifying dimensions of work that teachers find stressful such as role ambiguity, role conflict and organisational management. The TSI records responses on a 5-point Likert scale ('not at all stressful' to 'extremely stressful') assessing how stressful the respondent perceives each of these situations to be.

The Classroom Appraisal of Resources and Demands (CARD; Lambert et al., 2001) is a measure based on Lazarus and Folkman's (1984) transactional approach to stress which assesses teacher's cognitive appraisals of the work environment in terms of demands (stressors) that contribute to teacher stress and resources (provided by the school) that can help teachers manage those demands. The CARD comprises two scales: Classroom Demands (35 items) which asks respondents to rate the severity of different classroom demands (e.g. children with problem behaviours, administrative demands) on a 5-point scale where 1 = Not demanding and 5 = Extremely demanding; and Classroom Resources which asks respondents to rate the degree of 'helpfulness' of different school resources (e.g. instructional resources, support personnel) again on a 5-point Likert scale.
In addition to occupational stress questionnaires trying to identify stressors, self-report inventories that assess moderator variables due to individual differences, such as

coping skills (e.g. the COPE; Carver et al., 1989), personality and social support may be employed as part of a battery of questionnaires to investigate causes and correlates of teacher stress.

In addition, teacher stress research usually measures outcome measures of strain along with stressor measures, for example, the General Health Questionnaire (GHQ; Goldberg et al., 1979) which is a 12-point self-report scale measuring physical and mental health.

Another self-report strains measure is the Maslach Burnout Inventory (MBI; Maslach et al., 1996) which is the most used self-report measure for burnout (Hastings et al., 2004). The MBI comprises 22 items assessing the three components of burnout: emotional exhaustion (nine items) including frustration, fatigue, interpersonal stress; depersonalisation (five items) measuring the frequency of negative experiences with work colleagues/clients; personal accomplishment (eight items) measuring the frequency of positive experiences at work. Responses are recorded on a 7-point frequency scale ranging from 0 = never to 6 = everyday (Maslach et al., 1996).

The measurement methods typically used to investigate teacher stress have strengths and limitations as with all stress measurement tools (See critique of stress measurement tools and methods in Chapter One). However, consideration should be given to the fact that as the majority of teacher stress research employs self-report methods they are open to a range of response biases and methodological limitations as outlined in Chapter One. In addition, the main sources of stress reported may not generalise to all teachers. In some cases, an individual's main source of stress whilst being important to them may not be a common source of stress for other teachers. It's also possible that some sources of stress are over-reported especially if they are frequently attributed sources of stress or sources that assign blame to factors outside the individual (Kyriacou, 1987, 2001). Nevertheless, a wealth of research evidence points to the existence of various stressors and strains in the experience of teaching.

4.1.5 Rationale for Study Three

After reviewing the literature, it appears that teachers frequently report high levels of stressors and strains related to their work environment and that adverse health effects have been associated with their perceived stress levels. Stressors reported are multivariate although many are specific to teaching as a profession.

The prevalent method used to measure stressors and strains in teaching has traditionally been self-report measures. However, the limitations inherent to self-report measures previously reviewed in the Chapter One define the need to consider the use of accessible, additional measurement methods. The occupational stress-related Stroop task used in Study Two might be a suitable measure to use in conjunction with self-report measures, particularly considering the obtrusive nature and limitations of physiological and/or observational indicators.

An argument was advanced in the Literature Review and in Study 2 (white-collar workers), that anxiety (as an outcome of occupational stress) elicits attentional bias towards concern-related stimuli irrespective of emotional valence, namely occupational stress-related words in this doctoral research, presented in a specifically constructed emotional Stroop task. As cited in this Chapter, teachers have often reported occupation-specific stressors so it is useful to investigate whether the generic occupational stress-related words in this research are sufficiently concern-related to elicit attentional bias. In addition, some types of emotionally-disordered patients have displayed disproportionately more attentional bias towards negatively-valenced, threat-related stimuli than would be expected from application of the concern-relatedness hypothesis alone (e.g. Cassiday et al., 1992). This suggests that higher levels of stress could potentially elicit attentional bias towards negative threat-related word stimuli as well as, or instead of, occupational stress-related word stimuli in Study 3 given that teachers are expected to have higher levels of stress compared to the average worker (Johnson et al., 2005; Kyriacou, 2001).

The findings from Study Two suggest that the occupational-stress Stroop task might be a useful indicator of occupational stress in a homogenous sample of white-collar workers. Nevertheless, it is possible that occupational groups such as teachers, for whom research has frequently cited occupation-specific sources of stress, will not exhibit attentional bias differentially towards the generic occupational stress-related word stimuli employed in the occupational stress-related Stroop task but might additionally or alternatively respond to general threat from the social and physical threat stimuli. This could indicate that the occupational stress-related Stroop task containing generic work stress-related words is not universally applicable because specific occupations such as FE teachers require stimuli based on occupation-specific stressors.

In order to test the occupational stress-related Stroop task as an objective indicator of stress across different occupational groups, an opportunity sample of FE teachers were tested. The occupational stress literature shows that teachers generally report high levels of stress and furthermore they appear to be one of the most highly stressed professions in the UK (Johnson et al., 2005). This provides some theoretical justification for testing the occupational stress-related Stroop on a sample of teachers

The main aim of Study Three was to investigate the generalisability of the occupational stress-related Stroop task to a different occupational group, namely FE teachers.

Study Three aimed to utilise the occupational stress-related Stroop task to elicit and measure attentional bias in FE teachers identified as low and high stress by scores on the Sources of Pressure scale of the Pressure Management Indicator (PMI: Williams and Cooper, 1998).

Hypothesis One

Participants in the high occupational stress group will take significantly longer to colour-name occupational stress-related words in comparison to neutral unrelated words (within-subjects Hypothesis). This emotional Stroop effect will be specific to occupational stress-related words and no differences will be found between other threat-related word sets (social threat, physical threat) and neutral words.

Hypothesis Two

Participants in the high occupational stress group will take significantly longer to colour-name occupational stress-related words than neutral unrelated words in comparison to the low occupational stress group (between-subjects Hypothesis).

4.2 Study Three Method

4.2.1 Design

Study Three used a 2 x 4 mixed factorial design with occupational stress status (high or low stress) as the between-subjects independent variable and word type (occupational stress- related, social threat-related, physical threat-related and neutral unrelated) as the within- subjects independent variable. The dependent variable was the colour naming latencies (in milliseconds) recorded for each word type on the modified Stroop task.

4.2.2. Participants

Fifty-eight participants who were employed as full-time teachers at a Further Education college in Greater Manchester initially volunteered to take part in Study Three. The FE College had sixth form provision offering a wide range of academic, vocational and work-based courses for school leavers together with an extensive programme of full and part-time courses for adult learners. This target population was chosen because as previously outlined, research suggests that reported levels of occupational stress are often high in academics and they might be expected to have occupation-specific sources of stress. The data was purposely collected during May and June of the academic year as this was the examination and assessment period and therefore a time when academic and occupation- related demands typically increase. It was hoped to gain a discrete group of participants with higher perceived occupational stress scores by conducting the research in this occupational setting and at this time of year in order to test the notion that those with higher reported stress levels would exhibit more attentional bias towards occupational threat words on the modified Stroop task in comparison to controls.

Three participants were removed from the study due to incomplete or unreturned PMI questionnaires. The remaining 55 participants comprised 39 males and 16 females with normal or corrected to normal vision. Participants ages were classified by group as follows: 15-30 years, n = 8; 31-50 years, n = 38; 51 years and over, n = 9.

Initial contact was made with the Head Teacher of the FE College by the researcher which was followed by a meeting outlining the aims and procedure of the research and permission was given to collect data. Liaison with the organisation was through the Head Teacher and the researcher advised teaching staff of the general nature of the study without revealing procedural details. Teaching staff were encouraged to take part in the study but no coercion was used and attendance was not compulsory.

Prior to taking part in the study, participants were asked to read a Participant Brief and Consent Form detailing the phases of the study and what was required of them (Appendix 9 and 10).

4.2.3 Ethical Considerations

This research adhered to the BPS Code of Human Research Ethics (2010) and also followed University ethical procedures for research. Although participants were briefed, it was not possible to detail the full aims of the study as this could have primed participants to the stimuli in the modified Stroop task and confounded the results. Participants were advised of this prior to giving consent and told that the full research aims would be explained on completion of both stages of the study. They were then asked to read and sign the Consent Form to indicate their agreement to participate and also to generate a unique identifier code to be used in both phases of data collection to maintain anonymity. Participants were advised that they were free to withdraw their data at any point up to the proposed data aggregation date and they were reminded of this during the debrief at the end of their participation.

4.2.3 Materials

4.2.3.1 Measure 1: The Occupational Stress-Related Stroop Task

Study Two used the occupational stress-related Stroop task presentation hardware and software as previously described in Study Two.

Experimental Hardware

A Samsung laptop computer with a 12” SVGA colour screen and standard QWERTY keyboard were used to present the task. The keys numbered 5, 6, 7, and 8 were each covered by a coloured sticker so that they appeared as red, blue, green and yellow respectively to allow manual response. These keys were chosen as they are located at the top centre of a QWERTY keyboard so do not favour either right or left handedness in responses.

4.2.3.2 Measure 2: Pressure Management Indicator (PMI*)*

The 'Sources of Pressure' (SOP) subscale from The Pressure Management Indicator (PMI; Williams and Cooper, 1996) as outlined in Study Two was used as an index of perceived occupational stress in this study.

4.2.4 Procedure

Data collection took place over a 4-week period by prior arrangement with the FE College. Every teacher who agreed to participate after reading the Participant Brief was given an appointment day and time and requested to attend a designated office at the FE College. All participants were tested in a small, private office at the FE College. Participants were again asked to read the Participant Brief which outlined what participation would involve and to sign the consent section if they agreed to take part in both stages of the study (Appendix). They were also asked to create a unique identification code which was to be used in both phases of Study Three to ensure anonymity.

Data collection was implemented in two phases as follows:

4.2.4.1 Phase 1: The Occupational Stress-Related Stroop Task

Participants were seated approximately 30cm away from the computer screen and advised to take up a comfortable position as the task would take approximately five minutes to complete. They were advised to follow the on-screen instructions in order to complete the task and also to enter their age group and unique identification code The Stroop task procedure used in Study Two was followed as previously described.

4.2.4.2 Phase 2: The Pressure Management Indicator (PMI)

Following completion of the occupational stress-related Stroop task each participant was handed a PMI questionnaire booklet marked with their identification code and an A4 envelope. They were asked to read the instructions and return their completed questionnaire in the sealed envelope within14 days to a post box located in the staff room which the researcher emptied and resealed every 2 days during a fourteen-day period. The researcher sent emails after 7 days had elapsed reminding participants to return the questionnaire. Upon receipt of the completed PMI's the participants were thanked via email for their involvement in the study and sent a brief explanation of the rationale behind the study advising that if they wished to discuss anything further they should contact the researcher (Appendix 11). The PMI responses were matched with the corresponding Stroop task results and following this all contact details were detached from the data and destroyed to maintain anonymity.

4.4 Study Three Results

Participants' questionnaire (PMI) responses and colour naming latencies for each word type were entered into SPSS for further analysis.

4.4.1 The Pressure Management Indicator (PMI)

The Sources of Pressure (SOP) scale of the PMI was scored according to the authors instructions following the procedure recommended by the authors (Williams and Cooper, 1998) and supplied by the publishers, Resource Systems. This resulted in eight SOP subscale scores for each participant on each of the eight subscales and a total SOP score which was calculated by adding all 40 SOP scale items for each participant.

Internal consistency reliability for the total SOP and for each of the 8 subscales were calculated using Cronbach's alpha and were found to range between .71 and .90 (Table 4.1). The total SOP scale reliability which was used as a measure to allocate participants to comparison groups had reliability of $\alpha = .97$, 95% CI [.95, .98] which was significantly above .7 ($p < .001$) and generally deemed acceptable for psychometric tests in the social sciences (Nunnally and Bernstein, 1994).

4.4.2 Participant Characteristics

Two comparison groups were categorised based on occupational stress scores (as determined by PMI total SOP scores). For the current study, 25th and 75th percentile total SOP scores were used to create high and low stress groups in line with previous modified Stroop research which has established comparison groups within similar non-clinical samples (e.g. Mogg and Bradley, 2004). Study Two provided a theoretical and methodological justification for not pre-screening into groups using the PMI and this logic was also followed here.

Table 4.1

Cronbach's Alpha for Pressure Management Indicator Scales (N = 55)

Measure	Number of items	Cronbach's alpha	95% Confidence interval for alpha	
			Lower	Upper
PW	6	.90***	.85	.94
PR	8	.89***	.85	.93
PC	4	.88***	.82	.92
PO	4	.90***	.85	.94
PP	4	.72	.57	.82
PM	4	.81*	.71	.88
PH	6	.83**	.76	.89
PD	4	.71	.56	.82
TOT SOP	40	.97***	.95	.98

Note. PW = workload; PR = relationships; PC = recognition; PO = organisational climate; PP = personal responsibility; PM = managerial role; PH = home/work balance; PD = daily hassles; TOT SOP = total sources of pressure, *F* test with true value = 0.7, * $p < .05$. ** $p < .01$. *** $p < .001$

Participants with a PMI total SOP score equal to or lower than the 25th percentile (≤ 88.00) were assigned to a *'low stress'* (LS) group and participants with a PMI total SOP score equal to or higher than the 75th percentile score (≥ 149.00) were assigned to a *'high stress'* (HS) group. The LS group (*n* = 15) consisted of 13 males and 2 females, comprising 5 participants aged 15-30 and 10 aged 31-50, with a PMI total SOP mean of 75.73 (*SD* = 12.14). The HS group (*n* = 15) consisted of 9 males and 6 females, comprising 2 participants aged 15-30, 7 aged 31-50 and 6 aged 51 and over, with a mean overall SOP score of 160.00 (*SD* = 10.46).

A series of independent t-tests demonstrated that the HS group scored significantly higher than the LS group for the total SOP score and also on each of the eight SOP subscales ($p < .001$) indicating a significantly higher level of perceived occupational pressure in the HS group. Table 4.2 shows means, standard deviations, *t* values, and effect sizes using Cohen's *d*[6] (with 95% confidence intervals) for all subscales and the total SOP by low and high stress group.

4.4.3 Analysis of Stroop Colour Naming Latencies

Trials with outliers in colour naming latencies of three SD's above or below the participant's individual means were excluded from the analysis (Tabachnick and Fidell, 2013). Individual trials with errors (e.g. pressing an incorrect colour key) were also

[6] Cohen's d conventions for interpreting values of adjusted d (adjusted for sample size) are used throughout the results section for interpreting values of *d* (adjusted for sample size) where 0.2 – 0.49 is considered a 'small' effect size, 0.5 – 0.79 represents a 'medium' effect size and 0.8 and above is a 'large' effect size (Cohen, 1992

excluded from the analysis. Overall outliers and errors accounted for less than 3% of the data so were not analysed further. Means and standard deviations for each threat word type (OS, NU, ST, PT) were determined for the HS group and the LS group and are presented in Table 4.3.

Table 4.3

Stroop Colour Naming Latencies (milliseconds) by Word Type for High and Low Stress Groups

	Stroop Colour Naming Latencies (ms)			
	Low Stress n = 15		High Stress n = 15	
Word Type	*M*	*SD*	*M*	*SD*
Occupational (OS)	764.93	85.51	819.07	108.85
Neutral (NU)	770.93	89.85	794.40	93.69
Social (ST)	765.13	97.86	803.40	98.19
Physical (PT)	764.07	100.15	802.33	92.34

Table 4.2

Means, Standard Deviations and t-tests (with effect sizes) for Sources of Pressure Scores (SOP) on the PMI by Stress Group

Measure									
Sources of Pressure	Low Stress *n* = 15		High Stress *n* = 15					Effect Size CI (95%)	
	M	*SD*	*M*	*SD*	*t**	*df*	*d*	Lower	Upper
PW	12.00	2.70	26.13	6.42	7.86	18.79	2.79	1.64	3.94
PR	15.93	3.94	33.33	3.54	12.73	28.00	4.52	3.13	5.91
PC	6.93	2.15	17.40	3.83	9.22	28.00	3.28	2.07	4.49
PO	8.13	2.20	18.60	2.92	11.08	28.00	3.94	2.65	5.23
PP	9.40	2.44	15.40	1.96	7.42	28.00	2.64	1.63	3.65
PM	5.00	1.00	14.40	2.29	14.55	19.14	5.18	3.39	6.97
PH	9.33	2.23	20.53	3.56	10.33	28.00	3.67	2.40	4.94
PD	8.80	2.88	15.00	1.51	7.38	21.16	2.62	1.55	3.69
TOT SOP	75.73	12.14	160.00	10.46	20.36	28.00	7.24	5.19	9.28

Note: PW = workload; PR = relationships; PC = recognition; PO = organisational climate; PP = personal responsibility; PM = managerial role; PH = home/work balance; PD = daily hassles; TOT SOP = total sources of pressure * All t-tests significant at $p < .001$

To investigate differences in colour naming performance for the different word types, a 2 x 4 mixed factorial ANOVA was conducted with occupational stress status (low and high) as the between-subjects variable and threat word type (OS, NU, ST, PT) as the within- subjects variable. Colour naming latencies (in milliseconds) for each word type were the dependent variable. Mauchly's test was not significant so sphericity assumed test statistics were used. There was a significant main effect of word type, $F(3, 84) = 3.22$, $p = .027$, $\eta_p^2 = .103$ but no significant main effect of stress status, $F(1,28) = 1.23$, $p = .278$, $\eta_p^2 = .010$. There was also a significant interaction between word type and stress status, $F(3,84) = 6.64$, $p < .001$, $\eta_p^2 = .192$ which is illustrated in Figure 4.1.

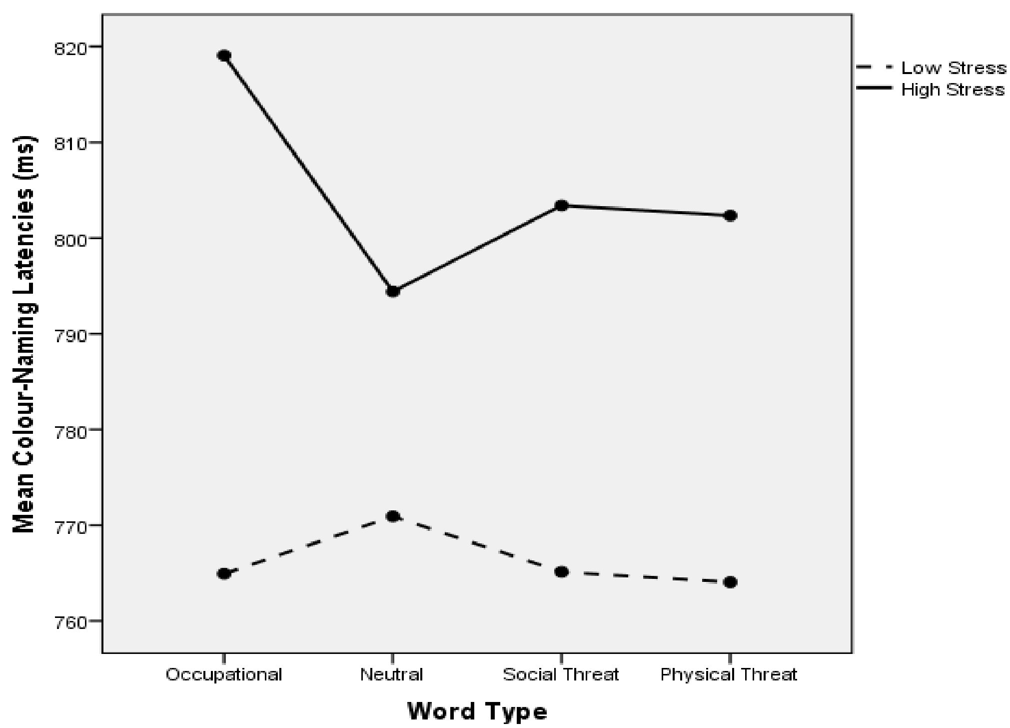

Figure 4.1. Means Plot showing Stroop colour naming latencies (milliseconds) as a function of word type and occupational stress group.

To interpret the significant interaction further, one-way ANOVAs were conducted for each of the high and low stress groups with repeated measures on word type (OS, NU, ST, PT). The analysis revealed a non-significant effect of word type on colour naming latencies in the LS group, $F(3,42) = 0.72$, $p = .545$, $\eta^2 = .049$. For the HS group, Mauchly's test was significant indicating that sphericity had been violated, $\chi^2(5) = 15.59$, $p = .008$. and given that $\varepsilon = .56$, Greenhouse-Geisser test statistics were used (Field, 2013). The results indicated that colour naming latencies differed significantly dependent on word type in the HS group, $F(1.67, 23.36) = 10.77$, $p < .001$, $\eta^2 = .435$.

To interpret the significant differences observed in the one-way ANOVA, simple effects analyses were carried out on just the HS group, using three paired t-tests between colour naming latencies for threat-related words (OS, PT and ST) and colour naming latencies for NU words. A Bonferroni correction was applied to control for familywise Type 1 error giving an adjusted alpha significance level of .016 (.05/3). Table 4.4 shows mean differences, t-test statistics and effect sizes (Cohen's *d*) with confidence intervals (95%). The t-tests revealed significantly slower colour naming latencies, $t(14) = 4.10$, $p < .001$, $d = 0.23$, 95% CI [0.10, 0.37] for OS words ($M = 819.07$, $SD = 108.85$ in comparison to NU words ($M = 794.40$, $SD = 93.69$) with a mean difference of 24.67 ($SD = 23.28$) milliseconds and a small effect size. In addition, the colour naming latencies for PT words ($M = 802.33$, $SD = 92.34$) in comparison to NU words ($M = 794.40$, $SD =$

93.69) were also significantly slower, $t(14) = 2.80$, $p = .014$, $d = 0.08$, CI [0.00, 0.16] with a negligible effect size.

Table 4.4

Paired Sample T-Tests on Colour Naming Latencies by Threat Word Types for the HS Group with Effect Sizes and Confidence Intervals

Colour Naming Latencies (ms)							
						CI (95%)	
Word Pair	Mean Difference	*SD*	*t*(14)	*p*	*d*	Lower	Upper
OS-NU	24.67	23.28	4.10	.001*	0.23	0.10	0.37
ST-NU	9.00	14.77	2.36	.033	0.09	0.01	0.17
PT-NU	7.93	10.98	2.80	.014*	0.08	0.00	0.16

Note. OS = Occupational stress-related words, NU = Neutral unrelated words, ST = Social threat-related words, PT = Physical threat-related words. * significant at Bonferroni corrected alpha, $p < .016$

Analysis of Interference Scores

To investigate differences in the pattern of colour naming responses between the high and low stress groups, interference scores were calculated by subtracting the colour-naming latencies for NU words from each of the threat word colour naming latencies (OS, ST, PT) for both high and low stress groups. Larger positive interference scores indicate more interference from threat words on colour naming latencies. Table 4.5 shows means and standard deviations for interference scores by word types and stress group.

Table 4.5

Colour Naming Interference Scores by Word Type and Stress Group

	Stroop Interference Scores (ms)			
	Low Stress		High Stress	
	n = 17		n = 18	
Word Type	*M*	*SD*	*M*	*SD*
OS - NU	-6.00	13.87	24.67	23.28
ST - NU	-5.80	22.99	9.00	14.78
PT - NU	-6.87	15.20	7.93	10.98

Note. OS = Occupational Stress-Related; ST = Social Threat-Related; PT = Physical Threat- Related

A 2 x 3 mixed factorial ANOVA was conducted with occupational stress status (low and high) as the between-subjects factor with repeated measures on word type (OS-NU, ST-NU, PT-NU) and interference scores as the dependent variable. There was a significant main effect of word type, $F(2,56) = 3.43$, $p = .039$, $\eta_p^2 = .109$ and of stress group, $F(1, 28) = 17.70$, $p < .001$, $\eta_p^2 = .387$. However, the interaction between word type and stress group was not significant, $F(2,56) = 3.12$, $p = .052$, $\eta_p^2 = .100$.

To interpret the significant main effect of word type interference, three independent t-tests were conducted on the interference scores for each threat word type (OS-NU, ST-NU, PT-NU) between the LS and HS groups. A Bonferroni correction was applied (.05/3) giving a new significance level of $\alpha = .016$. The HS group had significantly higher OS-NU interference scores ($M = 24.07$, $SD = 23.28$) than the LS group ($M = -6.00$, $SD = 13.87$)

with a mean difference of -30.67 milliseconds and large effect size, $t(22.82) = 4.38$, $p < .001$, $d = 1.56$, 95% CI [0.71 – 2.41]. The HS group also had a significantly higher PT-NU interference score ($M = 7.93$, $SD = 10.98$) than the LS group ($M = -6.87$, $SD = 15.20$) with a mean difference of 14.80 and a large effect size, $t(28) = 3.10$, $p = .005$, $d = 1.09$, 95% CI [0.31 – 1.87].

Mean differences, t-test values and effect sizes are shown in Table 4.6 with mean interference scores and error bars displayed graphically in Figure 4.2.

Table 4.6

Mean Differences, Independent t-Test Values and Effect Sizes for Interference Scores between HS and LS groups

Colour Naming Interference (ms)							
						CI (95%)	
Interference Word Type	Mean Difference	*SE*	*t*	*p*	*d*	Lower	Upper
OS-NU	30.67	7.00	4.38	< .001*	1.56	0.71	2.41
ST-NU	14.80	7.05	2.10	.045	0.75	0.01	1.50
PT-NU	14.80	4.84	3.10	.005*	1.09	0.31	1.87

Note. OS = Occupational Stress-Related; ST = Social Threat-Related; PT = Physical Threat- Related *Significant at Bonferroni corrected alpha, $p < .016$

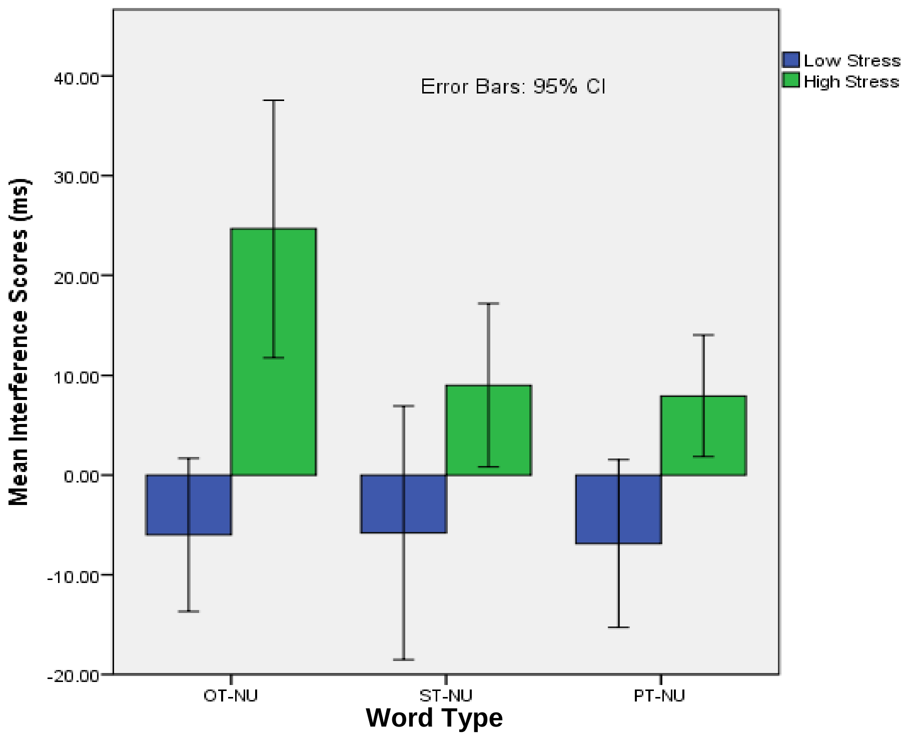

Figure 4.2. Mean interference scores with error bars by word types and stress group.

4.5 Summary of Results

The results of the analyses showed that the high stress group took significantly longer to colour-name occupational stress-related words than neutral unrelated words with a small effect size (*d* = 0.23). In addition, the high stress group demonstrated significantly longer colour naming latencies for physical threat-related words in comparison to neutral with a negligible effect size (*d* = 0.08) although there was no significant difference between social threat words and neutral words. These results offer partial support for Hypotheses 1 (within-subjects).

Examination of interference scores revealed that the high stress group had a significantly longer interference index for occupational threat words in relation to neutral words than the low stress group with a large effect size (*d* = 1.56). The interference index for physical threat in relation to neutral words was also significantly longer for the high stress group than the low stress group, with a large effect size (*d* = 1.09) but there were no significant differences for the social threat and neutral word interference index. These results offer partial support for Hypothesis Two (between-subjects)

The next chapter (Study Four) further extended the applicability of the generic occupational stress-related Stroop task used in Study Two and Study Three to a sample of firearms officers from the Greater Manchester Police Force. The findings from Studies Two and Three have so far offered some support for Stroop interference as indicated by attentional bias towards occupational stress-related words for participants higher in occupational stress across two different occupational groups.

Given that the nature of the firearms officer's role exposes them to physical threat (e.g. engagement with aggressive criminals carrying weapons including guns, risk of harm, being faced with injured members of the public and critical incidents) relatively more often than the average white-collar worker or teacher, there is the possibility that these participants might demonstrate attentional bias towards physical threat words either in preference to or in addition to occupational stress-related words.

Testing the occupational stress-related Stroop task containing a generic set of occupational stress-related words, social threat, physical threat and neutral words allows the various hypotheses involved in Stroop interference observed in performance on emotional Stroop tasks to be tested on another occupational group, with different work experiences.

Chapter Five (Study Four): Attentional Bias and Occupational Stress in Firearms Officers

5.1 Study Four: Introduction

The principal aim of Study Four was to employ the occupational stress-related Stroop task, the construction of which was detailed in Study One, to elicit attentional bias as an indicator of occupational stress in a sample of Police Firearms Officers.

Colour naming reaction times for the different word types (occupational, social threat, physical threat) were compared to responses to neutral words for high and low stress groups as categorised by scores on the Sources of Pressure Scale (SOP) of the Pressure Management Indicator (PMI; Williams and Cooper, 1998).

The target population of police firearms officers was chosen as the participants were all employed in the same occupational role and setting and this enabled testing of the generic occupational stress-related word stimuli in terms of their effectiveness in workers who might be expected to have more specific concerns related to their occupation and its demands. Given the role of firearms officers and the danger (real or perceived) attached to this role, these concerns may be more specific to the operational characteristics of the job (e.g. confrontation with violent offenders or having to discharge their firearms) some of which are physically threatening rather than simply related to generic occupational stress and these concerns could be reflected in colour naming response times.

5.1.1 Firearms Officers in the U.K.

Authorised firearms officers (AFOs) are police officers trained in the use of firearms and authorised to carry them on duty and are seen as a separate and somewhat elite group by other police officers. They may be called to attend at two types of incident; authorised where the operation is pre-planned; or spontaneous where the AFOs are called to an incident as it is occurring.

Home Office (2016) statistics show that in the period April 2015 to April 2016 there were 5,639 AFOs representing 4.4% of all police officers (*N* = 126,766) in England and Wales. There were 14,753 firearms operations, 85% of which involved armed response vehicles and firearms were discharged on seven occasions. Although this figure seems relatively low, it has increased from an average of four over the period 2011-2014.

There is a paucity of stress research on AFOs in the U.K. and what there is has tended to focus on post-traumatic stress disorder (e.g. Manolias et al., 1993). This might be explained by the extensive screening process using a battery of psychological tests that are employed to determine suitability for the role of an AFO in that individuals deemed to possess abnormal or unsuitable personality traits (e.g. emotional instability, hostility, potential for alcohol or substance abuse) would be eliminated from the selection process (Ho, 2001). Alternatively, it might also be because they are prepared for their role by the extensive training and ongoing support that is mandatory for AFOs (Beighton and Poma, 2015).

FAOs in the U.K. are part of the main police force even though their job might be viewed as distinct and therefore research on police stressors, strains and moderator variables generally will be reviewed as a rationale for Study Four.

5.1.2 Police Officer Stress

Policing has long been acknowledged as a stressful occupation (Alexander et al., 1993; Brown and Campbell, 1990, 1994; Gershon et al., 2009; Houdmont et al., 2012; Reiser, 1974, 1976; Violanti and Marshall, 1985, 1993, 1994) and moreover, has often been cited as one of the most stressful occupations in both the U.K. (Brown and Campbell, 1994; Johnson et al., 2006) and worldwide (Anshel, 2000; Liberman et al., 2002). In the U.K. policing was amongst the top three occupations reported by occupational physicians and psychiatrists in the Occupational Disease Intelligence Network system for the Surveillance of Occupational Stress and Mental Illness (Centre for Occupational and Environmental Health, 2000).

Work that is both physically and emotionally demanding and lacks flexibility and autonomy is thought to be particularly stressful (Murphy and Sauter, 2004; Quick et al., 1997). The role of a police officer exposes individuals to physically dangerous situations, violence and human tragedy on a regular basis (Bartol and Bartol, 2008) In addition, shift work, work overload and unsupportive management styles are reported as common characteristics of policing that restrict flexibility and autonomy (Brown and Campbell, 1990, 1994).

Firearms officers in the U.K. are expected to perform unpleasant, ambiguous and often physically dangerous duties in order to protect the public and society. Not only are they subject to scrutiny by forces such as the media and the public (particularly when discharge of their firearms results in loss of life), but they are also accountable to agencies such as the Independent Police Complaints Commission (IPCC) and their local force firearms procedures (Squires and Kennison, 2010). Furthermore, they are often viewed as separate and different by their unarmed police colleagues (Manolias and Hyatt-Williams, 1993).

However, not all research has concluded that policing is uniquely stressful and some research into police stress both in the U.K. and abroad has asserted that it is no more stressful than other occupations (Bar-On et al., 2000; Brown and Campbell, 1994; Gudjonsson and Adlam, 1983). Moreover, Bar-On et al. (2000) found that U.K. police officers had significantly higher positive affect and emotional stability in comparison to social care workers and suggested this might be because police training prepared them better for their duties or because there was a greater variability of duties integral to the job. It has also been proposed that police officers perceive commonly occurring unpleasant duties as normal and may only feel pressure when a particular duty deviates from the norm (Hart et al., 1995).

In a sample (N = 213) of male U.S. police officers, Zhao et al. (2002) found that reported levels of stress were around the same as for adult males generally and considerably lower than the norms for male college students and elderly males. They concluded that this sample of police officers were able to manage the stressors inherent to policing, possibly due to excellent training, the provision of support and counselling services, and also careful selection of police applicants. They also considered the possibility that policing might not be as dangerous a job as is often portrayed by the media, in that, in reality they do not face danger and have to employ extreme force on a regular basis. Although, it was acknowledged that this might be different for police officers working in major inner-city areas where crime rates are often higher (Zhao et al., 2002).

5.1.3 Police Stressors

Much of the research into police stress has been conducted outside of the U.K. with a significant amount coming from the U.S.A. and Australia where police routinely carry firearms and therefore it is difficult to extrapolate reported sources of stress in these studies to U.K. police officers, even those authorised to carry firearms. Nonetheless, research literature shows that there are many similarities between frequently reported major stressors in the U.K. research and in research from the U.S.A., Australia and Europe and therefore, the following section reviews commonly reported stressors from the body of police stress research across these regions.

Symonds (1970) proposed two major sources of occupational stressors in police work which can be categorised as either organisational (related to the nature of the police organisation) or operational (related to the nature of police duties) and these together with intra and interpersonal factors have generally been reinforced by research into what contributes to police stress (Anshel, 2000; Brown and Campbell, 1994; Patterson, 1992; Violanti and Aron, 1994)

5.1.3.1 Intra and Interpersonal Factors

Some police stress research has proposed that certain intra and interpersonal personality factors contribute to difficulties in carrying out police work effectively and might generate stress due to an individual's characteristics and/or from interactions with others (Brown and Campbell, 1994; Beutler et al., 1988; Sarchione et al., 1998).

These factors include, levels of self-esteem and self-confidence (Hewitt and Flett, 1991; Violanti and Aron, 1993; Scheier et al., 1986) hardiness (Kobassa, 1979; Lefcourt, 1992) Type A personality (Cooper and Marshall, 1976), optimism/pessimism (Anshel, 2000; Scheier et al., 1986) and authoritarianism (Anshel, 2000; Brown and Campbell, 1994). Frequently referred to as the ‘police personality’, it has also been suggested that police officers can become suspicious, cynical and rigid over time due to the policing experience and that this can impact on relationships with the community and others (Abrahamsen and Strype, 2010; Golembiewski and Kim, 1990; Twersky-Glasner, 2005).

Overall, research into the generalisability of these personality factors to police officers as a profession has been inconclusive with some studies having methodological problems (Brown and Campbell, 1994) and others finding no significant difference between police officers and other occupations in the prevalence of these factors (Gudjonsson and Adlam, 1983; McLaren et al., 1998). There is also some debate regarding whether these personality factors always have a negative effect and result in occupational stress (Davidson and Veno, 1980).

5.1.3.2 Organisational Stressors

Organisational stressors are those that stem from the nature of the police organisation and culture within which the police carry out their job (Brough, 2004). The police force

as an organisation is perceived to be bureaucratic with a culture traditionally characterised as ‘macho’, cynical and sexist (Brown, 2007).
Frequently reported organisational stressors appear fairly universal across different countries and regions and include, work demands affecting home life, excessive workload, lack of communication and consultation in decision making, staff shortages, long hours, lack of resources, bureaucratic procedures, and unsupportive management styles (Ayres and Flanagan, 1994; Collins and Gibbs, 2003; Kop et al., 1999; Morash et al., 2006; Slate et al., 2007).

Brown and Campbell (1994) found that the major stressors in a U.K. police officers were excessive workload, unsupportive managers, lack of communication and staff shortages. These organisational factors are not unique to policing and have emerged as dominant stressors in a range of other occupations (e.g. Kircaldy and Shephard, 2001) including teaching (e.g. Cox et al. 1988); management (e.g. Cavanaugh et al., 2000) and nursing (e.g. McVicar et al, 2003).

Collins and Gibbs (2003) found in a sample (N = 873) taken from a large U.K. county police force (males and females), that work demands affecting home life, little control over workload, lack of communication and consultation, and heavy workload were reported as major stressors. In this study 41% of the sample were described as being in a high stress group and in this group significant associations were also found with poorer mental health.

Houdmont et al. (2012) conducted a study with police officers from a large UK geographic police force (*N* = 1,729) using the HSE Management Standards Indicator Tool (Cousins et al., 2004). They found that 46% of respondents found work to be very or extremely stressful and that the seven dimensions of the Indicator Tool (demands, control, managerial support, colleague support, work relationships, role and change) were significantly and positively associated with perceived stress levels. The seven dimensions of the Indicator Tool represent organisational police stressors rather than operational police stressors. The results demonstrated that only two dimensions out of the seven (relationships at work and role) indicated higher than benchmark standards with ‘change‘ being the area requiring most attention (e.g. *staff are always consulted about changes at work*).

5.1.3.3 Operational Stressors

Operational stressors are those that are specifically associated with the nature of policing and duties inherent to the job (Brough, 2004). It is generally accepted that police officers are faced with physically and psychologically challenging circumstances that people in most other occupations are unlikely to encounter (Stephens and Long, 2000). Research has attempted to identify which of these circumstances external to organisation factors are most frequently reported as contributing to police stress. From a review of the literature occupational stressors appear to be influenced by the country or region in which police officers work, which may be due to differences in the nature of their job.

Operational stressors frequently cited in research with non-U.K. police officers include: encounters with the judicial system including court appearances; shootings involving police officers; dealing with victims of crime/violence and fatalities (particularly children); examination and criticism by the public and the media; relationships with the community; and being faced with violent/unpredictable situations (Can and Hendy, 2014; Gudjonsson and Adlam, 1985; Stephens et al., 1999; Violanti and Aron, 1994).

Operational stressors commonly reported by U.K. police officers include, shift work, ambiguous situations, physical threats from the public, having to use force, attending a sudden death, advising relatives of a family members death, and attending the death of a child (Brown and Campbell, 1994; Collins and Gibbs, 2003). However, there is a paucity of stress research on U.K. AFOs so it is difficult to conclude whether stressors inherent to their role are similar to other U.K. officers.

5.1.3.4 Critical or Traumatic Incidents

Critical incidents are a specific category of stressor and are typically viewed as operational stressors often reported by individuals working in the emergency services such as the police, fire service, ambulance service, emergency nurses and paramedics. Mitchell and Resnick (1981:3) defined critical or traumatic incidents as they relate to emergency personnel including police officers as, "…any situation faced by emergency personnel that causes them to experience strong emotional reactions which have a potential to interfere with their ability to function”

In a psychiatric context, critical or traumatic incidents are defined as, “…those the person experienced, witnessed, or was confronted with...that involved actual or threatened death or serious injury or a threat to the physical integrity of self or others'' (DSM-IV; American Psychiatric Association, 1994: 309).

Critical incidents in policing include, responding to a violent crime, attending a police funeral, making a violent arrest and needle injury, or exposure to bloody or bodily fluids (Gershon et al., 2009). Being involved in critical incidents can trigger acute stress responses that may reduce or break down an individual’s typical coping resources and lead to negative states in physical and psychological well-being including post-traumatic stress disorder (Mitchell et al., 2000).

Despite the fact that police work is seen as being dangerous and exposes police officers to violence and death, research has generally concluded, somewhat surprisingly, that organisational factors such as excessive workload and time pressures are more frequently perceived as major sources of stress (Biggam et al., 1997; Brough, 2004; Violanti and Aron, 1993) than police operational factors including critical incidents. This might be because critical incidents are rarer occurrences and most police officers have less exposure to them than the everyday organisational sources of stress frequently cited. Another possibility is that police officers expect to be involved in critical incidents but are not prepared for the pressure cause by organisational or police culture factors (Burke and Paton, 2006b).

Hart et al., (1995) suggested that police are trained to deal with operational duties intrinsic to their occupation but not the organisational stressors they encounter and therefore have less ability to cope. However, in a recent, large study of Scottish police officers by Falconer et al., (2013), they reported that police did not necessarily receive training for a particular incident they found stressful and furthermore that training could not really be provided for critical incidents such as multiple fatalities or informing relatives of a death. Police officers in the study generally accepted that personal experience was the most effective training to help them deal with such events.

5.1.4 Individual and Organisational Consequences of Police Stress

Despite the inconsistency regarding policing as a stressful occupation, where police stress has been reported it is clear that it is associated with negative psychological responses such as anxiety and depression (Bigham et al., 1997; Brown et al., 1999; Kircaldy and Shephard, 2001; Kop and Euwema, 2001), burnout (Gershon et al., 2009) and post- traumatic stress (Gershon et al., 2009).

Adverse physical responses have also been reported, including low energy, headaches, stomach pain, tightness in the chest, chronic lower back pain and chronic sleep disturbances (Anderson et al., 2002; Gershon et al., 2009). These responses are said to play a part in absenteeism (Anshell et al., 2000), reduced job satisfaction (Kirkcaldy et al., 1995), burnout (Golembiewski and Kim, 1990), early retirement (Kop et al., 1999) and staff turnover, (Anshel, 2000; Brown and Campbell, 1990, 1994).

Police stress has also been linked to officer suicide (Gershon et al., 2009; O'Hara and Violanti, 2009) and negative health behaviours such as increased drinking, smoking and drug-taking (Davey et al., 2001; Gershon et al., 2009).

Robinson et al. (1997) in a study of 100 suburban police officers in the U.S.A, identified exposure to critical incidents, especially those that can result in a fatality or serious injury to either police officers or the public, as the most reliable predictor of PTSD with a 13% prevalence in police officers as compared to the local community prevalence rate of around 2-3%. Rates in urban and armed officers may be even higher (Green, 2004).

Symptoms observed in police officers with PTSD include poor concentration, hypervigilance, high anxiety when a reminder of a critical incident occurs, distressing flashbacks and increases in alcohol and tobacco consumption (Green, 2004).

Relating the effects of critical incidents to UK police firearms officers, Manolias and Hyatt- Wllliams (1993:389) found in their interviews with police who were authorized firearms officers in the United Kingdom, that 67% of their sample reported "a marked emotional reaction" and an inability to stop thinking about a critical shooting incident they had been involved in.

5.1.5 Measuring Police Stress

Many studies into police stress have employed self-report questionnaires assessing general stressors which are typically reported across a range of occupations. Questionnaires such as the Occupational Stress Indicator (OSI; Cooper et al., 1988), the Job Stress Survey (JSS; Spielberger, 1994) and the Job Demands Control (JDC; Karasek, 1979, 1997) have been used, often in conjunction with other measures. However. it has been argued that generic occupational stress measures do not adequately represent stressors that are inherent to the role of the police officers (McCreary and Thompson, 2006) and therefore several police-specific self-report measures have also been developed and employed.

The Police Stress Questionnaire (PSQ; McCreary and Thompson, 2006) has been used in various studies into police stress (e.g. Acquadro et al., 2015; Juniper et al., 2010) and comprises two, 20-item scales; the PSQ-Op measuring occupational stressors (e.g. *‘traumatic events’, ‘shift work’*) and the PSQ-Org measuring organisational stressors (e.g. *‘bureaucratic red tape’, ‘staff shortages’*). Participants responses are measured on a 1 to 7 Likert scale ranging from 1 = not at all stressful and 7 = very stressful and the PSQ-Op and PSQ-Org have alpha reliabilities of .92 and .93 respectively. Other police stress specific scales used in research include, the Police Stress Scale (Beehr et al., 1995) and the Police Stress Survey (Spielberger et al., 1981).

Research has also employed supplementary scales to measure psychological responses to stress such as anxiety, depression, and burnout. These include, the General Health Questionnaire (GHQ; Goldberg, 1978), the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1970, 1983), and the Maslach Burnout Inventory (MBI; Maslach and Jackson, 1981, 1986). Additionally, scales that assess factors thought to mediate between stressors and the stress response are sometimes utilised for example, the Police Coping Scale (Beehr et al., 1995).

In terms of physiological and observational indicators, Anderson et al., (2001, 2002) used heart rate monitors together with observation physical activity as indicators of stress in a sample of Canadian police officers. The data gathered confirmed previous self-report research findings that police officers experience both physical and psychosocial stress in the execution of their jobs particularly immediately prior to a critical incident. Likewise, Violanti et al. (2006) measured CVD biomarkers using ultrasound scans of the brachial artery and found significant associations with PTSD in police officers.

5.1.6 Rationale for Study Four

Limitations of self-report, objective and physiological measures of occupational stress were previously outlined in Literature Review (Chapter One) and apply equally to the self-report measures and other measures of police officer stress which appear to be the most popular method. Therefore, it would be useful to have an additional measure of a more objective nature that is not as open to response biases, in addition to controlling for common method variance. It is proposed that the occupational stress-related Stroop task used in Study Two and Study Three might be a suitable measurement instrument to measure the outcomes of stress in terms of attentional bias.

In terms of attentional bias, it is feasible to predict that the concern-relatedness hypothesis used in Studies Two and Three could also be applied to firearms officers and that those with higher levels of occupational stress would exhibit Stroop interference towards occupational stress-related words in the emotional Stroop task. However, given the physically threatening aspect of policing as a profession, and in particular firearms officers, it is possible that the generic occupational stress words used as stimuli in the occupational stress-related Stroop task might not represent prevalent police stressors and that occupation-specific word stimuli are required dependent on the nature of the occupation being assessed for risk. There is also the possibility that firearms officers generally (irrespective of stress level) might respond to physical threat words given the nature of their work context and/or that those with higher levels of stress will exhibit Stroop interference towards physical threat words as an inherent element of their job, which is in line with both the concern-relatedness hypothesis and also Beck's (1985) danger schemata theory

Therefore, the main aim of Study Five was to further investigate the utility of the occupational stress-related Stroop task used in Study Two and Study Three to assess colour naming times of firearms officers in both high and low stress groups, as defined by scores on the Sources of Pressure scale of the Pressure Management Indicator (PMI; Williams and Cooper, 1998).

Hypothesis One

Participants in the high occupational stress group will take significantly longer to colour-name occupational stress-related words in comparison to neutral unrelated words (within-subjects Hypothesis). This emotional Stroop effect will be specific to occupational stress-related words and no differences will be found between other threat-related word sets (social threat, physical threat) and neutral words.

Hypothesis Two

Participants in the high occupational stress group will take significantly longer to colour-name occupational stress-related words than neutral unrelated words in comparison to the low occupational stress group (between-subjects Hypothesis).

5.2 Study Four Method

5.2.1 Design

Study Four employed a 2 x 4 mixed factorial design with occupational stress status (high and low) as the between-subjects independent variable and word type (occupational, physical threat, social threat and neutral unrelated word sets) as the within-subjects independent variable. The dependent variable was the colour naming latencies (in milliseconds) recorded for each word type on the modified Stroop task.

5.2.2 Participants

Fifty-two male participants were opportunity sampled from a target population of 120 police authorised 'firearms' officers (AFOs) who held the rank of sergeant or constable. They all belonged to the Tactical Firearms Unit, a dedicated firearms response team operating a variable shift pattern, which includes seven night shifts, seven morning shifts, seven afternoon shifts and several dedicated training periods, in a 5-week cycle.

The officers routinely carried firearms as part of their daily duties and responded to all spontaneous firearms related incidents in their geographical area. When called to emergencies they use, 'blue flashing lights' and 'sirens' to assist in expediting their response. Performance indicators are used to monitor the effectiveness of the unit.

All the participants were male, aged between 25 years and 48 years of age and had been firearms officers for between one and eight years. Strict physical, medical, tactical and shooting standards were maintained through regular monitoring and regular refresher training and testing. Failing to maintain the standards required results in a return to non- firearms duties for the individual officer.

At the parade and briefing that the firearms team have at the start of their shift, officers were given a brief outline of what would be required if they participated in the research. A general request was made for officers interested in participating to add their names to a list posted on the unit notice board. The names on the list were collated and appointments made for officers to participate at a suitable time during their duty hours.

5.2.3 Ethical Considerations

The nature of the research dictated that the ethical implications, including any psychological consequences for participants were evaluated using the British Psychological Society's guidelines for research with human participants (BPS, 2010) and also complied with the university's ethical guidelines.

The Personnel Director of the police force sampled gave permission for the research project to take place, following a brief presentation by the researcher. Participants were invited to take part in the experiment. The officers who agreed to participate were asked to read and sign a Participant Brief and Consent Form (Appendix 9 and 10), which provided a brief explanation of the research and an outline of what was expected of them. It was not possible to detail the full aims of the study as this could have primed participants to the stimuli in the modified Stroop task and confounded the results. The Participant Brief also explained that participation was voluntary and asked them to create a unique identifier code which would enable anonymity to be maintained throughout. The former point was emphasised verbally prior to the start of the experiment and participants were not coerced in any way. It was further explained that due to the anonymity of their participation, feedback on their individual results would not be possible but that a summary of the results could be provided at a later date if they wished. Participants were assured that their stress status would not be revealed to anyone following participation in the study and that they were free to withdraw themselves and/or their data at any time during the data collection process.

All participants were debriefed (Appendix 11) once the data collection methods were completed and they were also advised that if the process of taking part in the study raised any personal issues or concerns for them that arrangements had been made with their organisation's Welfare Unit for referral.

5.2.4 Materials

5.2.4.1 Measure 2: Occupational Stress-Related Stroop Task

This study employed the occupational stress-related Stroop task described and utilised in Studies Two and Three. The modified Stroop task presented different threat word types (occupational stress-related, physical threat-related, social threat-related and neutral unrelated) to measure participants' colour naming times (in milliseconds) to the four different word types.

Experimental Hardware

A Samsung laptop computer with a 12" SVGA colour screen and standard QWERTY keyboard were used to present the task. The keys numbered 5, 6, 7, and 8 were each covered by a coloured sticker so that they appeared as red, blue, green and yellow respectively to allow manual response. These keys were chosen as they are located at the top centre of a QWERTY keyboard so do not favour either right or left handedness in responses.

5.2.4.2 Measure 1: The Pressure Management Indicator (PMI)

The Pressure Management Indicator (PMI; Williams and Cooper, 1998) as described and implemented in Studies Two and Three was used to record participants' responses as indicators of occupational stress.

5.2.5 Procedure

The experiment was conducted in a small private office in the participants' workplace where there would be no disruption. Participants were asked to read a brief of the study and sign the consent section if they agreed to take part. Study Four repeated the two stages of data collection used in Study Two and Three:

5.2.5.1 Phase 1. The Occupational Stress-Related Stroop

The computerised occupational stress-related Stroop task utilised in Studies Two, and Three was completed by each of the participants and responses retained for analysis.

5.2.5.2 Phase 2. The Pressure Management Indicator

Participants completed the PMI self-report questionnaire. Unlike Study Two and Three where participants took the PMI away and completed in their own time, the PMI was completed immediately after the Stroop task by the participants. This was due to time constraints and the possibility of difficulties accessing the participants on another occasion.

5.3 Study Four Results

Participants responses on the PMI and colour naming latencies from the occupational stress-related Stroop were entered into SPSS for analysis.

5.3.1 The Pressure Management Indicator (PMI)

The Sources of Pressure (SOP) scale of the PMI was scored following the authors (Williams and Cooper, 1998) instructions producing eight subscale scores and a total SOP score for each participant. Internal consistency reliability for each subscale and the overall SOP was calculated using Cronbach's alpha and was found to range between .78 and .94 which is generally deemed acceptable for psychometric scales in the social sciences (Nunnally and Bernstein, 1994). The total SOP scale, which was used to allocate participants to high and low occupational stress categories had an alpha reliability of .97, CI [.96, .98] which was significantly higher than the acceptable level of .7 ($p < .001$). Alpha reliabilities for each of the SOP subscales and the total SOP scale are shown in Table 5.1.

5.3.2 Participant Characteristics

As with Study Two and Study Three participants were not pre-screened for stress status prior to taking part in the study as this could have primed responses to the occupational stress-related words used in the Stroop task and also revealed the purpose of the study, eliciting demand characteristics (Orne, 1962). For the purpose of data analysis 25th and 75th percentile splits were effected to create a 'low stress' (LS) group and a 'high stress' (HS) group. This follows the same method as Study Two and Three and is in line with procedures commonly used in attentional bias research into anxiety disorders to create experimental and control groups using relatively high and low scorers on anxiety inventories. Participants with a mean overall SOP score equal to or lower than the 25th percentile score of 82 were assigned to a 'low stress' (LS) group (n = 13, M = 66.00, SD = 14.11); and participants with a mean overall SOP score equal to or greater than 75th percentile score of 134 were assigned to the 'high stress' (HS) group (n = 13, M = 151.62, SD = 15.17). All participants in the LS and HS groups were male and aged 31-50. Means and standard deviations for scores on each of the eight subscales and the total SOP scale for HS and LS groups are shown in Table 5.2.

A series of independent t-tests showed that the HS group had significantly higher total SOP scores than the LS group (p < .001). This was also the case for each of the eight subscales of the SOP scale indicating that the HS group perceived significantly more occupational pressure from these sources of stress than the LS group. Table 5.2 shows t values, and effect sizes using Cohen's d[7] (with 95% confidence intervals).

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[7] Cohen's *d* conventions are used throughout the results section for interpreting values of *d* (adjusted for sample size) where 0.2 – 0.49 is considered a 'small' effect size, 0.5 – 0.79 represents a 'medium' effect size and 0.8 and above is a 'large' effect size (Cohen, 1992).

Table 5.1

Cronbach's Alpha for the Sources of Pressure Scale on the PMI (N = 52)

Measure	Number of items	Cronbach's alpha	95% Confidence interval for alpha	
			Lower	Upper
PW	6	.83**	.75	.89
PR	8	.94***	.91	.96
PC	4	.92***	.88	.95
PO	4	.87***	.80	.92
PP	4	.85***	.77	.91
PM	4	.82**	.72	.89
PH	6	.88***	.81	.92
PD	4	.78	.67	.87
TOT SOP	40	.97***	.96	.98

Note. PW = workload; PR = relationships; PC = recognition; PO = organisational climate; PP = personal responsibility; PM = managerial role; PH = home/work balance; PD = daily hassles; TOT SOP = total sources of pressure; *F* test with true value = 0.7, * $p < .05$. ** $p < .01$. *** $p < .001$

5.3.3. Analysis of Stroop Colour Naming Response Times

Trials with outliers in colour naming latencies of three SD's above or below the participant's individual means were excluded from the analysis (Tabachnick and Fidell, 2013). Individual trials with errors were also excluded from the analysis. Outliers and errors accounted for less than 1% of the data so were not analysed further.

Means and standard deviations for each word type (OS, NU, ST, PT) were determined for the HS group and the LS group and are presented in Table 5.3.

Table 5.2

Means, Standard Deviations and t-tests (with effect sizes) for Sources of Pressure Scores on the Pressure Management Indicator (PMI) by Stress Group Status

Measure									
Sources of Pressure	Low Stress n = 13		High Stress n = 13					CI (95%)	
	M	*SD*	*M*	*SD*	*t**	*df*	*d*	Lower	Upper
PW	10.69	3.17	21.77	1.10	7.84	24.00	4.52	2.72	6.32
PR	15.85	5.37	35.31	15.85	10.25	24.00	3.89	2.52	5.26
PC	5.08	1.44	16.77	3.09	12.38	17.00	4.70	2.94	6.46
PO	6.62	2.06	16.85	2.08	12.61	24.00	4.79	3.23	6.35
PP	7.85	3.51	15.77	2.20	6.90	24.00	2.62	1.50	3.74
PM	5.00	1.41	12.46	4.16	6.13	14.74	2.33	1.18	3.47
PH	7.85	1.63	19.15	5.63	6.96	13.99	2.64	1.39	3.89
PD	7.08	1.63	13.54	2.15	6.92	24.00	2.62	1.54	3.70
TOT SOP	66.00	14.11	151.62	15.17	14.90	24.00	5.76	4.24	7.27

Note. PW = workload; PR = relationships; PC = recognition; PO = organisational climate; PP = personal responsibility; PM = managerial role; PH = home/work balance; PD = daily hassles; TOT SOP = total sources of pressure. *All t-tests significant at $p < .000$

Table 5.3

Stroop Colour Naming Latencies (milliseconds) by Word Type for High and Low Stress Groups

	Stroop Colour Naming Latencies (ms)			
	Low Stress *n* = 13		High Stress *n* = 13	
Word Type	*M*	*SD*	*M*	*SD*
Occupational (OS)	736.54	77.74	760.77	78.00
Neutral (NU)	732.46	74.85	739.08	64.83
Social (ST)	735.62	75.29	736.92	67.40
Physical (PT)	731.23	73.64	746.46	65.02

A 2 x 4 mixed factorial ANOVA was conducted with occupational stress status (high vs. low) as the between-subjects variable, word type (OS, NU, ST, PT) as the within-subjects variable and colour-naming reaction times (in milliseconds) as the dependent variable. The ANOVA revealed a significant main effect of word type, $F(3, 72) = 5.53$, $p = .002$, $\eta_p^2 = .187$ but no significant main effect of occupational stress status, $F(1, 24) = 0.18$, $p = .676$, $\eta_p^2 = .007$. on colour naming latencies. There was also a significant interaction between word type and stress status, $F(3, 72) = 3.88$, $p = .012$, $\eta_p^2 = .139$.

To investigate this interaction further a one-way ANOVA with repeated measures on word type was conducted for each of the LS and HS groups separately. These revealed significant differences in colour naming times due to the effect of word type manipulation in the HS stress group (F(3, 36) = 7.79, p = < .001, η^2 = .394) but not in the LS group (F(3, 36) = 0.64, p = .637, η^2 = .045).

To interpret the differences observed in the one-way ANOVA, simple effects analyses were carried out between colour naming times for each of the threat word types (OS, ST and PT) and the NU words for the HS group only, using three paired t-tests with a Bonferroni corrected alpha significance of .016 (.05/3) to control for familywise Type 1 error. The t-tests revealed significantly slower colour naming times for OS words in comparison to NU words, t(12) = 3.60, p =.004, mean difference = 21.69, SD = 21.74, d = 0.29, 95% CI [0.09, 0.49] with a small effect size. No further colour naming differences were observed between any of the other threat word types (ST and PT) and NU words (p > .016).

The results indicated that the colour naming latencies for occupational threat words (M = 760.77, SD = 78.00) were significantly slower than for neutral words (M = 736.54, SD = 77.74). There were no significant differences in colour naming latencies between social threat and neutral words or physical threat and neutral words (p > .016). Table 5.4 shows mean differences, t-test statistics and Cohen's d effect sizes with confidence intervals (95%).

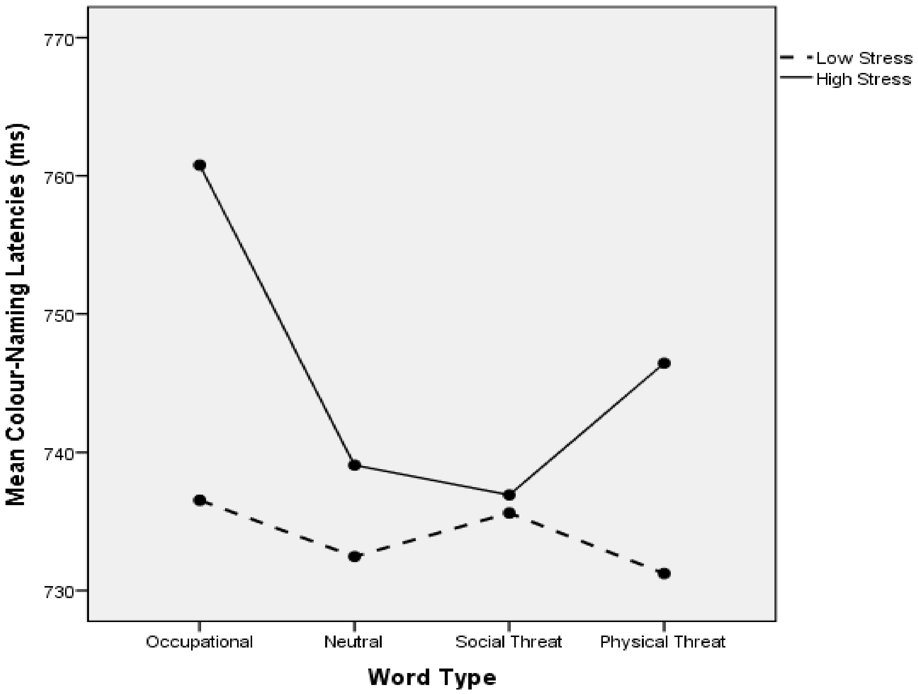

Figure 5.1. Means plot of colour naming times by word type and stress group.

Table 5.4

Paired Sample T-Tests on Colour Naming Latencies by Threat Word Types for the HS Group with Cohen's d Effect Sizes and Confidence Intervals

	Colour Naming Latencies (ms)						
						CI (95%)	
Word Pair	Mean Difference	*SD*	*t*(12)	*p*	*d*	Lower	Upper
OS-NU	21.69	21.74	3.60	.004*	0.29	0.09	0.49
ST-NU	-2.15	12.10	0.64	.533	-0.03	-0.15	0.08
PT-NU	7.39	17.11	1.56	.146	0.11	-0.03	0.25

Note. OS = Occupational stress-related words, NU = Neutral unrelated words, ST = Social threat-related words, PT = Physical threat-related words. * significant at Bonferroni corrected alpha = < .016

Analysis of Interference Scores

To investigate differences in the pattern of colour naming responses between the high and low stress groups, interference scores were calculated by subtracting the colour- naming latencies for NU words from each of the threat word colour naming latencies (OS, ST, PT) for both high and low stress groups. Larger positive interference scores indicate more interference from threat words relative to neutral words. Table 5.5 shows means and standard deviations for interference scores by word types and stress group.

Table 5.5

Colour Naming Interference Scores by Word Type and Stress Group

	Stroop Interference Scores (ms)			
	Low Stress *n* = 17		High Stress *n* = 18	
Interference Type	*M*	*SD*	*M*	*SD*
OS - NU	4.08	16.78	21.69	21.74
ST - NU	3.15	15.02	-2.15	12.10
PT - NU	-1.23	18.16	7.38	17.11

Note. OS = Occupational Stress-Related; ST = Social Threat-Related; PT = Physical Threat-Related

A 2 x 3 mixed factorial ANOVA was conducted with occupational stress status (low and high) as the between-subjects factor with repeated measures on word type interference (OS- NU, ST-NU, PT-NU) and interference scores as the dependent variable. There were significant main effects of interference type, $F(2, 48) = 5.76$, $p = .006$, $\eta_p^2 = .193$ and stress group, $F(1, 24) = 1.94$, $p = .176$, $\eta_p^2 = .075$. These were qualified by a significant interaction between word type interference and stress group, $F(2, 48) = 4.50$, $p = .016$, $\eta_p^2 = .158$.

To further interpret the significant interaction, one-way ANOVAs were conducted on each of the LS and HS groups interference scores separately with repeated measures on word type interference (OS-NU, ST-NU, PT-NU). Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(2) = 6.16$, $p = .046$. Given that $\varepsilon = .70$, Greenhouse-Geisser corrected tests are reported (Field, 2013). This revealed significant differences for the HS group, $F(1.40, 16.80) = 7.94$, $p = .007$, $\eta_p^2 = .398$ but not for the LS group, $F(2, 24) = 0.70$, $p = .508$, $\eta_p^2 = .055$. This indicates a significant difference between interference scores within the HS group only.

To investigate whether any of the interference scores were significantly higher in the HS group than the LS group (Hypothesis Two), three independent t-tests were conducted with a Bonferroni correction (.05/3) and a new significance level of α = .016. The results indicated no significant differences between the HS and LS group in interference scores for any of the threat-related words ($p > .016$). The interference score for OS-NU marginally failed to reach significance, $t(24) = 2.31$, $p = .030$, $d = 0.88$, 95% CI [.06 – 1.69], with a large effect size (albeit with a relatively wide confidence interval).

Table 5.6

Mean Differences, Independent t-Test Values and Effect Sizes for Interference Scores between HS and LS groups

Colour Naming Interference (ms)							
						CI (95%)	
Interference Type	Mean Difference	*SE*	*t*	*p*	*d*	Lower	Upper
OS-NU	17.62	7.62	2.31	.030	0.88	0.06	1.69
ST-NU	5.31	5.35	0.99	.331	-0.38	-1.16	0.41
PT-NU	8.62	6.92	1.25	.225	0.47	-0.31	1.26

Note. OS = Occupational Stress-Related; ST = Social Threat-Related; PT = Physical Threat-Related. *Significant at Bonferroni corrected alpha, p < 016.

5.4 Summary of Results

As with studies Two and Three, the results show that the high stress group took significantly longer to colour-name occupational stress-related words than neutral unrelated words with a small effect size (*d* = 0.29). There were no significant differences between the other threat words (social or physical) and neutral unrelated words within the high stress group which fully lends support to Hypothesis One. There were also no significant differences in colour naming latencies for any of the threat words (occupational, social or physical) in comparison to neutral words in the low stress group.

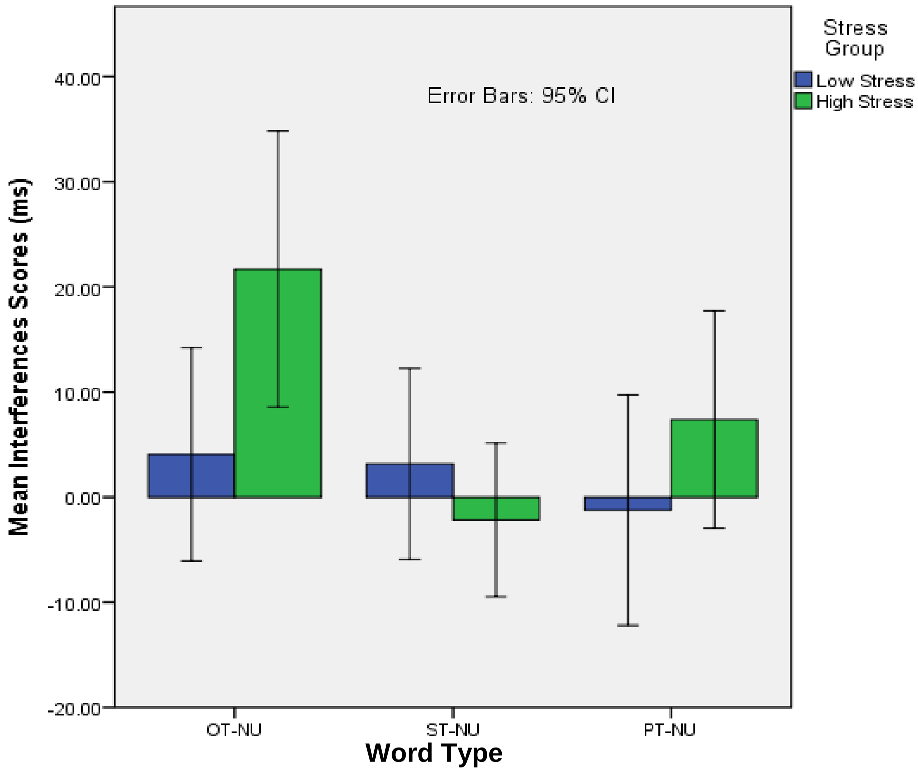

Figure 5.2. Mean interference scores with error bars by word types and stress group.

With respect to differences in the pattern of responding between the low stress and high stress groups, there were no significant differences in interference scores for any of the threat-related words (occupational, social, physical). The interference index for occupational stress-related words and neutral words marginally missed significance at the adjusted alpha level but did however have a large effect size (d = 0.88) which suggests that the small sample size might be contributory to non-significant alpha due to a lack of power. Hypothesis Two was not supported by these results.

Chapter Six: Discussion

This Discussion is divided into the following sections; summary of Studies One to Four; discussion of major findings in relation to past research; significant contributions to research; limitations and future research; and practical implications of the research.

6.1 Summary of Studies One to Four

6.1.1 Study One

Study One was primarily a methodology study detailing the allocation of appropriate stimuli for the occupational stress-related Stroop task to be used in Studies Two, Three and Four. A set of twenty occupational stress-related words was derived by content analysis of texts collected from three different sources (semi-structured interviews, focus group and self-report questionnaires). The aim was to produce words that adequately represented generic characteristics of the workplace perceived to cause pressure which was deemed to be achieved using methodological triangulation.

Two sets of twenty, threat-related control words (social threat and physical threat) were also compiled using words from previous emotional Stroop research and following considerations inherent to the characteristics of emotional Stroop stimuli.

A final control word set of twenty neutral unrelated words was derived from John's (1988) list of emotionally-rated words used in previous emotional Stroop studies.

Word stimuli were balanced across word types for syllabic length and the emotional valence of each word set was checked for positivity or negativity so that physical threat-related and social threat-related words were significantly more negative than the occupational stress-related words and the neutral words. The occupational stress- related words were chosen for concern-relatedness and not general threat

Word frequency was balanced across all word types using Kilgarriff's (1997) searchable, online frequency list derived from the BNC (a British-English corpus) so that there were no significant differences in frequency between the four, word sets (p> .05).

The final stimuli for the occupational stress-related emotional Stroop comprised four sets of 20 words namely, occupational stress-related, social threat-related, physical threat-related and neutral unrelated words. Syllable length, emotional valence and word frequency in British-English were all controlled for so the aims of Study One were achieved.

6.1.2 Study Two

Study Two utilised the occupational stress-related Stroop detailed in Study One to investigate the pattern of colour naming responses in a sample of white-collar workers categorised into high and low stress based on their responses to a self-report questionnaire measuring occupational stress (the PMI). Participants were asked to name the colour of 80 words presented individually on a computer screen with each word presented once in each of four different colours (a total of 240 individual presentations) and their response times as indicated by pressing coloured keys were recorded.

The main findings indicated that the high stress group took significantly longer to colour-name occupational stress-related words in comparison to neutral words (small effect size) with no significant differences between the other threat words and neutral words lending support to Hypothesis One. With respect to differences between the high and low stress groups, the high stress group had a significantly longer interference index for occupational stress-related words than the low stress group with a small effect size. This difference was specific to the occupational stress words as no other differences were observed for other threat words (social or physical) between the high and low stress groups. These results concur with Hypothesis Two.

6.1.3 Study Three

Study Three used the occupational stress-related Stroop and the PMI questionnaire to explore the possibility that the generic occupational stress-related words in the task might elicit differential patterns of attentional bias from participants categorised as high and low stress in a sample of Further Education teachers. Given that Stroop interference was observed in Study Two, the aim of Study Three was to test the utility of the occupational stress-related Stroop in a different occupational setting.

The main findings of Study Three supported the prediction that the high stress group would take significantly longer to colour-name occupational stress-related words than neutral which concurs with Hypothesis One. However, the FE teachers also took significantly longer to colour-name physical threat-related words compared to neutral words, albeit with a negligible effect size which is contrary to what was predicted. These results taken together, lend partial support for Hypothesis One.

In relation to differences in the pattern of Stroop interference between the high and low stress groups, the high stress group demonstrated significantly larger interference scores between occupational stress-related and neutral words lending support to Hypothesis Two. The HS group also had significantly larger interference scores between physical threat-related and neutral words than the LS group suggesting an attentional bias towards PT words which was not predicted.

6.1.4 Study Four

Study Four followed the same design and methodology as Study Two and Study Three but tested the occupational stress-related Stroop task on a sample of police firearms officers. As with Study Three the main aim was to investigate the utility and generalisability of this Stroop task, which contained words intended to represent generic sources of stress on an occupational group who might be expected to perceive more role-specific stressors given the physical and potentially violent nature of their job.

The primary findings were that the high stress group took significantly longer to colour- name occupational stress-related words than neutral words. In addition, there were no significant differences for other threat word types (social and physical) when compared to neutral words demonstrating that attentional bias was specific to concern-related stimuli for participants reporting higher occupational stress. These results are in accordance with Hypothesis One (within-subjects).

With respect to the pattern of Stroop interference between the high and low stress group, no significant differences were revealed for occupational stress, social threat or physical threat interference scores as a function of stress status (between-subjects) which is counter to Hypothesis Two.

6.2 Discussion of Findings in Relation to Past Research

6.2.1 Study One

Study One aimed to construct a set of words related to frequently perceived work stressors by gathering data from semi-structured interviews, a free elicitation task with a focus group and texts from four popular occupational stress self-report questionnaires which were content analysed producing the twenty, occupational stress- related words. The words derived appeared to be representative of job demands and sources of stress frequently reported in the work stress literature. Occupational stress research has frequently reported job demands such as, excessive workload, tight deadlines, lack of support from management, and lack of consultation as perceived stressors leading to adverse physical and psychological outcomes (e.g. Demerouti et al., 2001; Johnson et al., 2005; Lee et al., 2011; Lee and Ashforth, 1996; Nieuwenhuijsen et al., 2003; Stansfield et al., 1995) and these constructs were denoted by appropriate words in the occupational stress-related Stroop used across all the studies. The concern was whether generic occupational stress words would adequately characterise stressors experienced by different occupations or whether more bespoke versions of the Stroop were required for different occupational settings, especially as self-report scales such as the Management Standards Indicator Tool have been criticised for failing to do this (e.g. Houdmont et al., 2012; Bevan et al., 2010). However, initial findings from the three studies in the current research seem to support the use of the generic occupational stress-related Stroop as an indicator of perceived stress as it currently stands.

The rationale for using the four different word sets followed recommendations by Williams et al. (1996) in that there should be at least one set of neutral stimuli as well as at least one set of threat-related stimuli. Sets of social threat-related and physical threat-related words derived from past emotional Stroop research were included in addition to a set of occupational stress-related words, to control for various factors inherent to emotional Stroop research including the threat-relatedness hypothesis which proposes that any threatening stimuli will cause Stroop interference in anxious individuals (Mathews and MacLeod, 1985). The occupational stress-related words were chosen to be consistent with the concern-relatedness or context specificity hypothesis (Mathews and Klug, 1993) as words highly related to the individual's immediate concerns elicit more Stroop interference than words that are not, regardless of emotional valence or general threat value. The results of all three studies demonstrated that the high stress groups took significantly longer to colour-name occupational stress-related words (that were also relatively neutral in terms of emotional valence) in comparison to both social and physical threat words, lending support to the concern-relatedness hypothesis and is in line with other research (e.g. Watts et al., 1986; McNally et al., 1992; Becker et al., 2001; Mogg et al, 1989; Reiman and McNally, 1995).

Study One controlled for potential confounding from lexical characteristics of words such as length, frequency and emotional valence, with interference from threat words (Balota et al., 2004; Burt, 1999, 2002; Larsen et al., 2006) such that there were no significant differences for length and frequency across the word sets and the threat- related words (social and physical) were significantly more negative than both the neutral and occupational stress-related words. This was of particular importance given the evidence from studies using lexical decision tasks which found longer response times towards words with lower frequencies (e.g. Balota and Spieler, 1999; Balota et al., 2004; Monsell, 1991); longer words/syllables (e.g. Ferrand and New, 2003; New et al., 2006); and emotional valence (e.g. Estes and Verges, 2008). The same has been found looking at words used in emotional Stroop research for example, Larsen et al. (2006) who found from a review of studies that negative (threat) and disorder-specific words were not only significantly longer but also had significantly lower frequencies (therefore were less familiar) than neutral control words. Likewise, word length (letters or syllables); word frequency and emotional valence are said to play a part in emotional Stroop colour naming times (Burt, 2002; Kahan and Hely, 2008).

Past emotional Stroop research has often used frequency lists derived from American- English word databases even when the participants first language has been British-English (e.g. Jessop et al., 2004; McKenna and Sharma, 1995, 2004: Newman et al., 2008) and given the confounding effect of frequency suggested by some research (e.g. Burt, 2002; Balota et al., 2004; Kahan and Healy, 2008; Larsen et al., 2004; this seemed an important consideration to control for when constructing the stimuli for the current research. Fillmore et al. (1998) also highlighted the considerable distinctions between British and American English in terms of meaning and usage and therefore matching for frequency in British-English was an important achievement for this research.

6.2.2 Study Two, Three and Four

The findings from Studies Two, Three and Four which used the occupational stress-related Stroop to test the utility across white-collar workers, FE teachers and police firearms officers respectively, are in mainly in accordance with the large body of previous emotional Stroop anxiety research (e.g. Bar Haim et al., 2007; Mathews and MacLeod, 1985; Williams et al., 1996) in terms of within-subjects effects in that Stroop interference was found in the higher occupational stress participants, for occupational stress-related words but not for any of the other threat-related words. These findingd also correspond to emotional Stroop studies on participants with other affective states such as, depression (e.g. Epp et al., 2012; McNeil et al., 1999); eating disorders (e.g. Dobson and Dozois, 2004; Faunce, 2002); and addiction (e.g. Boyer and Dickerson, 2003; Field et al., 2006), in that significant Stroop interference was observed for stimuli relating to the current concerns of participants, which in the current research was occupational stress.

The results of Study Two, Three and Four are also in line with Woodfield et al. (1995) who found attentional bias towards a small set of negative occupational stress words in a sample of managers categorised as high stress, using the emotional Stroop. Woodfield et al. (1995) also found significant differences between the high and low stress groups in interference scores (stress - neutral) which was also found in the white- collar workers and FE teachers but not in the police firearms officers. It was not possible to compare the interference indices in Woodfield et al.'s (1985) study with the ones calculated in the current research given that they used blocked, card presentation with voice response which produces slower colour naming times. They also only provided mean times taken to colour-name each *condition* where the Stroop task constructed for use in this doctoral research produced mean *word* colour naming times. Therefore, no further conclusions can be reached in terms of the differences in Stroop interference between that study and the current research.

With respect to the firearms officers' results in Study Four, it might have been expected that Stroop interference would have occurred for not only occupational stress-related words but also physical threat stimuli given the physically threatening operational stressors that are an integral part of their job role (Stephens and Long, 2000). However, significant Stroop interference was only found for the occupational stress words in comparison to neutral and not for either social or physical threat words. Furthermore, this within-subjects interference was only observed in the high stress group.

The non- significant difference between the high and low stress groups for interference scores (calculated differences between threat words and neutral) might be explained by error variance from extreme scores in the high and/or low stress groups which is not partialled out in between-subjects analyses (Cisler et al., 2010).

The current research has expanded on Woodfield et al.'s (1995) research and controlled for possible confounding from methodological variables by reducing word repetition, delivering the stress questionnaire after the Stroop task to avoid priming by association or negative affect, using a single, randomised presentation rather than blocked to reduce priming and having additional control word sets to investigate general threat-relatedness as opposed to concern-relatedness.

The results of the three current studies which utilised the occupational stress-related Stroop are taken as support for elicitation of an automatic attentional bias towards personally threatening stimuli (occupational stress-related) due to the semantic content of this stimuli capturing attention, thereby reducing attentional capacity for the primary task of colour naming (e.g. Eysenck et al., 2007; Williams et al., 1996).

These conclusions are consistent with cognitive theories which attempt to explain attentional bias in anxious individuals. Beck's schema theory (Beck, 1976; Beck, et al., 1979, 1985; Beck and Clark, 1988, 1997) proposes that anxious individuals have a dominant 'danger' mode that triggers associated schemata stored from past experience, automatically directing processing resources towards environmental danger or threat. This process is not consciously mediated but occurs without conscious awareness. One explanation for the findings of the current research is that the occupational stress-related words triggered a dominant ‘danger’ mode which directed attentional processing towards these stimuli in individuals who perceived higher levels of stress.

Beck’s schema theory also makes a series of predictions relating to attentional biases in anxious individuals which can be linked to the Stroop interference observed in Studies One, Two and Three. Firstly, that anxious individuals will selectively attend to stimuli associated with a dominant threat schema in preference to non-threatening stimuli. This effect was observed in all three of the studies conducted using the occupational stress-related Stroop in that the high stress group took significantly longer to colour- name occupational stress-related words than neutral words. Secondly, that they are more likely to interpret ambiguous stimuli as threatening in comparison to non-anxious individuals. This was also observed as the occupational stress-related words were emotionally ambiguous, not generally threatening and consequentially participants in the low stress groups did not respond differentially to them. Finally, that anxious individuals have a reduced processing capacity due to constantly scanning the environment for threat and so have less available for other tasks. The slower colour- naming latencies for occupational stress-related words in comparison to neutral demonstrates that once the personal threat value of these words is detected (via the automatic process of word reading) it reduces the capacity to carry out the strategic task of colour naming for the occupational stress words. In this way, the colour naming times are significantly longer for occupational stress-related words in comparison to neutral, social threat or physical threat.

The findings of Studies Two, Three and Four are also in accordance with Eysenck's (1992) hypervigilance theory in that high stress participants exhibited hypervigilance due to occupational stress (e.g. anxiety, arousal, worry) which then led to automatic selective attention towards the occupational stress-related words, distractibility by the meaning of the words and subsequent narrowing of attention towards reading the word, resulting in impaired colour naming performance. Hypervigilance towards threat also increases as stress levels increase. Eysenck's (1992) theory is based on the hypothesis that anxiety and resulting vigilance towards the environment has an inherent evolutionary function to enable individuals to escape from danger. It is however maladaptive when the individual becomes hypervigilant and develops attentional bias towards stimuli that does not have a general threat value as with the occupational stress stimuli which others might find ambiguous.

Eysenck et al.'s (2007) Attentional Control theory focusses on the balance between processing efficiency and performance effectiveness predicting that in anxious individuals, worry (symptomatic of stress) increases resource requirements and reduces processing efficiency but not necessarily performance effectiveness. In the occupational stress-related Stroop where more attentional resources are required for the controlled (strategic) process of colour naming, stress decreases processing efficiency (uses more processing capacity). Additionally, stress impairs top-down (goal- driven) processes and increases the influence of bottom-up (stimulus-driven) processing which reduces attentional control. This is exhibited in the occupational stress-related Stroop by the high stress groups being unable to inhibit automatic allocation of attention towards occupational stress words and being unable to shift attention away from reading the occupational stress-related words in order to name the colour.

Eysenck et al.'s Attentional Control Theory (Eysenck et al., 2007) with its emphasis on capacity-resource in anxious individuals has also been related to biases in attention displayed in stressed individuals, in that easily accessible, automatically activated stimuli are processed more efficiently. This is believed to be because stress and physiological arousal use up processing resources required for controlled attention (Wells and Mathews, 1994) as with anxiety. In the high stress groups from Studies Two, Three and Four the easily accessible, automatically activated material would have been stimuli associated with occupational stress as their current concern, even though the meaning of these words was irrelevant to completion of the task (colour naming). In this way, little or no attention is available to colour-name the occupational stress words and performance is impaired.

In line with proposals from the PDP Model (Cohen et al., 1990), the occupational stress- related words could be said to have elicited Stroop interference in the high stress groups due to them having a stronger connection in the processing pathway (as work stress was a current concern) and consequently elevated activation levels at the Intermediate Units. The high stress group could not ignore the word content as it was being processed along this pathway and conscious attention was therefore directed towards word reading (by the Task Demand Unit). Therefore, the interference observed for colour naming of occupational stress words occurred without strategic attentional processing supporting the argument for an automatic, pre-attentive bias.

The PDP model also offers a possible explanation for why the FE teachers in Study Three exhibited attentional bias towards physical threat words as well as occupational stress words. Williams et al. (1996) posited that this could be due to neuromodulatory control of input units previously linked to environmental threat and increasing activation. Physical threat words might have a higher evolutionary threat value as they relate to personal danger, physical injury and ill health. Individual differences in the FE teachers (e.g. personality or trait anxiety levels) could have made them more vulnerable to the semantic content of physical threat words given that this was not observed in Studies Two or Four.

The aforementioned theories of anxiety and attention all appear to offer useful explanations for the Stroop interference observed in the research conducted using the occupational stress-related Stroop task across Studies, Two, Three and Four but no single theory appears entirely sufficient to support the findings across all of the studies that tested the occupational stress-related Stroop task. Although these studies suggest that the results obtained might be due to attentional bias towards stimuli perceived as threatening by participants reporting higher levels of stress (and possible anxiety as an outcome of stress), there is still no conclusive evidence that this is due to an unconscious, adaptive attentional bias towards perceived threat and other factors should be considered. It has been proposed that factors arising from methodological differences in operational variables and/or population-based variables might be responsible Stroop interference. The following section considers some of these factors.

6.2.3 Operational and Population-Based Moderators

Although there is substantial research evidence for emotional Stroop interference there have been suggestions that operational and population-based variables could moderate the Stroop effect observed in Studies Two, Three and Four. Various strategies were employed in both the construction of the occupational stress-related Stroop and in the methodology to control for or reduce the majority of these variables.

Bradley et al. (1997) advocated that anxious individuals take more time to colour-name concern-related words due to familiarity acquired talking and thinking about them and that this ‘expert’ knowledge primes them towards these words in the Stroop task. Likewise, it is possible that participants in the high stress groups are more familiar with occupational stress-related words as they might spend time worrying or talking about the topic with work colleagues, friends and family. Objective familiarity (word frequency) was balanced across the word sets, but it was not possible to assess subjective (personal) relevance of the occupational stress words prior to completion of the task. Social and physical threat stimuli which have objective threat value were included to control for this across the word types. Additionally, there is evidence from research investigating Stroop interference in patients after receiving therapy, which shows that even where patients had become increasingly familiar with concern-related words during therapy, Stroop interference was reduced or disappeared following exposure to the threat or therapy (Lavy et al., 1993; Mathews et al., 1995; Mattia et al., 1993) and did not increase as might be expected due to more familiarity. Hence, familiarity with occupational stress words is unlikely to be an explanation for the effects observed in Studies Two, Three and Four.

A single, randomised computer presentation was chosen as although blocked design has frequently shown more Stroop interference (Bar Haim et al, 2007) there is an ongoing debate regarding whether this larger effect is due to attentional bias or priming due to the same types of words being blocked together. By using single, semi- randomised presentation of words (so that the same type of word was not repeated twice in succession), ‘carry over’ effects of the occupational stress stimuli, should have been reduced, as it has been suggested that the subjective threat value lowers mood (Algom et al., 2004; McKenna and Sharma, 2004) and makes participants more receptive to subsequent occupational stress stimuli in the same block.

To control for excessive repetition of the same words and practice effects (Williams et al., 1996), a set of at twenty occupational stress-related words and three sets of twenty control words were presented once in each of the four colours and in a semi- randomised order to avoid the same word being presented on an immediately following trial. A limitation of the only previously published emotional Stroop study related to occupational stress conducted by Woodfield et al. (1995), was that only five occupational stress-related words (and controls) were used which meant more repetition across the task. Furthermore, each of the word types were presented an equal number of times so repetition effects would have occurred across all stimuli irrespective of threat value to the participants. This was not observed in any of the studies, therefore word repetition is unlikely to have affected the results.

Supraliminal presentation was chosen as it is easier to operationalise and because past research with subliminal presentations has generally indicated that disruption of colour naming is not necessarily mediated by conscious attentional strategies but is frequently associated with a pre-attentive, automatic bias for threat-related stimuli (Pfaf and Khan, 2007; Williams et al., 1996). The results from Studies Two, Three and Four found Stroop interference in the high stress group for occupational stress-related words in comparison to neutral words which seem to support the existence of an automatic attentional bias towards concern-related stimuli. Specificity of Stroop stimuli has also been put forward as a moderator of emotional Stroop interference in anxious individuals. Consequentially, the occupational stress- related words were chosen to represent occupationally stressed individuals' concerns (concern-related hypothesis) as this appeared the most convincing argument to emerge from past research with non-clinical participants (Williams et al., 1996).

Concern-relatedness appeared a better explanation than threat-relatedness for the Stroop interference observed between occupational stress-related words and neutral words for the high-stress groups only. Interference due to threat-relatedness was not found in either the high or low stress groups for any of the studies as colour naming times for social and physical threat words did not significantly differ from neutral within the groups. However, when using the interference scores rather than colour naming times the high stress group of FE teachers in Study Three had significantly more interference than the low stress group for both occupational stress words and physical threat words indicating some support for threat-relatedness as well as the concern- relatedness.

When considering the possible effects of the emotionality hypothesis (e.g. Martin et al., 1991; Mogg and Marden 1990) on the current studies, the occupational stress stimuli had a relatively neutral valence (4.40 where a score of 5.00 is neutral) and the social and physical threat words were significantly more negative, so neither the emotionality hypothesis nor the general threat hypothesis applies to the significant Stroop interference effects observed in Studies Two and Three which concurs with results from past research using concern-related stimuli.

The results from Study Two (white-collar workers) and Study Four (police firearms) are in line with the concern-relatedness hypothesis (Mathews and Klug, 1993) as the high stress groups in both studies took significantly longer to colour-name occupational stress-related words compared to neutral words and, in comparison to the social and physical threat-related words. This infers that the high stress group selectively attended to stimuli related to their concerns irrespective of threat-relatedness or emotional valence. With respect to Study Three (FE teachers), whilst there is support for the concern-relatedness hypothesis in that the high stress group selectively attended to occupational stress-related stimuli in comparison to neutral words, they also took significantly longer to colour-name physical threat words than neutral words suggesting that the generally threatening nature of these words had captured their attention which is in line with the threat-relatedness hypothesis (e.g. Mathews and MacLeod, 1985). A possible explanation for task interference by physical threat words displayed in the high stress FE teachers is that emotional arousal from the generally threatening tone of these words e.g. *mutilated, cemetery, cancer* caused increased levels of negative affect which uses up processing capacity and interferes with the strategic task of colour naming (Algom et al., 2004; McKenna and Sharma, 2004). It might be that the physical threat words have a high threat value as they represent personal physical danger (Mogg and Bradley, 1998) but also that the high stress group could be more vigilant due to chronic physiological arousal (Eysenck, 1992).

6.2.3 Allocation of Participants to High and Low Stress Groups

The PMI (Williams and Cooper, 1998) was used as a self-report indicator of occupational stress in Studies Two, Three and Four and also as a measure to allocate participants into high and low stress groups according to their total mean score on the Sources of Pressure (SOP) scale. Analysis of the reliabilities showed good internal consistency reliability of the total sources of pressure (SOP) score for each of the three different samples (Study One, $\alpha = .93$; Study Two, $\alpha = .97$; Study Three, $\alpha = .97$) indicating that the test items on the SOP scale measured what they were meant to measure, that is, perceived sources of pressure.

Unlike emotional Stroop studies with clinical anxiety samples, comparison groups were not pre-screened for stress using the PMI and allocated into high and low stress groups beforehand but rather the questionnaire was completed after completion of the occupational stress-related Stroop to reduce the possibility of priming participants to the stimuli in task (Bradley et al., 1997) and also to reduce the chance of negative affect produced by a questionnaire asking about work stress carrying over into the Stroop task and confounding results (Lundh and Czyzykov-Czarnocka (2001). This seemed to be effective as participants did not appear to know what the emotional Stroop was measuring as demonstrated by questions posed to the researcher after they had completed the task.

6.2.4 Major Contributions to Research

A major contribution to emotional Stroop research made by this doctoral thesis is the original construction of an occupational stress-related Stroop task and its application to three different occupational settings. From an extensive search of the emotional Stroop literature, this appears to be an innovative area of research with only one previously published study using workers specifically as participants (Woodfield et al., 1985). Apart from the fact that this was over thirty years ago, Woodfield et al. (1985) did not use specific occupational stress-related stimuli, were not aiming to construct an objective indicator of occupational stress, and had various other methodological limitations previously cited, thus leaving a gap in the research literature.

With respect to the measurement of occupational stress, this doctoral thesis has provided the potential for an objective measure of occupational stress to be used in conjunction with other methods. Previous research has highlighted inadequacies in traditional measurement methods for occupational stressors and strains and suggested that risk assessment could be improved by using a combination of different measures to overcome issues these inadequacies (e.g. Briner et al., 2001; Frese and Zapf, 1988; Paulhus and Vazire, 200; Lindell and Whitney, 2001). The occupational stress-related Stroop offers an alternative to self-report, observation and physiological measures of stress and has several advantages. It is relatively quick to complete, non-intrusive, does not rely on the individuals subjective account of the stress experience, is not open to response biases and can be easily analysed and interpreted. Furthermore, there is scope for the occupational stress-related Stroop to be used prior to organisational interventions and again after interventions to monitor attentional bias as an indicator of stress in the same way that past research has used the emotional Stroop before and after therapy for various anxiety disorders (e.g. Lavy et al., 1993; Masia et al., 1999; Thorpe and Salkovskis, 1997; Watts et al., 1986).

6.2.5 Limitations and Further Research

6.2.5.1 Study One

In terms of Study One which detailed the construction of word lists, a possible limitation was noted during the process of word designation for the occupational stress-related word set in that some of the themes identified from content analysis were difficult to adequately represent using a single word. For example, the theme 'lack of advancement or promotion' was denoted by the word '*unpromoted'* and 'lack of consultation or discussion' by the word '*unconsulted*'. Neither of these words appears in several British-English dictionaries which suggests they occur rarely in everyday language, nevertheless they do appear in Kilgarriff's (1997) written word frequency list and therefore any possible confounding due to the word's relative obscurity in comparison to the neutral words was controlled for by balancing for frequency across all of the control word groups as recommended by Larsen et al. (2006).

Another issue was the combining of themes to arrive at the stimulus word, 'Workload'. In particular, the themes, Workload', 'Work Demands' and 'Customer Demands' were combined and represented by *'Workload'*. In hindsight, *'Customer Demands'* might not be adequately represented by this word when the word 'Customers' could have been added to the list. It was felt at the time that 'customers' was not a generic occupational word and could be limited to occupations where customers are generally referred to for example, retail work or service industries.

Since the construction of these word lists, an updated version of the BNC frequency list from which Kilgarriff (1997) derived his frequency list, has been made available in a searchable online database (BNC XML Edition, 2007). It would be advisable when carrying out emotional Stroop research or other research using lexical tasks to utilise the most recent version available given contemporary changes in language use that might occur due to for example, advances in technology or changing practices.

6.2.5.2 Study Two, Three and Four

Although the results from Studies Two and Three found significant within and between- subjects Stroop interference in line with past research, Study Four (firearms officers) found that there were no significant between-groups differences for occupational stress words and neutral words using interference scores (OS-NU) despite finding a significant within-groups effect. A possible explanation for this, is that although the interference score for OS-NU marginally missed statistical significance, it had a large effect size suggesting lack of power due to the relatively small stress group sizes (*n* = 13) in Study Three. Another consideration might be that within-subjects differences are the more reliable indicator of attentional bias because they are free of error variance from extreme scores and diagnostic specificity that are inherent with between-subjects comparisons (Cisler et al., 2009) and that might have been present in the firearms officers interference scores.

Further testing of the occupational Stroop is needed to clarify these anomalies. Longitudinal research with repeated testing over time would not only be useful to investigate the efficacy of the occupational Stroop as an indicator of stress and as a way to monitor organisational interventions, but would also provide data to check test- retest reliability.

Whilst the present research shows support for the occupational stress-related Stroop task in terms of eliciting attentional bias towards occupational stress-related words in high stress individuals, it is acknowledged that it does not provide any information about which stressors are the most important for any given individual or worker groups. However, the same can be said for physiological indicators of stress and also to some degree, self-report measures. Self-report scales have been used in risk assessment as an initial indicator of the presence of stress or a lack of meeting adequate standards for well-being. The Management Standards Indicator Tool has been employed in this way as a first measure to indicate the need for more in-depth analysis of areas identified (e.g. Cousins et al., 2004).

The occupational stress-related Stroop is offered as an objective indicator of attentional bias towards work stress and does not aim to identify specific areas of concern, but rather it is suggested as an additional measure to be used in occupational risk assessment exercises in conjunction with self-report, interview, physiological or observational measures. A combination of different measures would not only reduce the limitations with some of the current popular methods but would also control for common method variance (Lindell and Whitney, 2001) as highlighted in Chapter One.

Another consideration is that the psychometric properties of the occupational stress- related Stroop task were not measured over the course of this research as the focus was on testing utility in different occupations rather than repeated testing of the same individuals. However, if this version of the Stroop were to be used as one of the measures in an occupational risk assessment it ought to be able to reliably measure colour naming latencies for the same individuals over time, so test-retest reliability is important.

Past research, although limited, has shown acceptable to high test-retest reliabilities when colour naming times for each set of words are used, but unacceptable reliabilities when interference scores (threat-related minus neutral response latencies) have been examined over repeated tests (Eide et al., 2002; Kindt et al., 1996; Strauss et al., 2004) so further research on the psychometric properties of the emotional Stroop is required. As well as being an important consideration for the utility of occupational stress- related Stroop, the reliability of emotional Stroop tests over time has significant implications for clinical and experimental research that currently uses interference (or bias) scores as indicators of attentional bias. Future development of the occupational stress-related Stroop should involve investigation of test-retest reliabilities with the same individuals for at least the occupational stress-related and neutral words over time.

6.2.6 Practical Implications

The findings from the application of the occupational stress-related Stroop to three different occupational settings in this doctoral thesis have demonstrated a consistent attentional bias towards occupational stress-related words in comparison to neutral for high stress participants. This attentional bias was specific to the high stress group as no within-subjects differences were observed for any of the low stress groups indicating that the attentional bias was characterised by occupational stress status.

Therefore, there is some justification for suggesting that the occupational stress-related Stroop should be further piloted as a measure of occupational stress. Ideally this would involve larger occupational samples and assessment of test-retest reliability as well as using it in conjunction with a range of other measurement methods including self-report scales, interviews, physiological indicators and observations.

The occupational Stroop is a relatively inexpensive, time-efficient, non-invasive, tool for the measurement of occupational stress which could be a useful addition to current measurement methods as a preliminary screening tool to assess the presence of stress in an organisation.

6.2.6 Concluding Comments

The primary aims of this research were to review the current position on occupational stress and its measurement and to construct an occupational stress-related Stroop task representing contemporary, generic work stressors, before testing the utility of this as an objective indicator of occupational stress across different occupational groups. These aims were successfully achieved.

Occupational stress and its physiological, psychological and behavioural outcomes have been of continuing concern to UK Health and Safety organisations for quite some time and subsequently risk assessment strategies have been drawn up and recommended for regular use in assessing the health of organisations and their employees (e.g. the HSE Management Standards). Nevertheless, methods frequently employed to identify psychosocial factors contributing to risk and consequent harm are beset with methodological limitations not least the suggestion that self-reports of stress and strain are overly subjective and open to a range of biases. This defines the requirement to consider alternative or supplementary measures that might be more objective and not be affected by these biases.

Cognitive theories of anxiety and attention propose that anxiety causes cognitive biases that affect attentional performance (e.g. Beck et al., 1985; Eysenck et al., 2007). These theories were offered as possible explanations for processes underpinning the emotional Stroop interference observed in an extensive body of research looking at participants in anxiety states/disorders as well as other affective conditions (See Bar Haim et al, 2007 for a review). Given the conceptual overlap between and stress and anxiety (as an outcome of stress) and the evidence that stress also affects cognitive performance, it seemed feasible that these theories could be extended to apply to individuals with occupational stress.

The above factors taken together provided the rationale for constructing a bespoke occupational stress-related Stroop task (which accounted for factors inherent to the emotional Stroop paradigm) and piloting this across different occupational groups in this doctoral research.

In terms of the effectiveness of the occupational Stroop as an indicator of stress, the groups identified as high stress demonstrated a significant Stroop interference towards occupational threat words relative to neutral words in all three studies, whereas the low stress groups did not. The participants occupation did not appear to affect the pattern of Stroop interference towards occupational threat words although high stress FE teachers also exhibited interference for physical threat words which needs further consideration. Participants who scored highly on an established self-report scale (the PMI) made up the high stress groups in each study and subsequently displayed attentional bias towards occupational threat words in comparison to neutral words and relative to the low stress group with the exception of the firearms officers who showed no between groups differences in interference scores.

Further research is recommended to test the occupational Stroop on large samples from various occupational groups and on repeated occasions to assess its reliability and validity, but the initial studies conducted in this research have suggested that it could prove to be useful in future organisational risk assessment exercises.

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Appendices

Appendix 1: Participant Information Sheet (Interviews)

Participant Information Sheet

My name is Elaine Reeves and I am conducting this research as part of my PhD study at Manchester Metropolitan University, Manchester, United Kingdom.

The purpose of this research is to gather your perceptions of occupational stress.

You have been approached because the study requires the opinions of people who are in full-time employment.

Your participation is entirely voluntary and it is completely up to you to decide whether or not you take part.

If you decide you would like to take part, you will be asked for your opinions on workplace stress via a brief face to face interview conducted by the researcher.

The information you provide is confidential as only words or phrases from your interview will be used in the research. The data collected for this study will be stored securely and only the researchers conducting this study will have access to this data:

- Audio recordings will be destroyed and/or deleted once the project has been submitted for publication/examined.

- The files on the computer will be encrypted (that is no-one other than the researcher will be able to access them) and the computer itself password protected.

- At the end of the study, hard copies of consent forms will be scanned and the electronic files will be saved on a computer for ten years. At the end of this period, they will be destroyed.

- Anonymised single words or phrases from your interview may be used in the reports or publications from the study, so your name will not be attached to them.

- All your personal data will be confidential and will be kept separately from your interview responses.

The results will be summarised and reported in a doctoral thesis and may be submitted for publication in an academic or professional journal.

There are no risks anticipated with participating in this study. However, if you experience any distress following participation you are encouraged to inform the researcher.

Although you may find participating interesting, there are no direct benefits to taking part.

If you have any questions about the study, please contact the researcher: Elaine Reeves (e.reeves@mmu.ac.uk). Thank you for taking the time to read this information sheet

Appendix 2: Consent Form (Interviews)

Appendix 2: Consent Form (Interviews)

Consent Form

I am asking if you are willing to take part in a research project which aims to gather participants' perceptions of workplace stress via a face to face interview.
Before you consent to participating in the study we ask that you read the participant information sheet and mark each box below with your initials if you agree. If you have any questions or queries before signing the consent form please contact to the principal researcher, Elaine Reeves (e.reeves@mmu.ac.uk)

Please initial each statement

1. I confirm that I have read the Participant Information Sheet and fully understand what is expected of me within this study. ☐
2. I confirm that I have had the opportunity to ask any questions and to have them answered. ☐
3. I understand that my participation is voluntary and that I am free to withdraw without giving any reason up until such point that the data has been pooled for analysis. ☐
4. I understand that in order for my data to be withdrawn, I will need to contact the researcher via email with the inclusion of the code I have created as part of my participation. ☐
5. I understand that the information from my responses will be pooled with other participants' responses and may be published. ☐
6. I consent to the data generated as part of this research to be used in reports, conferences and training events. ☐
7. I understand that any information I give will remain strictly confidential and anonymous. ☐
8. I consent to Manchester Metropolitan University keeping written transcriptions of the interview for 10 years after the study has finished. ☐
9. I consent to take part in the above study. ☐

Name of Participant..

Signature..

Date..

Name of Researcher..

Signature..

Appendix 3: Debrief (Interviews and Focus Group)

Participant De-brief

Name of Researcher: Elaine Reeves
University: Manchester Metropolitan University

Thank-you for taking part in my research. The data you contributed will help me to complete my Doctoral Thesis which is focussed on Attentional bias and Occupational stress. As part of this research I am collecting data on perceived sources of stress in the workplace and your data will be used to develop word stimuli for an occupational stress-related Stroop task.

If you have any questions about my study please feel free to ask them now. I hope that you enjoyed participating in my study.

Your data will be kept securely and anonymised. On completion of my PhD copies of the data will be destroyed. However, if it is to be considered for use in publications, it will be stored in a secure place until needed. If you wish to withdraw your data you can do so by contacting the researcher at e.reeves@mmu.ac.uk. In order to withdraw your data from my data base which is anonymised you will be asked for your unique, personal code. Please write the code you used throughout the two phases of this study into the boxes below.

Table 1: Creating your unique, anonymous personal code:

	Please insert the day of the month on which you were born (e.g., 04 or 12) in the box below	Please insert the last two letters of your home postcode (e.g. AD or SU) in the box below	Please insert the last two digits of your home telephone number (e.g., 02, or 98) in the box below
Your unique, anonymous personal code is:			

Appendix 4: Interview Schedule (Study One)

1) *What aspects of your work do you most/least enjoy*?

1) *Are there particular times or situations at work when you felt stressed or pressured? [If yes, probe further]*

2) *Is there anything that your workplace could do to ease the stress/pressure at work?*

3) *Do you get help from anyone which helps you deal with the effects of stress/pressures at work?*

Appendix 5: Participant Information Sheet (Focus Group)

Participant Information Sheet

My name is Elaine Reeves and I am conducting this research as part of my PhD study at Manchester Metropolitan University, Manchester, United Kingdom.

The purpose of this research is to gather your perceptions of occupational stress. You have been approached because the study requires the opinions of people who are in full-time employment.

Your participation is entirely voluntary and it is completely up to you to decide whether or not you take part.

If you decide you would like to take part, you will be asked for your opinions on workplace stress during a small group discussion facilitated by the researcher. The discussion will last for approximately thirty to forty minutes and will be recorded. During the discussion, you will be asked to write down words or phrases that represent your perceptions of occupational stress.

The information you provide is confidential as only words or phrases from your interview will be used in the research. The data collected for this study will be stored securely and only the researchers conducting this study will have access to this data:

- Audio recordings will be destroyed and/or deleted once the project has been submitted for publication/examined.

- The files on the computer will be encrypted (that is no-one other than the researcher will be able to access them) and the computer itself password protected.

- At the end of the study, hard copies of consent forms will be scanned and the electronic files will be saved on a computer for ten years. At the end of this period, they will be destroyed.

- The typed version of your interview will be made anonymous by removing any identifying information including your name.

- Anonymised single words or phrases from your interview may be used in the reports or publications from the study, so your name will not be attached to them.

- All your personal data will be confidential and will be kept separately from your interview responses.

The results will be summarised and reported in a doctoral thesis and may be submitted for publication in an academic or professional journal.

There are no risks anticipated with participating in this study. However, if you experience any distress following participation you are encouraged to inform the researcher.

Although you may find participating interesting, there are no direct benefits to taking part.

If you have any questions about the study, please contact the main researcher: Elaine Reeves (e.reeves@mmu.ac.uk). Thank you for taking the time to read this information sheet.

Appendix 6: Focus Group Elicitation Task

Response Sheet

Instructions

Please read the questions below and overleaf and discuss each one in turn with the group.

The facilitator will tell you when to begin and you will be given 5 minutes for discussion of Question 1. At the end of this five-minute interval, the facilitator will ask you to write down words or short phrases that come to mind about the topic in the space under the question.

Question 1. What do you think causes occupational stress?

The researcher will collect your responses at the end.

Appendix 7: Consent Form (Focus group)

Appendix 7: Consent Form (Focus Group)

Consent Form

I am asking if you are willing to take part in a research project which aims to gather participants' perceptions of workplace stress from a focus group discussion.
Before you consent to participating in the study we ask that you read the participant information sheet and mark each box below with your initials if you agree. If you have any questions or queries before signing the consent form please contact to the principal researcher, Elaine Reeves (e.reeves@mmu.ac.uk)

Please initial each statement

1. I confirm that I have read the Participant Information Sheet and fully understand what is expected of me within this study. ☐
2. I confirm that I have had the opportunity to ask any questions and to have them answered. ☐
3. I understand that my participation is voluntary and that I am free to withdraw without giving any reason up until such point that the data has been pooled for analysis. ☐
4. I understand that in order for my data to be withdrawn, I will need to contact the researcher via email with the inclusion of the code I have created as part of my participation. ☐
5. I understand that the information from my responses will be pooled with other participants' responses and may be published. ☐
6. I consent to the data generated as part of this research to be used in reports, conferences and training events. ☐
7. I understand that any information I give will remain strictly confidential and anonymous. ☐
8. I consent to Manchester Metropolitan University keeping written transcriptions of the interview for 10 years after the study has finished. ☐
9. I consent to take part in the above study. ☐

Name of Participant________________ **Signature**__________________ **Date** __________

Name of Researcher ________________ **Signature** __________________ **Date** __________

Appendix 8: Frequency and Word Length of Occupational Stroop Stimuli

Syllabic Length and Frequency of Occurrence Counts for Word Sets for the Occupational Stress-Related Stroop Task

Occupational Stress			Neutral Unrelated			Social Threat			Physical Threat		
	L	F		L	F		L	F		L	F
Untrained	2	2	Bracelet	2	195	Inept	2	91	Scalpel	2	96
Workrole	2	2	Acquaint	2	58	Disgraced	2	183	Deathbed	2	80
Workload	2	488	Sausage	2	515	Despised	2	420	Fracture	2	418
Deadlines	2	926	Voltage	2	912	Ashamed	2	1100	Inquest	2	900
Targets	2	2649	Tennis	2	2635	Opposed	2	2638	Collapse	2	2568
Colleagues	2	5557	Package	2	5287	Afraid	2	5967	Disease	2	8905
Unguided	3	8	Adhesive	3	320	Ridiculed	3	143	Cancerous	3	82
Uninformed	3	101	Majestic	3	288	Ominous	3	351	Infectious	3	473
Overworked	3	146	Pianist	3	325	Pitiful	3	203	Haemorrhage	3	325
Powerless	3	461	Gigantic	3	406	Pathetic	3	717	Paralysed	3	439
Management	3	21794	Yesterday	3	19459	Embarrassed	3	1483	Injury	3	4602
Family	3	34488	Already	3	34292	Rejected	3	3982	Violence	3	5607
Unconsulted	4	2	Gesticulate	4	9	Mortifying	4	18	Disfigurement	4	33
Unpromoted	4	2	Watercolours	4	314	Inferior	4	861	Anaesthetic	4	321
Unsupported	4	113	Panoramic	4	193	Idiotic	4	91	Malignancy	4	118
Undervalued	4	119	Moderator	4	202	Indecisive	4	98	Mutilated	4	197
Accountable	4	659	Monastery	4	617	Inhibited	4	520	Coronary	4	546
Redundancy	4	1142	Civilian	4	1377	Inadequate	4	2319	Casualty	4	751
Bureaucracy	4	1312	Academy	4	1393	Isolated	4	2813	Cemetery	4	765
Technology	4	11785	Generally	4	11568	Abandoned	3	3031	Emergency	4	3943

Participant Information Sheet

My name is Elaine Reeves and I am conducting this research as part of my PhD study at Manchester Metropolitan University, Manchester, United Kingdom.

The purpose of this research is to investigate automatic biases in attention in working adults. You have been approached because the study requires information from people who are in full-time employment.

Your participation is entirely voluntary and it is completely up to you to decide whether or not you take part.

If you decide you would like to take part, you will be asked to complete a brief computerised task where you are asked to name the colour that words are printed in. This will be followed by a request for you to complete a self-report questionnaire in your own time which is to be returned to the researcher at a later date.

The information you provide is confidential as only pooled data and not individual responses will be used in the research. The data collected for this study will be stored securely and only the researchers conducting this study will have access to this data:

- Hard copies of questionnaires will be kept in a locked cabinet.
- The files on the computer will be encrypted (that is no-one other than the researcher will be able to access them) and the computer itself password protected.
- At the end of the study, consent forms will be scanned and the electronic files will be saved on a computer for ten years. At the end of this period, they will be destroyed.
- All your personal data will be confidential and will be kept separately from your responses to the computer task and the questionnaire.

The results will be summarised and reported in my doctoral thesis and may be submitted for publication in an academic or professional journal.

There are no risks anticipated with participating in this study. However, if you experience any distress following participation you are encouraged to inform the researcher.

Although you may find participating interesting, there are no direct benefits in taking part.

If you have any questions about the study, please contact the main researcher:

Elaine Reeves (e.reeves@mmu.ac.uk)

Thank you for taking the time to read this information sheet.

Your data will be identified using only your unique code. Please create this code using the instructions given and write in the boxes below. You will need to use this code again during the research and will be given prompts to remind you.

Table 1: Creating your unique, anonymous personal code:

	Please insert the day of the month on which you were born (e.g., 04 or 12) in the box below	Please insert the last two letters of your home postcode (e.g. AD or SU) in the box below	Please insert the last two digits of your home telephone number (e.g., 02, or 98) in the box below
Your unique, anonymous personal code is:			

Appendix 10: Consent Form (Stroop and PMI)

Appendix: 8: Consent Form (Stroop & PMI)

Consent Form

I am asking if you are willing to take part in a research project which aims to investigate automatic biases in attention using a computerised task and a self-report questionnaire.
Before you consent to participating in the study we ask that you read the participant information sheet and mark each box below with your initials if you agree. If you have any questions or queries before signing the consent form please contact to the principal researcher, Elaine Reeves (e.reeves@mmu.ac.uk)

Please initial each statement

1. I confirm that I have read the Participant Information Sheet and fully understand what is expected of me within this study. ☐
2. I confirm that I have had the opportunity to ask any questions and to have them answered. ☐
3. I understand that my participation is voluntary and that I am free to withdraw without giving any reason up until such point that the data has been pooled for analysis. ☐
4. I understand that in order for my data to be withdrawn, I will need to contact the researcher via email with the inclusion of the code I have created as part of my participation. ☐
5. I understand that the information from my responses will be pooled with other participants' responses and may be published. ☐
6. I consent to the data generated as part of this research to be used in reports, conferences and training events. ☐
7. I understand that any information I give will remain strictly confidential and anonymous. ☐
8. I consent to take part in the above study. ☐

Name of Participant_________________ Signature___________________ Date __________

Name of Researcher _________________Signature ___________________Date __________

Appendix 11: Participant Debrief

Participant Debrief

Name of Researcher: Elaine Reeves
University: Manchester Metropolitan University

Thank-you for taking part in my research. The data you contributed will help me to complete my Doctoral Thesis which is focussed on Attentional bias and Occupational stress.

The computerised task you completed is called a Stroop task and measures the time taken to name the colour that words are printed in. The task contained words related to occupational stress along with control words and longer times for the occupational stress words indicates an attentional bias towards these words. The aim is to create a Stroop task that can objectively measure occupational stress.

If you have any questions about my study please feel free to ask the now. I hope that you enjoyed participating in my study.

Your data will be kept securely and anonymised. On completion of my PhD copies of the data will be destroyed. However, if it is to be considered for use in publications, it will be stored in a secure place until needed. If you wish to withdraw your data you can do so by contacting the researcher at e.reeves@mmu.ac.uk. In order to withdraw your data from my data base which is anonymised you will be asked for your unique, personal code. Please write the code you used throughout the two phases of this study into the boxes overleaf.

Table 1: Creating your unique, anonymous personal code:

	Please insert the day of the month on which you were born (e.g., 04 or 12) in the box below	Please insert the last two letters of your home postcode (e.g. AD or SU) in the box below	Please insert the last two digits of your home telephone number (e.g., 02, or 98) in the box below
Your unique, anonymous personal code is:			