The Nature of Boredom

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ABSTRACT

Though boredom is considered a universal experience "there is no agreed definition or well-developed instrument for measuring it, and there is no comprehensive theory of its causes" (Fisher 1993). Nevertheless the bored are thought to have worse work records, more accidents, higher absenteeism, and to show a host of unfortunate behaviours from delinquency to substance abuse.

This research shows the existing literature of boredom to be inconsistent or inconclusive. Field observation of boring and repetitive work suggested a new model of the behaviours that are thought to be boredom related. In this model, requisite mental resource allocation is assumed to progressively decrease as a task becomes more and more familiar. Natural inertia in the allocation system results in temporary misalignments between allocated resource and task-demand. It is these misalignments that cause bored-type behaviour. The awareness of these misalignments may register as felt-boredom.

The predictions of this **Inertial Resource Allocation Model** (IRAM) were tested in a series of experiments. It was shown that misallocation of mental resource can be reliably measured, that it is individually variable, and that it does indeed predict behaviours, notably work quality and absence, that are considered boredom sensitive.

Misallocation of mental resource is proposed as a <u>sufficient</u> condition for inducing 'bored-type behaviour'. However, though necessary, it is <u>not sufficient</u>, to induce 'felt-boredom'. The same mismatch may be interpreted differently in other contexts.

The conclusion is that boredom is too vague a notion to be useful to Psychology. However, a measurable and operationally defined feature of mental functioning -- mental inertia -- can explain all the phenomena once associated with the idea of boredom.

SECTION ONE - INTRODUCTION

Chapter 1: The problem of boredom

Boredom is a common experience that has defied precise definition. It is ubiquitous yet there is no agreed instrument for measuring it. It is one feeling yet a host of complex explanations are offered for its origins. It is pervasive yet intractable.

Boredom implies a lack of interest induced by familiarity. 'Boring' is not the same as 'uninteresting'. The interesting easily transmutes into the boring with repetition over time; however that process is not readily reversible. In short boredom appears to be event and time dependent.

At first sight boredom appears to be no mystery. It appears to be universal subjective experience. However, on closer examination, it is evident that popular understanding of boredom is confused and there is no adequate theory to supplement it. Little is gained by re-describing boredom in terms of monotony, lack of stimulation and dullness of mind. All that is already implicit in the word boredom. A scientific theory must explain how and why people become bored and lead to predictions that are neither tautological nor self-evident.

<u>Overview of the boredom literature.</u>

There have been two major reviews of the boredom literature in recent times, Smith (1981) and Fisher (1993). The former predates the beginning of this study. It was important in formulating a view of the state of research at the onset. Fisher's work was published when the study was well underway, and confirmed that little had changed in the intervening years.

Smith's view in 1981 was that "the amount of research devoted to the topic of boredom by psychologists and psychiatrists is astonishingly small when compared to literary treatments and to the acknowledged importance of the topic" (Smith 1981 p338). Smith found only forty papers published in the period 1926-81 that were directly concerned with boredom. "It is, " he concludes, "unclear what processes lead to us feeling bored. The existing research on boredom is limited ... little is known about the experience itself and how is generated."

Even the title of Fisher's 1993 paper -- *Boredom at work: a neglected concept* -- suggests little had changed during in the decade since Smith's review. Fisher's conclusion is worth restating. "There is no agreed definition of the construct [of boredom]," she says, " or well-developed instrument for measuring it, and there is no comprehensive theory of its causes" (Fisher 1993 p395-396).

Definitions of boredom

Many definitions of boredom offered in the literature are nothing more than lists of causes, antecedents or effects of boredom. This atheoretical tendency is hardly confined to the issue of boredom. Boredom could be no more than a convenient term for expressing a collection of loosely connected feelings. The term may have no use beyond the colloquial. There are precedents in the psychological literature. Briner and Reynolds (1993), for example, proposed that 'stress' is a rubric; neither a variable nor a single phenomenon, but a heading for a range of diverse phenomena which may or may not be causally related. The same could be true of boredom.

Boredom has been variously defined as conflict or constraint (Barmack 1938, 1939; Fenichel 1951; Geiwitz 1966; Stagner 1975): as feeling or affect (Barmack 1938;

Bailey, Thackeray, Pearl & Parish 1976; Hamilton 1981; Hamilton, Haier & Buchsbaum 1981), particularly a feeling associated with depressed states (Farmer & Sundberg 1986): as a drive state, or non-optimal arousal level (Berlyne 1960; Zuckerman 1979): as a concentration on the passage of time (Drory 1982; Grubb 1975; James 1908; Ornstein 1969): as the inability to keep oneself amused (Csikzentimihalyi 1975; Hamilton 1981).

Boredom is often considered a motive driving or inhibiting other behaviours. So Smith (1981 p338) offered 'cessation of exploration induced by the repeated confirmation of expectancy (habituation)' as a definition. Smith, in his review, focused on definitions that post-date the earliest experimental work (Barmack 1938) and does not, for example, discuss James's eloquent proposition that boredom "comes about whenever, from relative emptiness of a tract of time, we grow attentive to the passage of time itself". For James "the odiousness of the whole experience comes from its insipidity ... the feeling of time is the least stimulating experience we can have" (James 1908 p284).

By 1989 Damrad-Frye and Laird (1989 p320) are suggesting that boredom "seems to represent a metacognitive judgement about one's attentional activity". This is close to Fisher's (1993 p396) preferred definition that boredom is "an unpleasant, transient affective state in which the individual feels a pervasive lack of interest in and difficulty concentrating on the current activity".

Fisher appears to regard this 'transient affective state' as an emotion (following Smith & Ellsworth 1985; Russell 1980). The difficulty here is that emotion itself is such a slippery concept. Emotion historically "has proved utterly refractory to definitional effort: probably no other term in psychology shares its non-definability with its frequency of use" (Reber 1985). Defining one difficult concept in terms of another yet more intractable scarcely improves matters.

Themes in boredom theory

Theories of boredom are as diverse as the definitions. They encompass the full range of psychological perspectives from trait and state orthodoxy to social constructivism and psychodynamics. A recurring theme is boredom as a state of internal conflict.

Barmack derives his definition from experimentation. Boredom is, he says, "a state of conflict between the tendency to continue and the tendency to get away from a situation which has become unpleasant" (Barmack 1938 p125). Recently Mikulas and Vodanovich (1993 p3) also offered a state definition: "Boredom is as state of relatively low arousal and dissatisfaction which is attributed to an inadequately stimulating situation".

Fenichel (1951) -- arguing from a psychodynamic perspective -- also addresses the conflictual nature of boredom. He distinguishes two variants of boredom; normal and pathological. The former is motivational (broadly similar to Barmack 1938 notion) with boredom arising "when we must not do what we want to do or must do what we do not want to do" (p339). Pathological boredom however is quite different. This boredom is an expression of an approach-avoidance conflict that arises from the frustration of individual aims. The basic defence mechanism of repression extinguishes the aims, leaving an aimlessness and lack of energy. Boredom does not generate exploratory, sensation-seeking behaviour, but rather the reverse. There is a retreat into apathy. The boredom of unemployment could be of this nature (c.f. Jahoda, Lazarsfeld & Zeisl 1971). The school-children in Robinson's (1975) study also showed the repression typical of this variant of boredom.

Berlyne (1960) also defines boredom in state terms. The state of boredom provokes a search for diversion. Poulton's (1960) and Wendt's (1955) experiments suggest that this search naturally culminates in an optimum state somewhere between the extremes of mental fatigue and boredom. Wendt found that performance on arithmetic tasks deteriorates in line with reported boredom. These finding however contradict Smith's (1953; 1955).

For McBain (1961) boredom is again a state; an unpleasant, subjective one provoked by jobs in which we are not interested. Boredom, in his analysis, is <u>not</u> monotony. McBain defines monotony as 'low variability or arousal opportunity' (e.g., watchkeeping task). McBain's definition overlaps with the first two factors in Geiwitz's definition(1964). Geiwitz's four factors were arousal, subjective repetitiveness, unpleasantness, and constraint. These same factors appear in other accounts although (as with Smith 1981) the study itself was very small (only four subjects) and possibly biased (all subjects selected on basis of high scores on the *Stanford Hypnotic Susceptibility Scale*).

Giewitz attempts to resolve the apparent contradiction between Berlyne and Hebb's views. The former links boredom to high arousal (research findings supported by the experimental data of London, Schubert & Washburn 1972). The latter (Hebb 1955) sees low arousal as key.

Monotony, boredom and vigilance tasks are frequently linked. Smith (1966) proposes that such tasks are boring because they are undemanding (and thus uninteresting). This places the root cause of boredom firmly in the environment. However substantial individual performance differences are found on vigilance tasks and these differences are consistent over time. (Buckner, Harabedian & McGrath 1966; Benedetti & Loeb 1972; Mackworth 1950; Parasuraman & Davies 1977: Teichner 1974). This suggests the root cause of boredom is to be found in the individual not in the environment.

Mackworth (1969) explains the apparent differences in performance of introverts and extroverts on vigilance tasks by suggesting that the latter habituate more quickly and thus require more stimulation to maintain an optimal level of arousal. Hill (1975) supports this view. His studies of accidents among lorry drivers suggest that useful strategies for dealing with boredom (e.g., mental game playing, counting objects passed) work by increasing arousal by enhancing perceived stimulus complexity (a tactic favoured by extroverts - Berlyne 1970).

Thackray, Jones and Touchstone (1973) claim that *impulsivity* is the dimension that explains the poorer performance of extroverts. Zuckeman, Kolin, Price and Zoob (1969) *sensation seeking scale* measures a similar trait close to *impulsivity.* Smith (1981 p335) suggests that a comparable *boredom susceptibility scale* might be useful.

Physiological and behavioural research on people doing boring experimental tasks again shows a confusing picture (Bailey, Thackrey, Pearl & Parish 1976). Bailey et al's conclusion is that "boredom is a complex response pattern consisting of a variety of changes". Jerison (1977) considers the presentation rate of events to be particularly relevant to the onset of boredom. However at high rates people reporting high levels of subjective boredom showed no decrement in performance. This is a counter-intuitive but consistent with Hopkin's (1990) observations.

Craig's (1978) research is disconcerting. He found that the ratio of the number of detection responses (true and false) to the number of signals tends to be higher early in a watchkeeping task. If we assume that boredom increases during such activity then it looks as if responsiveness improves with boredom.

<u>The Major controversies</u>

Boredom is still a controversial issue. On the one hand it has been proposed that boredom arises when an unstimulating environment leads to low arousal (Barmack 1937; Fiske & Maddi 1961; Geiwitz 1966; Hebb 1966). On the other hand others (Berlyne 1960; London et al 1972) see low stimulation leading to high arousal (to compensate back to the optimal). We see similar discrepancies throughout the literature of affect (Tuohy 1984 p10). Favourability of stimuli, for example, has been found to increase with mere familiarity (Harrison 1977; Hill 1978; Zajonc 1968) or decrease with familiarity (Cantor & Kubose 1969) or stay the same irrespective of familiarity (Crandall, Montgomery, Rees & Stang 1973). Tuohy's elegant explanation is that different studies have, in effect, looked at different sections of the same general inverted-U curve.

The overall picture of boredom is very confused. There are several plausible, but competing, explanations for boredom. However, despite the controversy there is agreement on the importance of the topic, and the general conviction that the main consequence of boredom is a struggle to maintain attention.

The objectives of this study

The first aim is to reconcile the diverse findings of boredom research into one comprehensive theory. We may propose a theory for a phenomenon that cannot yet be measured. However, effective testing of a theory and substantial progress are frequently only possible when we have effective measures. In physics, for example, the crucial distinction between heat and temperature could only be made after the invention of the thermometer.

This thesis then has three core objectives:

1. - to explain why and how people become bored.
2. - to develop a scientific theory of bored behaviour
3. - to test that theory by experiment.

The basic premise is that either boredom serves a purpose or it is a by-product of other processes that are themselves useful.

Methods employed

Shackleton (1981) suggests there have been three main approaches to the study of boredom; elaboration of psychological theory (relevant but derived elsewhere), industrial study and laboratory experiment. This study uses all three approaches (overview in appendix 13).

Chapter 2: Bored behaviour

There is no agreed definition of boredom so it is appropriate to begin by considering boredom-related behaviours. Unfortunately we then run into immediate and serious difficulty.

There are few obvious, unequivocal and objective signs of boredom (Damrad-Frye & Laird 1989; Plutchik 1980; Scherer 1984; Tomkins 1962). Plutchik, in his model of the eight emotions, suggests yawning, inattention and restlessness as behavioural indicators. Wyatt, Langdon and Stock's (1937) view that there was a unique work output curve associated with boredom is discounted today (see Shackleton 1981). Thus the existence or otherwise of the bored state cannot be reliably deduced from work performance measures alone (Hopkin 1990).

The lack of characteristic and overt signs of boredom reflects its emotional nature. The situation, from observational point of view, may be even worse with other emotions. A person may whistle not so much from happiness, but in an attempt to keep their spirits from sinking still further. Lack of behavioural indicators has driven boredom research in the direction of self-report. There are obvious difficulties with this approach. Can we rely on accurate and honest reporting? Is the self-awareness of the reporter refined enough to discern between proximate states such as boredom and mild depression?

Self-report's general weaknesses are compounded by the appraisal and labelling that is believed to occur before an emotion is experienced (Lazarus 1982; Lazarus, Kanner & Folkman 1980). The labels 'boring' and 'boredom' are acquired in a social context. Social effects and mutual labelling are likely to be important. When others say a task is challenging, contains autonomy, or is boring, tedious or routine, this affects our own judgments (Griffin 1983; Thomas & Griffin 1983; Weiss & Shaw 1979; Zalesny & Ford 1990). Where would that leave self-report? Perhaps (following Vygotsky) when we label something 'boring' in inner speech that makes it boring.

Labels can be more than descriptions. When we have trouble maintaining attention, we may label a situation as boring. We may prefer "I am bored" as an excuse to "I am lazy" or "I am stupid" as conclusions to be drawn from our own behaviour. The appraisal "I am bored" may entrain the question "What is making me bored?" This conveniently projects fault into the environment (Mayer & Gaschke 1988; Smith & Ellsworth 1985).

Kagan and Rosman (1964) introduced low level distracting noise to tasks of varying difficulty. Some who experienced difficulty with the task, but were unaware precisely why (because of the low level), appeared to rationalise their problem thus: 'I am not paying attention <u>because</u> I am bored'. Listening tasks of intermediate difficulty produced the largest performance decrements. This suggests that accurate allocation is the issue, not shortage of free capacity. Damrad-Frye and Laird (1989) conducted a similar experiment and conclude that "boredom seems to represent a metacognitive judgment about ones attentional activity (p320)".

The label 'boring' could be a displacement or projection onto the environment rather than an actual appraisal. Both appraisal and labelling were manipulated experimentally by London and Monell (1974) who used fast or slow running clocks to warp the perception of the passage of time.

London and Monell's experimental tasks were 20 minutes long. However during the task the fast clock advanced 30 minutes. The slow clock advanced only 10 minutes. Thus the apparent time frame for each group was distorted by 10 minutes, but in different directions (+/- 10mins.). Those with the fast clocks described the task as more interesting than those with the slow clocks. London and Monell suggest this was because the period of elapsed time (20 min.) felt shorter than the 30 minutes registered on the clock. If a task feels shorter than it actually is then we infer that is because it is interesting. Barratt (1972 in Zuckerman 1983) found anxiety related to such time estimation errors, but *impulsivity* did not.

London and Monell's (1974) findings suggest we comprehend our own feeling states in the same ways as we do those of others (Bem 1972; Ryle 1949). We infer feelings -- our own and others -- from the behaviours exhibited. This process is largely subconscious. All we are aware of is the product of the evaluation (e.g., the states of interest or boredom). We are not aware how these states arise.

If we infer states from behaviour then that suggests there may be other ways of manipulating emotion. Troutwine and O'Neal (1981) showed that a sense of coercion increased the boredom of individuals in a tape-listening task. All their subjects listened to the same tape. Those who were convinced that 'they chose to listen' found it less boring .

Shackleton (1981) takes up the issue of coercion or constraint. He lists constraint, unvarying stimulation, and discrepancy of task difficulty and individual competence as the main explanations of workplace boredom. Others have remarked on constraint issues (Gewitz 1966; Guest, Williams & Dewe 1978). Organisational rules that prohibit talking, prescribe exact work procedures, or limit breaks may contribute to boredom directly by reducing stimulation and variety. Indirectly such constraints and controls may affect the appraisal of the situation by producing psychological reactance. Reactance theory proposes that threats to freedom of choice produce a desire to reassert that personal freedom and forbidden activities then become particularly attractive (Brehm & Brehm 1981). Thoughts of such illicit activities may then make work even less engaging.

If individuals feel their task behaviour is caused by external factors they tend to loose interest in that task. Autonomy has the reverse effect. Autonomy, particularly group autonomy, is central to many attempts to enhance organisational output. Even repetitive, monotonous and fractionalized tasks need not produce boredom if actions are self-directed (Bell 1975). Real autonomy may matter less than the perception of autonomy. Sanders, Halcomb, Fray and Owens (1976), for example, found that those with high *internal locus of control* made more correct detections and fewer omission errors on a vigilance task than those with high *external locus of control* .

Perceived autonomy may motivate because people make an erroneous positive appraisal (attribution theorists call this 'over-justification' - Lepper & Greene 1978; Staw 1976). We decide 'this is uninteresting' because extrinsic controls are in place (i.e., If I am being forced to pay attention it must be because the task is unrewarding). The more obvious the controls the less likely it is that potentially interesting features of a task will be noticed (Deci & Ryan 1985). Ryan (1982) goes on to show that even internally imposed controls (e.g., duty, avoidance of guilt) can reduce intrinsic interest. The opposite is also true. The job must be interesting if controls are not in place. In the work situation, however, individual autonomy may not motivate if the external demands for performance or quality are unmitigated. Then external controls are rightly perceived as dominant.

Molstad (1986) gives examples of perceived control. He found workers who chose to do boring work to escape from situations where they were both controlled and stressed. Being left alone in these situations was the only real form of autonomy, or freedom available. Molstad (p228) quotes Blauner (1964) who says, "the most unsatisfactory situation seems to be the job which is not intrinsically interesting and yet requires rather constant attention".

The countering of the coercive features of the environment, whether real or imagined, so as to sustain individual autonomy must take effort. Thus over-control should induce errors indistinguishable from those normally attributed to boredom. Perhaps the sensations of excessive external control and boredom are only superficially different.

Boredom, whatever the origins of the sensation, is blamed for many mishaps in the workplace. In the short run, bored employees experience lapses in attention and even fall asleep, take longer to notice and correct errors, and have more accidents (Cox 1980; Drory 1982; O'Hanlon 1981). Errors and omissions proliferate in relatively simple tasks when these tasks are embedded within a period of time when very little is happening. Grose (1989) recounts how an entire cockpit crew fell asleep on a routine flight and overflew their destination by 100 miles before being woken by Air Traffic Control. In the long term there is evidence that boredom on repetitive jobs is associated with job dissatisfaction (Caplan, Cobb, French, Harrison & Pinneau 1975), poor work performance (Drory 1982; Gardell 1971) and absenteeism (Saito, Kishida, Endo, & Saito 1972). Drory's conclusion was however that boredom among long-distance drivers related more strongly to property damage (e.g., accidents) than to absenteeism. He thought the former reflected a lowered state of alertness whereas the latter was a symptom of a negative attitude to the work itself.

Boredom has been associated with lower academic performance (Maroldo 1986; Robinson 1975); emotional upset, stress, hostility, increased risk taking or thrill seeking and drug and alcohol consumption (Hamilton 1983; Orcutt 1984; Wasson 1981; Zuckerman 1979); substance abuse (Carol & Zuckerman 1977; Johnson & O'Malley 1986; Pascale & Sylvester 1988; Paulson, Coombs & Richardson 1990; Watt & Vodanovich 1991); eating disorder (Abramson & Stinson 1977; Ganley 1989; Martin 1989; Sahakian 1983; Wilson 1986) and pathological gambling (Blascynski, McConaghy & Frankova 1990; Kuley & Jacobs 1988). Bored Russian officers invented Russian Roulette. The author, Graham Greene, claimed to have periodically resorted to this ultimate form of boredom relief. He bored even of that. Less extreme forms of gambling on extermination such as drunken driving (Arnett 1990) and excessive smoking (Ferguson 1973) have been blamed on boredom.

There is powerful correlative evidence that suggests boredom causes similar problems to stress (Thackray 1981). People doing monotonous jobs experience greater health problems, particularly heart attacks, that may be stress related (Alfredsson, Karasek & Theorell 1982; Caplan et al 1975; Frankenhauser & Gardell 1976; Orth-Gomer, Hamsten, Perski, Theorell & De Faire 1976; Samilova 1971). This author's own experience leads him to suspect that some accidents may arise not so much from error as from collapse of ordered behaviour induced by boredom. Such a collapse would go some way to explain the many mysteries of human error.

When a mishap defies technical explanation human error is often blamed. But frequently, human error is no more than a convenient explanatory dustbin. No error, in the real sense of an unintended action, may have occurred. The action taken was usually intended. Unfortunately it was inappropriate. Such actions are particularly common after extended periods of low activity. They are also common when unexpected changes occur in essentially routine activity. At such times may people act in a bizarre fashion. They should know and often do know later that their actions were odd. Experts may be more vulnerable to such errors than the novices.

Negative transfer or habit- interference was blamed for many World War II aircraft accidents (Fitts & Jones 1961). Inexperienced pilots performed certain types of task better than experienced pilots. Practised reactions disadvantaged the experts.

Hendrick (1983) was able to measure the extent of habit-interference in a flight-simulator under 'reversed control stick conditions' (i.e., to bank right you move the stick to the left; to dive you pull the stick back). He compared experienced (more than 1000 hours on type) and novice pilot (less than 10 hours on type). The pilots had to maintain altitude, while rolling-out onto a new and specific compass heading. Under 'normal stick' conditions (i.e., left-stick moves aircraft left) the experienced pilots out-performed the novices. However under 'reversed stick conditions' the experienced pilots performed significantly worse than the novices. The heading errors of the experienced pilots were twice as large as those of the novices. The altitude errors were four times as great ($p \leq .001$).

Skill exacts a price. In novel situations familiarity and habit can be dangerous. There is no reason why habit should not interfere with behaviour from moment to moment. Habits are established very rapidly.

Habituation implies progressive desensitisation. Almost any repeated stimulus will do this (e.g., a pure tone sounded for half an hour reduces in perceived loudness by as much as 20 dB). Such progressive desensitising is associated with physiological changes. London et al (1972) found that a subjective increase in boredom linked to an increasing ANS activity. They consider two explanations; that the subject evoked a self-produced arousal in an attempt to maintain attention or alternatively that brainstem arousal occurred because of a decrease in cortical activation. Stagner (1975) suggests a third possibility. Constraint may increase hostility and this hostility may increase ANS activity.

The EEG evidence is interesting, but again inconclusive. Heron (1957) and Serafetinides (1971) observed increases in theta rhythms in isolation studies. Beatty, Greenberg, Deubler and O'Hanlon (1974) found an increase in this rhythm was induced by the monotony of a vigilance task, and was also associated with rising errors. It is also Stagner's (1975) view that theta rhythm is reliably associated with both boredom and loss of efficiency.

Habituation can, at least in part, explain how experts become susceptible to attentional failures. Routine conditions do not test their skill. It is experienced pilots that fall sleep on long-haul flights (see CHIRP - *Confidential Human Incident Reports* of the Institute of Aviation Medicine, Farnborough, UK). The proportion who doze may be high. An inflight study of pilot behaviour (reported in Kiernan 1994) shows that 5 out of the 9 pilots observed slept at their controls even though they knew researchers were monitoring them. One pilot nodded off twice and two of the naps lasted longer than 10 minutes.

If warnings are missed, mishaps are likely. Warnings are also misinterpreted. Bryant, De Bievre and Dyer-Smith (1988) found many accidents occurred despite those involved being aware of the dangers. In all the marine collisions they studied the parties were aware of the threat. Frequently the signs of danger were obvious and unambiguous. Others have made similar observations and invoked stress as the explanation. If stress is an explanation of marine accidents it must be extremely local stress. The bulk of the marine navigator's task (+80% of the time) is low-load monitoring (Habberley, Taylor & Dyer-Smith 1989). There are other, more likely explanations than stress.

It could be that habituation to a low-load task reduces our thresholds of awareness. It is equally possible that warning signals are actively screened out of awareness. Groth (1987) suggested that in the unstimulating conditions of social and physical isolation, characteristic of marine watchkeeping, needs and feelings can only be dealt with by loosing all awareness of self. Consequently, watchkeepers lose their orientation in time and space and hallucinations occur. This defensive turning-off sounds very similar to psychodynamic accounts of boredom (e.g., Fenichel 1951).

In many accidents, skilled people make apparent errors of judgment, and judgment itself is thought by some to be eroded by boredom (Hopkin 1990). Judgment, however, is a particularly fuzzy notion. Jaques's view was that judgement is ineffable. "A major point about problem solving, exercise of judgment and decision making, is that we are dealing with a process that is not accessible to conscious knowledge and reason" (Jaques & Cason 1994 p10). We know what we decide, but cannot know how or why. We distinguish good from bad judgments by considering outcomes. If judgment is essential subconscious activity then we cannot easily exclude the possibility that there may be unconscious forces driving individuals toward dangerous encounters (i.e., unconscious intentionality). There are, however, few theories that can accommodate unconscious forces within an empirical investigation (pre-conscious processing - Dixon 1971; 1981- is a notable exception).

An alternative explanation of boredom's apparent deleterious effects on judgment is cognitive regression. It could be that boredom does dull the mind and reduce its ability to function efficiently. The language of boredom is certainly suggestive (e.g., bored stupid, bored out of my mind). Both Molstad (1986) and Dyer-Smith (1992a) comment on apparently similar trends in very different workplaces. Judgment itself might be particularly affected. One indicator of boredom could be the rate of erosion of judgement.

Boredom is generally considered an emotion. Judgment is a cognitive concept. The distinction may be merely linguistic here, and require dissolution rather than resolution. There may be a pre-awareness aspect to judgment. Emotion research suggests there is an appraisal of situational cues and labelling before an emotion is experienced (Lazarus 1982; Lazarus et al 1980; Smith & Ellsworth 1985). This appraisal may be a pre-conscious decision about the allocation of resources. 'What allocation of resources is this situation worth?' is the question. The decision might be to cognitive shift down a gear. Feedback tells us if an action was appropriate or not. That feedback could be felt as emotion. The apparent erosion of judgment or any cognitive regression thus may be intended rather than merely symptomatic.

Nowlis (1966) provides some support for such a gear-shifting metaphor. He found boredom highest just before lunch and at the end of the working day. This is when expectations of the shift end must be in mind (also found by Wyatt et al 1937). Leary, Rogers, Canfield and Coe (1986) suggested that boredom occurs because of attending to stimuli that are not intrinsically captivating. The level of boredom experienced then should be a direct function of the cognitive effort required to sustain focused attention on the uninteresting stimulus. A difficulty then might arise when an individual must shift up a gear to tackle some more demanding task. If there is any inertia in the system, instantaneously available capacity may be insufficient to meet demand and apparent errors of judgment occur. For a period, behaviour could become erratic, and possibly even random.

The collapse of ordered behaviour is known to occur with the imposition of excessive levels of information input. It is reasonable to suppose that 'excessive' is a relative term. Given a boring situation, adaptation may so reduce attention that even minor loads become excessive. The prediction is (this is pursued later in the experiments) that failures will occur when a load follows immediately after a period of underload. This decrement can be imagined to apply a local stress, and might relate directly to individual ability to organise inputs and behaviour generally.

These conjectures about the etiology of accidents are extremely difficult to justify empirically from records. One difficulty of investigative work is the heavy reliance on the witnesses' and actors' accounts and their post-hoc explanations for their behaviour. The reasons they give for their actions may not be the real reasons but merely explanations. Indeed, for a reason to be a real reason in anyone else's estimation, the interpretative systems of both participants in that dialogue must, to some extent, overlap (Taylor 1987b). The same logic may hold within, as well as between, individuals.

Following an accident, experts are highly motivated to explain it away in terms of external and meaningful factors. It is common in the aftermath of an accident to hear someone say, "Yes, I did that, but don't ask me why". Later a perfectly rational explanation may be generated (Bryant et al 1988). Dyer-Smith (1988) found that expert interpretations of accidents tended to converge rapidly to a group consensus. It was only immediately following an accident that experts would admit confusion. The need to appear to have been, if not in control of the situation, at least in control of themselves, is very strong. Facts are rearranged or invented to fit the preferred type of explanation (e.g., an engineering explanation for engineers). There is no necessary dishonesty here. The memory of disordered and random behaviour is very short indeed, and recalled mainly as a sensation. Inevitably the written record and testimony of accidents reflects these later rational appraisals. The breakdown of ordered behaviour has been examined experimentally.

Isaac and O'Connor (1969) examined the loss of an acquired skill under load (following Jaques 1956a; 1956b). They investigated the relationship between an individual's ability to organise their behaviour under stress to their level of capability. The capability argument is a complex and contentious one that cannot be pursued here, but in brief the Jaquesian model is similar to Piaget's (1950), though applied to adults. It is a stage theory that proposes that capability, unlike intelligence, is not cumulative. The more capable do not merely have more ability, they have quite different ability. The mode of collapse of ordered behaviour might be gradual for some but catastrophic for others.

Susceptibility to error is just one of a host of unfortunate behaviours associated with boredom. The list of such behaviours is very long and indeed Brissett and Snow's (1993 p237) catalogue of them is arguably too comprehensive. A construct can be so all-encompassing that it appears to exclude nothing and so looses its explanatory power.

Chapter 3: Boredom and the environment

Situations, real or imagined, certainly contribute to boredom genesis. Popular explanations tend to blame the environment; it is unstimulating situations that make us bored. Many psychologists have taken a similar line.

Underload and boredom

Certainly low stimulation activity (e.g., inspection duties, vigilance tasks) is associated with reported boredom (Cox 1980; Davies & Parasuraman 1982; Davies, Shackleton & Parasuraman 1983; Smith 1981; Thackray 1981). However such situations are also constraining. It is not clear which facet, low-stimulation or high constraint, is the more important. Automation has amplified both. Graeber (1989) thinks automation produces the conditions ideal for performance atrophy on the airliner flight-deck: "The only remaining flight-deck duty (90% of the time) is monitoring". The pilot may still choose between computer suggested alternatives but fatigue and boredom also impairs the ability to choose appropriately.

Engaging tasks that are high on 'skill variety' should be the least boring (Hackman & Oldham 1980). Restricted 'skill variety' is a similar notion to Fisher's (1987) 'qualitative underload'. Fisher studied narrative reports of incidents of boredom on and off the job. She found three main causes of boredom: quantitative overload, variability of task demand, and qualitative underload. The latter is the most important (reported in 55% of cases). Qualitative underload following high levels of activity was a particular problem. Absolute load is not key. The nature of the load compared to prior experience is.

Caplan et al's (1975) work neatly knits together the conclusions of Fisher (1993) and Hackman and Oldham (1980). Caplan et al found a weak though significant negative (r = -0.20) correlation between self-report of boredom and qualitative underload and a stronger negative correlation (r = -0.59) between such self-report of boredom and perceived under-use of skills. However the correlation of two sets of self-report items is not telling evidence.

The popular belief that higher capacity people are more prone to boredom implies the qualitative underload argument. Any task should tax the less able more than the able. The able should experience qualitative underload. There is some limited evidence that the more intelligent have a problem with boredom (London et al 1972; Thompson 1929). Negative correlations have been found between boredom susceptibility and IQ (Robinson 1975), education level (Drory 1982), and ability test scores (Fogelman 1976). Bill (1923) found turnover on repetitive clerical jobs highest among the most intelligent and lowest among the least intelligent. But finding better work may just be easier for brighter workers.

Drory (1982) used military rank, education and intellectual activities as proxies for capacity. These proxies did correlate positively with self-reported boredom but that could have easily been an artefact of self-report. Admitting satisfaction with dull activities might, given prevalent stereotyping, suggest unintelligence. Drory admits this possibility (p145).

Underload is a significant consideration in job design (Hackman & Oldham 1980; Sims, Szilagyi & Keller 1976), but few have attempted to assess underload directly (Sales 1970 and Shaw & Weekley 1985 are the exceptions). Only the extreme case of underload -- sensory deprivation -- has been thoroughly examined.

Overload and boredom

Qualitative over-load may produce boredom when a task is too difficult for the person involved. A lecture on particle physics might bore a psychology student because it was incomprehensible. Underload and overload arguments fit well with 'optimum challenge' arguments (Csikzentmihalyi 1975; Buck 1988; Deci & Ryan 1985; Locke & Latham 1990; White 1959).

Boredom and company

When a task is unstimulating, other things become important. Boring situations are more tolerable if the company is good. But not all company is good company. Some people have a talent for boring others. They do, as Gravino quips, "deprive you of solitude without providing you with company". What makes a person boring is unclear, but being uninteresting, unfriendly or uncommunicative 'helps'; so too does banal or egocentric conversation or a slow and unemotional delivery (Leary et al 1986).

Boredom at work

The desire to keep workforces performing close to peak levels has driven work-based research. Increased output without increased reward is *motivation* in management-speak. Involvement is a way of achieving that output.

Absence of involvement is characteristic of boredom. The emotional parts of life give us the most pleasure according to Balchin (1947). The absence of emotional involvement in work creates, in his view, a personality that is a study of frustration saturated with repressed fantasies. Selling your labour in such circumstances is selling your life. An aggressive reaction is understandable, perhaps even appropriate.

Interpretation of the environment

The situation cannot be entirely to blame for boredom. A situation may be objectively stimulating yet not interesting right now (Hill & Perkins 1985). Sensory monotony may not be necessary for boredom to arise. The perception of a situation as monotonous may be both sufficient and necessary (Perkins & Hill 1985). Perkins and Hill distinguish monotony from boredom. This distinction is not always clearly made.

Whether we label a situation 'interesting' or 'dull' may depend on the quality and quantity of the constructs we employ. Those using more and finer distinctions on a rating task (e.g. employ more complex schemata - Linville 1982) become less bored. The conclusion is probably tautological -- monotony implies lack of variety -- but it also explains why the incomprehensible is boring. If we cannot construct a schema we become bored.

We may be label a situation 'boring' because we do not understand it or because we decide "there is nothing in it [this activity] for me" (Locke & Latham 1990 p239). Perhaps there is a genuine choice involved. Schema complexity could be a product of the choices we make in focusing our attention.

Content of thought is linked to current concerns (Klinger 1977, 1987; Klinger, Barta & Maxeiner 1980). Klinger et al suggest that 'pre-attentive gatekeepers' screen in cues related to current concerns and screen out others cues. So even if a job is normally interesting, current concerns can create attentional difficulties. The Klinger model implies that important 'executive' functions are going on beneath the level of consciousness.

This author has personal experience of this phenomenon. In one case, a large and respected oil major had suffered a doubling in the monthly accident rates aboard ship immediately following the announcement that they intended to move fleet 'offshore'. This corporate sleight-of-hand is the process by which ships are registered in states who provide the 'convenience' of low or no regulation of safety and crew conditions. In another case, a large engineering company suffered a spate of expensive accidents to power station turbines as these were moved by crane around an engineering works. The increase in accidents coincided with the spread of rumours about forthcoming redundancies among the crane drivers. Current concern is a better explanation than incompetence, though sabotage is also possible.

The attentional difficulties typical of boredom have been linked to a variety of deficiencies and aberrant behaviours (see Bercher & Kanter's 1984 review). Links have been made to reading disability, hyperactivity, mental retardation, sensory impairment, neurological impairment, behaviour disorder, schizophrenia and depression. The link to depression is particularly interesting. The symptoms of boredom bear a striking resemblance to those of low level depression. Whereas a mentally healthy person "is often viewed as having an interest in, and engaging with the environment," (Warr 1990) the depressed and the bored are both disengaged. It could be that the underlying causes of both boredom and depression are identical but the expression of feeling varies with personality. Boredom has been linked to extroversion whereas depression is more commonly associated with introversion. The chances are that depression and boredom both result from an interaction between personal and situational factors. It is quite possible that there are biological underpinnings to both. Sensitivity to stimulation might be such an underpinning.

Depression has many facets. Byrne and Baron's (1994) analysis of the *Beck depression inventory* (BDI) suggests both its first order and second order factors relate to boredom. Could depression and boredom be different points on one continuum? Fromm (1977) puts it this way: "Boredom [is] in a dynamic, characterological sense ... a state of chronic depression". However other evidence suggests otherwise. Although boredom proneness scores do significantly and positively correlate with depression (Farmer & Sundberg 1986; Sundberg, Latkin, Farmer & Saoud 1991), they appear to be distinct constructs.

Ahmed (1990) measured depression with the MMPI (Hathaway & McKinley 1967) and personality with the EPI (Eysenck & Eysenck 1968). Their conclusion is that bored people are unhappy but not depressed ($r = .31$ EPI with MMPI).

There are states of boredom that may be quite independent of the environment. Pathological boredom (Bernstein 1975; Fenichel 1951; Gabriel 1988; Hamilton 1983) or hyper-boredom (Healy 1984) are so described because they appear to be independent of prevailing conditions. How do such states come about? The consensus is that such boredom is the outcome of a repression or failure to develop a capacity to focus attention normally and find stimulation in the environment.

Chapter 4: Boredom and stimulation

A situation alone does not cause boredom. Our reactions to a situation may be more important than the actual level of stimulation. On the one hand boredom is said to arise when an unstimulating environment leads to low arousal (Barmack 1937: Fiske & Maddi 1961; Geiwitz 1966; Hebb 1966). On the other hand low stimulation can apparently lead to high arousal intended to restore an optimal level of stimulation (Mikulas & Vodanovich 1993). The latter hypothesis is intuitively more reasonable. If a task is unstimulating then it seems logical that additional or different stimulation should be sought (Bryant & Zillmann 1984; London et al 1972; Scott 1966). This, Berlyne (1960) argues, is the function of play. Play sustains a high level of stimulation. Subsidiary behaviours such as daydreaming, singing, and talking may do the same (Kishida 1977). It may be logical that low stimulation should lead to compensating activity but it is not always true. The literature of arousal is replete with such contradictions.

Csikzentmihalyi (1975) found that many people cannot always engage with compensating actvity when nothing interesting is going on. 'Flow' is Csikzentmihalyi's word for the feeling we get when we are engaged. He deliberately deprived his subjects of that 'flow' feeling but offered them plenty of opportunity for compensating activity (deliberately unstimulating reading). His volunteers were unable to read; they found it impossible to concentrate. They had nothing to do and could do nothing.

Csikzentmihalyi concludes that when our mind is constrained not to wander at will and fantasise we have great difficulty in focusing it on anything. Fantasy can enhance internal stimulation. The 'pathologically bored' (Fenichel 1951) cannot even use fantasy to escape from boredom.

The different ways people use stimuli may determine their relative susceptibility to boredom. The idea that individuals respond differently to the same sensory stimulation is central to reducer/augmenter theory (Petrie 1967). Herzog and Weintraub (1985) argue that incoming stimulation is treated in two different ways by individuals depending on their internal needs. An *augmenter* is someone who consistently enhances (augments) incoming stimulation; a *reducer* consistently diminishes it. The *augmenter* augments stimuli because they are (relatively) under-stimulated. The *reducer* reduces stimuli because they are (relatively) over-stimulated.

Petrie used kinesthetic after-effects to measure the *augmenter/reducer* dimension. The procedure involves feeling an inducing block and then estimating the relative width of a test block. The measure of the trait -- *augmenter/reducer* -- is the width estimate. An *augmenter* over-estimates the test block's width; a *reducer* under-estimates it.

There have been severe criticisms of the kinesthetic after-effect technique (Herzog & Weintraub 1977; Morgan & Hilgard 1972; Morgan, Lezard, Prytulak & Hilgard 1970). However Herzog and Weintraub (1985) argue that the *augmenter/reducer* idea is still useful. Performance on the Petrie task correlated well with four personality indexes found in the questionnaire they developed.

It is possible that so-called *time-order errors* or TOE (Hellstrom 1985) deteriorate the accuracy of the Petrie process. Two TOEs have been studied; the Kappa and Tau effects (summaries in Lechelt & Borchert 1977; Jones & Huang 1982; Huang & Jones 1982). When a series of stimuli become physically closer the perceived time between each gets longer (The Kappa effect). As stimuli become more frequent the perceived physical distance between them shrinks (The Tau effect). The Tau effect could distort kinesthetic after-effects.

TOE seems reliably detected, though some are scathing of the TOE idea: "the name [time order error] like the one given to the Holy Roman Empire, is a misnomer in all particulars" (Steven quoted in Hellstrom 1985 p36).

Petrie and others (Davis, Cowles & Kohn 1983; Zentall & Zentall 1983) argue for a centrally located *stimulus intensity modulator* that adjusts the incoming stimulus to the optimal level. Robertson, Gillespie, Hiatt and Rose's (1977) evidence supports this thesis. They found that *reducers* reported a cycle ergometer exercise significantly less stressful than *augmenters* although no physiological difference in exertion or fatigue could be measured. Such a *stimulus intensity modulator* must have executive as well as monitoring components.

Larsen and Zarate (1991) argue that "reducers should seek out more intense stimulation so as to compensate for their generally unstimulated condition". They concluded that *reducers* are under-stimulated (as extroverts are believed to be). *Reducers* need stimulation and abhor inactivity. Larsen and Zarate do not discuss the complementary hypothesis that *augmenters* should avoid stimulation because they are relatively over-stimulated. Larsen and Zarate cite Barnes (1976) in support of their case. Other approaches are similar (e.g., extroversion - Eysenck 1967; reactivity - Strelau 1987; strength of the nervous system - Zuckerman 1987). Larsen and Zarate, however, make the novel, and intriguing, proposal that emotion itself may be manipulated by the individual to serve the stimulation requirements of that individual. We may deliberately get excited to make what we are doing more exciting.

Larsen and Zarate's subjects did a boring task and then chose an activity to follow. The priming task was certainly boring. One subject fell asleep. The post-priming choice was between one task billed as 'emotional negative' and another described as 'somewhat negative' (if the label 'positive' had been used everyone would have chosen that option). Larsen and Zarate measured the dimension *reducer-augmenter* with a questionnaire (derived from Herzog & Weintraub 1985). Those choosing the negative, emotion-inducing task scored more in the *reducter* direction ($p < .05$).

Larsen and Zarate's key results are unconvincing. However, they also looked at reaction time (RT) on the boredom inducting task and found a moderate correlation between the RT and the evaluation of how 'interesting' the task was. Embedded within that result, but scarcely discussed by them, is a most interesting finding (Table 1 p716). There was a marked between-subject difference in estimates of the duration of the boring induction task. The task was 35 mins long. Those who opted for the negative experience afterwards had under-estimated the duration of the task by a mere 2.4 mins (-6.8%). Those who elected for the more sedate option underestimated it by 13.6 mins (-38.9%). The actual figures were:

	Stimulation choosers	**Others**
Estimate(mins)	*32.6 (S.D.=9.22)	*21.4 (S.D.=7.9)

* $p \leq .001$)

Table 4.1: Subject differences in duration estimates of a boring task (from Larsen & Zarate 1991).

If time drags when we are bored then estimate of the time we took to do a task may indicate how bored we got. This idea is the central idea in London and Monell's

(1974) experiments (discussed in chapter 2). It looks like Larsen and Zarate's *stimulation choosers* were also bored; no surprise given how boring the induction task was. However the *stimulation choosers* were also more variable in their time estimates. That is interesting. Time distortion may more complex than mere exaggeration.

Given the contradictions in the arousal literature it is not surprising that workplace attempts to increase involvement have had patchy success. Providing extra, external stimulation appears to alleviate boredom only in low complexity tasks (Gardner 1990). One personal way of increasing stimulation, without increasing the amount to be done, is to vary the pace of working (Runcie 1980). The bout-working style of some students might be an example of this tactic. By starting work near to a deadline and attacking it as one large enterprise, stimulation may be kept high for a period. According to Hill (1975) this tactic is favoured by extroverts.

Helping others at work may provide social stimulation (Morris & Reilly 1987; Schaller & Cialdini 1988) and alleviate our boredom. The down-side, as Kiechell (1984) points out, is the way some bored executives annoy by 'micro-managing' their subordinates. Theft, unsafe behaviour, and sabotage can also be explained as individual efforts to increase stimulation. One of Molstad's (1986) subjects explained the sabotage impulse thus: "It's so dull out there I'd just like to make something happen, to have something interesting to do or see".

Boring situations can provoke varying reactions. Stimulation theories alone cannot explain the range and complexity of individual responses. Extra stimulation may be sought or it may not be sought. Sensation itself may be modulated directly or indirectly by manipulating the emotions. Time itself can be distorted.

Chapter 5: Time sense and boredom

Boredom arises over a period and the feeling is intimately connected to the perception of the passage of time (James 1908 p.284). We may have become more sensitive to the passage of time as time has come to dominate the running of industrial society. That may have made us more boredom prone too.

Many languages, perhaps most, now have words for boredom (e.g., taedium, ennui) but boredom is a relative recent addition to everyday, English vocabulary. Boredom is not an entry in Dr. Johnson's 18th century dictionary. Colloquial use begins with the industrial age.

With the industrial age, work became machine-paced and wages were paid by the work-hour. Societal noise (Klapp 1986) increased with the pace of life. The conditions were ripe for boredom to become "probably the most difficult and pervasive problem facing advanced industrial societies. And the more advanced the society, the more advanced the boredom" (*The Economist* quoted in Guest et al 1978). Time-urgent, sensation seeking behaviour has been legitimated, exaggerated and encouraged (Kass & Vodanovich 1990). We have come to expect and to need our days to be action-packed.

Our needs, expectations and perceptions are probably more important than the real passage of time. Time and longing often feature in words for boredom. In German boredom *langeweile* is literally 'a long time' and *kurzeweile* (to frolic) is 'a short time'. Time flies when we are having fun. Time goes on and on when we are bored.

Hozier (1988) describes how the flow of subjective time is apparently arrested for bored psychotherapy patients. Normally we see time as one stream flowing naturally from the past into the here and now, and on into future. For the bored patient the present seemed to stand still. In the absence of external stimulation adaptive people may relieve boredom by creating their own internal stimulation. Hozier believes bored patients experience the need to do these things, but are somehow inhibited in action (Waugh 1979 uses a similar argument).

Brissett and Snow (1993) distinguish two types of boredom. Some quality of the time experience is lacking in both. Either the 'sense of momentum or the 'sense of control over the future' is missing. There are some similarities between Brissett and Snow's 'sense of momentum' and Csikzentmihalyi's 'flow'. Both ideas are different to the swing or rhythm sometimes experienced in work that Baldamus (1961) termed 'traction'.

Traction for Baldamus was the opposite of distraction. It was a feeling of being pulled along by the inertia inherent in a particular activity. Runcie (1980 p108) describes traction thus; "Once the worker has the rhythm of the job it is not nearly so hard to do it as it is to describe it. You become adapted to the flow of the job and begin to find other things to do with your mind". Traction for Runcie permits distraction. Flow (or sense of momentum) is a more positive sensation of being in tune with an activity.

For Brissett and Snow (1993) this tune has a rhythm. A rhythm is a rhythm because it is patterned. But if a rhythm is totally predictable it is boring. Both the 'sense of momentum' and the 'sense of control over the future' are features of a satisfying, rhythmic experience. Hartocollis's (1972) view is similar. He suggests that boredom is not only a disturbance in the sense of time, but of the inability to synchronise attention with the activities of the environment (i.e.. to attune to the rhythm). Such difficulties are typically schizoid (Csikzentmihalyi 1975).

Brissett and Snow suggest that it is the experience of non-involvement in the social rhythms of life that gives boredom its blandness (e.g., unemployment - Jahoda et al 1971). On the other hand, if a person is fully entrained by a social rhythm, but has no control over events, boredom is still likely to result. Work on production lines is like this.

A good rhythm remains essentially the same but varies somewhat. Both predictability and variability are key issues in workplace boredom. The earliest studies (Wyatt, Langdon & Stock 1937 discussed in Shackleton 1981) showed boredom was associated with increases in the variability of the time taken to complete cycles of work. Wyatt et al studied work output curves produced under various conditions of boredom and fatigue. They thought the shape of these curves might be a reliable indicator of boredom. Though output falls over time it rises towards the tail end of a period of boring work. They linked the rise to pleasant anticipations of the impending end to the work. Shackleton (1981) criticises Wyatt et al's methodology (e.g., it is not clear that all workers were doing the same task) and points out that others (e.g., Smith 1953) have failed to replicate their findings. Shackleton (1981 p31) concludes that "there was insufficient evidence to warrant the conclusion that there is a curve of output uniquely associated with boredom".

Chapter 6: Boredom as a defence

Attentional difficulty could be a reason for boredom rather than an effect of boredom. Becoming bored could be a strategy for dealing with attentional difficulties. The bored often claim they want to do something, but do not know what that something is. They only know that it is not what they are doing now. To psychoanalysts this suggests that boredom involves some defensive damming of unfulfilled longing. Such damming is blatant in some types of boring work. A watchkeeper's desire to sleep is thwarted by sense of duty or fear of consequences. This is the simplest case. Here there is conscious awareness of the conflict. However conflict may be unconscious.

Fenichel (1951) sees in boredom a wish confronting a threat, and being partially dammed. The damming cannot be complete since the unpleasantness remains. A stand-off results. Nothing happens; neither fantasy nor action. The instinctual tension is present; the instinctual aim is missing. Waugh (1979) in a similar vein sees fantasy and fear in the bored holding each other in balance, while the individual lacks the courage to face either. Psychodynamic interpretations are richer in explanation than evidence but there is clearly an auto-aggressive flavour to the language of boredom. 'Boring' has obvious destructive connotations (e.g., boring into). The bored talk of 'killing time' as if time was an enemy. Bored mariners refer to life aboard ship as 'deadtime' (Dyer-Smith & Stein 1993).

Fenichel's (1951 p292) claims that "the central problem of psychology of boredom is the inhibition of both the drive to activity, and the readiness to accept the craved activity". Fenichel (p296) describes libido as somehow prevented from being invested in reality and turned on the self (counter-cathected). Hozier's (1988) argument is similar.

In brief, the psychodynamic view of boredom is that it is a form of repressive defence, and thus the product of some deep, subconscious purpose. Boredom is indeed, on occasion, functional. It 'worked' for the inmates of the concentration camps and still works for the long-term unemployed. There is sense in rejecting hope when hope is hopeless. For hope in a hopeless situation may lead to the extremes of despair and depression when hopes are inevitably dashed. Boredom may be a first line of defence. That defence can fail and crushing alienation invade. Alienation is possibly an extreme, pathological form of boredom. The ordinarily bored blame the environment for their troubles and feel superior. The alienated and depressed blame themselves and feel inferior. Defences have failed. The consequences may be dire.

Alienation involves a corrosive sense of meaninglessness. Boredom may be a way of giving meaning "to an otherwise meaningless event" (Askins 1980 p136). By being bored we can communicate to others that we are above a particular type of involvement. Boredom might have particular role to play here precisely because it is so commonplace yet ill defined. It can provide both a motive and an explanation for otherwise meaningless behaviour. Thus boredom is used to justify teenage car-theft, vandalism and minor social infringements such as a forgetfulness (Hoover 1986). These behaviours could be meaningless.

Boredom is popularly believed to be particularly acute among teenagers. Age does appear to correlate negatively with boredom in adults (Smith 1955; Stagner 1975). Spitz (1937) believes boredom begins to appear around 3-5 years. If boredom susceptibility does begin then why should it not peak in the teen years? It could just as easily be that boredom as a distinct emotion only becomes fully discriminated from other proximate emotions in the teen years. However at any point of development the label employed to describe an emotional experience is not that experience. The experience may outgrow the words use to describe it.

A heightened need for stimulation in teenagers could explain their boredom. Equally the diagnosis of boredom may be particularly useful in the teen years. This period involves crises of adjustment for everyone. The older generation might explain otherwise inexplicable teenage behaviour as being caused by boredom. The teenager struggling to make sense of their own inexplicable behaviour might invoke boredom as an explanation acceptable to his/her elders.

Boredom may be a maligned emotion. It serves us well as a form of communication and as a defence against the extremes of depression, alienation and meaninglessness. It is an antidote to both nothingness and societal noise (Klapp 1986). The unpleasant sensation may signal that subconscious defences have been activated and are doing their work effectively. When boredom fails depression threatens. Beneath boredom is the pit of apathy.

Chapter 7: Individual boredom proneness

Boredom clearly involves some interaction or adjustment between individuals and the situations in which they find themselves. Some principally blame the environment for boredom others see the putative trait of boredom proneness as more important. Viteles's (1932 p547) position on workplace boredom is clear; "In the final analysis, it is to the susceptibility of the individual, and not to the task that the responsibility for the feeling of boredom must in large part be ascribed".

Wyatt et al (1937) disagree. They claim boredom is task dependent. Workers were bored by some processes, but were comparatively free from boredom when employed on other types of work. However Shackleton (1981) is critical of Wyatt et al's measures. Later, considering industrial inspectors and examiners, Wyatt et al claim (quoted in Shackleton 1981) that some individuals are inherently incapable of maintaining uniform attitudes for any length of time. This latter conclusion appears to contradict their earlier one that boredom is task dependent.

There is some evidence for a boredom proneness trait (Thackray, Bailey & Touchstone 1977; Stagner 1975). Thackray et al distinguish 'high boredom' and 'low boredom' groups in air traffic controllers. Stagner thinks routine factory work gives particular individuals severe mental problems. Stagner quotes one of Kornhauser's (1965) assembly line respondents; "When you're there 23 years, you get fed up with the monotonous routine. We've had some men crack up".

Who might be the boredom prone? Suggestions include the insecure; the easily led; those with low levels of creativity; those who are impatient with time (Herman 1984); the incompetent at maintaining and discovering interesting ways to spend time (Farmer & Sundberg 1986); the non-assertive (Tolar 1989). Tolar predicted and found several correlates of boredom proneness (Table 7.1):

	Pearson's r	**Significance**
Assertiveness	-.41	$p \leq .001$
External locus	+.20	insignificant.
Length of Sleeping periods	+.25	insignificant.
Alienation	+.28	$p \leq .02$

Table 7.1: Correlates of boredom proneness (after Tolar 1989)

Younger male, extrovert, intelligent workers are said to be more susceptible to the experience of boredom than others (Hill 1975; Smith 1955; Stagner 1975). Many others have suspected that vulnerability to boredom is an aspect of personality that is stable across time and space. Thus extroverts are said to be more easily bored by monotonous tasks than introverts (Davies & Hockey 1966; Drory 1982). The explanation offered is that extroverts need more external stimulation to maintain optimal levels of arousal (Eysenck 1967) and therefore are more likely to be bored than introverts (Ahmed 1990; Davies & Parasuraman 1982; Gardner & Cummings 1988; Guest et al 1978; Hill 1975; Smith 1955, 1981). These findings are scarcely surprising and perhaps tautological. If extroversion means anything at all it must include a tendency to be concerned with, and derive satisfaction from, the physical and social environment (Reber 1985). Similarly the introvert's preference for relatively unstimulating environments follows from the definition of an introvert.

A typical extrovert, according to Eysenck (1965), is someone who has "a kind of stimulus hunger". Eysenck claims this is why extroverts smoke more. McManus and Weeks (1982 p355) concludes, in a study of smokers, that a single personality dimension relating to stimulus hunger (at least in the Eysenck & Eaves 1980 sense) "seems difficult to sustain in the light of present evidence". Their view was that the hunger was for alternative stimuli rather than more of the same stimuli (Greenwood 1953).

Given the supposed nature of extroverts, the real surprise is that the research results have been mixed and not incontestable. The most reliable finding is [probably] that extroverts have better strategies for dealing with boredom (e.g., they seek out stimulation). Biases in information-processing might be important here (Matthews 1992).

Extroverts appear to do better under stressful or arousing conditions than introverts (Corcoran 1972). Unfortunately this effect may reverse in the evening (Revelle, Humphreys, Simon & Gilliland 1980) and seems task dependent. Tasks requiring low level encoding show the effect and higher tasks do not (Matthews, Davies & Lees 1990). Matthews (1989) saw extroversion as a higher order factor involved in the control of the relationship between arousal and cognition. That relationship might be qualitatively different in extroverts and introverts. The proposition of a higher order effect is interesting whether one subscribes to trait theory or not.

Trait theory has been contentious throughout its long history. The core difficulty (Deary & Matthews 1993) has been whether a purely factor analytic justification for facets and scales is acceptable. The connection between questionnaire items may only reflect their semantic similarity. The problem is especially acute when two supposed traits, such as extroversion and boredom proneness, are being considered. One may easily subsume the other. This is why Kline (1992; 1993) argues that all personality factors must be identified, not from their factor loadings but from their correlations with external criteria. Deary and Matthews (1993) believe Eysenck's factor E is reliably associated with greater resource availability, and readiness to respond, which are both negatively associated with boredom.

The two central assumptions of traditional trait theory rest uneasily with mainstream research into boredom. These two assumptions are named 'causal primacy' and 'inner locus' by Matthew et al (1990). Causal primary has causality flowing from the trait to behaviour. Thus because you are an extrovert you behave in a certain way. Inner locus captures the idea that core personal qualities are often latent rather than manifest. Irrespective of whether these assumptions are reasonable elsewhere, there are no grounds [as yet] for accepting them in the boredom case.

If personality is merely treated as a useful idea then the problem of integrating trait theory with boredom research is less acute. Personality is an abstraction like the equator. However the idea of personality as a real thing is deeply embedded in popular consciousness. Even fictional characters are happily described in trait terms.

Some elements of the dimension extroversion-introversion are useful in discussing boredom. *Distractability* is one such. According to Kagan and Rosman (1964) *distractability* is higher in extroverts . The *distractability* of the extrovert is like the poor hearing of the partially deaf. Everything must be played at high volume to be heard by extroverts.

There have been several attempts to assess boredom proneness directly. One sub-scale of the *Sensation Seeking Scale* is named *Boredom Susceptibility* (Zuckerman 1979; Zuckerman, Eysenck & Eysenck 1978; Zuckerman, Kolin, Price & Zoob 1969). Farmer and Sundberg (1986) developed a trait measure they call the *Boredom Proneness Scale* and related scores on it to performance on a simple repetitive task.

These scales do not appear to measure the same thing. Ahmed (1990) found Zuckerman's scale did not correlate significantly with Farmer and Sundberg's.

Furnham (1984) found a slight, but significant, positive ($r = .18$) relationship between scores on Zuckerman's *Boredom Susceptibility* sub-scale and *Type A* scores. The relationship is as expected since *Type As* are impatient by definition (Kass & Vodanovich 1990; Smith 1981).

Farmer and Sundberg's (1986) *Boredom Proneness Scale* uses a typical battery of self-report questions, but it is not clear that they tell us anything more useful about boredom proneness than the direct question "Do you get bored easily?". To say with confidence how boredom prone someone might be would require us to place them in a potentially boring circumstance and measure how bored they actually become. Tsuda's (1988) delightful and ingenious experiments on task irrelevant behaviours demonstrate how this might be done.

Tsuda placed subjects in a swivel chair that was wired to record their involuntary movements during vigilance tasks (Francis Galton had used involuntary 'fidgets' in the audience of *Royal Geographical Society* meetings as a measure of boredom). Tsuda found that involuntary swinging of the chair was more pronounced in a low attention task than in a high attention task. It could be that involuntary activity is absorbing some excess capacity within the low attention part of the task, when a signal is expected but not present. Task irrelevant behaviours might thus be important in the maintaining appropriate levels of arousal without incurring the cost of boredom. If so then external control of such behaviours should increase felt boredom and depress performance. The implication is certainly there in Tsuda's work, but neither he, nor anyone else [to this author's knowledge] has conducted such an experiments.

Workplace studies often look to enhance task relevant behaviours and suppress task irrelevant behaviours The managerial 'need for control' can overwhelm even an alliance of common-sense and research knowledge (Bell 1975: Brehm & Brehm 1981; Ryan 1982). If task subsidiary behaviour interfere with task performance then they may be thought important. But the trivial may be more important than that.

There have been many attempts to link boredom susceptibility to personality and to individual ability. The evidence is equivocal. Perhaps there is a boredom proneness trait. Perhaps the more able do become bored more easily. The personal observations and accident experience of this author suggested an alternative hypothesis. Perhaps individuals at any level of capability become less able as they become bored.

Chapter 8: Boredom as emotion

Is boredom an emotion? Smith and Ellsworth (1985) and Russell (1980) offer evidence that boredom is a distinct emotional state not an aspect of depression. Many support this view (Farmer & Sundberg 1986; Sundberg et al 1991; Ahmed 1990; Izard 1977; Plutchik 1980; Scherer 1984; Tomkins 1962). However the fact of consensus resolves little. For as Reber (1985) puts it "[emotion] has proved utterly refractory to definitional effort: probably no other term in psychology shares its non-definability with its frequency of use".

Theories of emotion cover the entire range from the linguistic and socially constructed (Hayes, Conway & Morris 1994) to the physiological and neurological (Pribram 1984; Whybrow 1984; Davidson 1983; Pansepp 1982). Darwin (1872) argues that basic emotions are shared by all cultures. Even today his questionnaire study of missionaries and 'protectors of aborigines' although small (36 replies) seems a model of rigour and insight. Darwin's concludes that "the same state of mind [emotion] is expressed throughout the world with remarkable uniformity". Darwin thought animals experienced emotions. Others disagree. Waugh (1979) quotes Revers (1956) and Bilz (1960) in support of his claim that only humans can suffer boredom since only we have a sense of time. There is some danger in such anthropocentric arrogance.

Plutchik's (1980) model of the eight basic emotions places 'boredom' close to 'loathing' and 'disgust', but milder and in the direction of 'annoyance' and 'pensiveness'. Johnson-Laird and Oatley (1988), however, do not include boredom among their six basic emotions (these correspond roughly to happiness, sadness, fear, anger and disgust). This is peculiar. Boredom clearly passes their linguistic test for 'basic-ness'. Basic emotions, in their view, are felt, but cannot be dis-aggregated. They meet the conditions "I feel x but I don't know why". For Johnson-Laird and Oatley 'anger' is basic and 'gladness' is not basic because we may say "I feel angry but I don't know why", but it is odd to say "I feel glad but I don't know why".

Johnson-Laird and Oatley claim boredom is not a basic emotion. Yet people , unprompted by researchers' lists, frequently say "I feel bored but I don't know why". There is no need to theorise here about possible expressions that people might or might not use. The expression **is** used. Boredom must be a basic emotion within their framework. Ortony and Clore (1989) criticise the Johnson-Laird and Oatley model, particularly the linguistic test, but do not mention boredom as a glaring discrepancy.

Johnson-Laird and Oatley label boredom as complex (i.e., composed of a mix of more basic emotions). Boredom for Johnson-Laird and Oatley (1988) is a "complex [emotion]; mild depression as a result of feeling that one has no goals" (p110). The logic of their system demands that either boredom is basic or boredom is not an emotion.

Johnson-Laird and Oatley list 590 words that they believe pass the *Clore test* (Clore, Ortony & Foss 1987). Clore et al had subjects rate emotional terms. A genuine emotion they regarded to be one that you could both 'feel' and 'be'. Thus one may 'be happy' or 'feel happy'. We may 'feel ignored' but can only 'be ignored' by others. Happiness qualifies as a genuine emotion; being ignored does not. Since we can certainly 'feel bored' and 'be bored' on the Clore system boredom is an emotion.

If there are basic emotions, are there eight (Plutchik 1980); six (Johnson-Laird & Oatley 1988); two (positive and negative - as Ortony & Clore 1989 p136 suggest might be the "unpalatable conclusion" of the Johnson-Laird model); one (with the positive and negative on the same continuum); none (they are just words) or an infinite number (each experience being unique)? Perhaps the enterprise of disaggregation and labelling is doomed. Emotions may belong to that part of existence that "is beyond the power of words to define" (Lao Tsu).

Boredom could be classified as a mood rather an emotion. Some see moods as persistent emotions (Schwarz & Clore 1988). Boredom certainly extends over time. That may be one reason why it is so difficult to be precise about causes. We may not know why we are bored because we have forgotten why.

Here again a semantic morass beckons. Reber (1985) defines mood in exactly the opposite direction to Schwarz and Clore. Mood for Reber is a "relatively short-lived, low intensity emotional state". For Schwarz and Clore emotion is a short-lived mood. Mood, like so many other psychological terms, is used confidently in the literature. Its effects are measured and reported (e.g., mood-congruent memory). Reber says mood is "used freely". That is an understatement.

There is no unequivocal distinction made between mood and emotion and no agreement on the nature of either. Complex emotion may or may not be built up from more basis ones. The only thing that all emotions seem to have in common is valence and intensity (Hayes et al 1994). Lists of basic emotions are posted but there is no obvious position for boredom on any such lists.

Chapter 9: The language of boredom

The mood-emotion literature is confused and confusing. Linguistic analysis is more coherent and suggestive.

There are many more adjectives describing negative emotional experiences than positive. In the 590 emotional adjective list Johnson-Laird and Oatley (1988) offer around 60% of the words have negative connotations and 27% positive (the remainder are ambiguous). This difference is highly significant and suggestive.

Words discriminate between ideas. "All happy families are alike", says Tolstoy in the opening sentences of *Anna Karenina*, "Every unhappy family is unhappy in their own way". The diversity of unhappy families creates the need for an extensive vocabulary of unhappiness to describe the differences between them. Furthermore only those unhappy families need a sophisticated language of affect. The happy may not reflect why they are happy, but the unhappy certainly wonder they are not (Hayes et al 1995). The unhappy need more words than the happy. The unhappy have more to think about.

When we are happy nothing needs to be done. When we are unhappy something ought to be done -- but what? Action is useful only in situations where current conditions are unsatisfactory. A positive emotion may signal an excess of good fortune. There is no need to act (except perhaps in extremes - mania or euphoria might be dangerous). Fine distinctions in thought are useful as a prelude to action. The need to differentiate proximate negative feelings prior to action may have skewed our vocabulary in the negative direction.

Thus the language of emotion suggests that it signals a discrepancy between our expectations or needs and the state of the world. Emotion warns us that aspects of the environment must be attended to (Mandler 1982). The basic process might be one of 'nulling' (i.e., no discrepancy then no emotion). If emotions are 'calls to action' no purpose would be solved by 'calls to inaction' (Frijda's 1970 view is similar). Social context might well influence the attribution 'something must be done' or 'nothing needs to be done'. We might feel relative happy when others are depressed or alternatively adjust our feelings to feel less happy (as suggested by equity theory) so as not to be emotionally out-of-step with our miserable fellows.

Freud (1957 p120) advocates the nulling model. "The nervous system," he wrote " is an apparatus which has the function of getting rid of the stimuli which reach it, or of reducing them to the lowest possible level; or which, if it were feasible, would maintain itself in an altogether unstimulated condition". Freud describes a drive behind a process of adjustment. However, the language of boredom suggests that the feeling itself is a signal that advises adjustments be made. But what adjustments?

The language of boredom suggests that the adjustments boredom 'advises' are somehow connected to the allocation of mental resources. Boredom creates a sense of mental regression. Clichés express this feeling (e.g., I was out of my mind with boredom; bored silly; bored to death). Molstad (1986 p226-227) reports this experience of regression while working in a beer bottling plant.

"When doing this work I experienced strong feelings of mental regression. My fantasies became progressively more childlike ... it was only with some difficulty and effort that I could muster my consciousness to return to normal after hours of this work ... at times I even regretted going to the lunch-room on breaks because it required focusing my attention on the here and now."

If boredom is a prompt to adaptive action then 'satisfactory' boredom should be transitory. It should disappear once requisite adjustments have been made. However the bored do not necessarily act to alleviate their boredom. There is certainly doubt about the actions boredom might prompt.

Chapters 10: Boredom and appraisal

The attempts to categorise and define boredom logically are unconvincing. Linguistic analysis suggests boredom, and perhaps all affective experience, is a symptom or a signal rather than a state (this is also Brenner's 1953 view). Boredom may be "an alerting phenomenon that all is not well and something must be done. It cries out to us that 'attention must be paid' to the quality of our lives" (Gaylin 1979 p129 quoted in Brissett & Snow 1993). Prior appraisal (e.g., all is not well) is implicit in this view of boredom.

An appraisal is clearly an act of cognition; an emotion is a feeling. Emotion and cognition have been established in apparent opposition. For tracts of time, emotional thinking has been equated with faulty thinking (Mayer 1987). This divisive thesis is especially dubious since there is no consensus about the constitution of either emotion or cognition (Hayes et al 1994).

There have been many attempts to establish the link between the putative systems of cognition and emotion. On the one hand Oatley and Johnson-Laird (1987) and Ortony, Clore and Collins (1988) have suggested models for a cognitive theory of emotions. On the other Plutchik (1980) saw cognition evolving in the service of emotions. The argument about primacy has raged since the earliest times (James 1907; Cannon 1929) and is still with us (e.g., in the debate between Lazarus and Zajonc discussed in Scherer & Ekman 1984). The argument may be futile (Scherer 1984).

Some advocate an integrated level of analysis (Watts 1992). Cognitive processes and the responses they induce may occur simultaneously and be inseparable components of an affect (Schur 1969). It is only when this activity surfaces into awareness that it may be labelled. Thus emotional labelling occurs late. It is also the case that emotional sophistication appears relatively late in childhood development. Some argue that emotions are social constructs (Harré 1988: Armon-Jones 1988). But do words used to label emotions really describe the associated behaviours or merely interpret them (Bedford 1988)? Boredom may be used both to explain and excuse teenage vandalism (see chapter 6).

The emotion-cognition link has most obviously been investigated in a string of cueing experiments (Broadbent & Broadbent 1988; McCleod, Matthews & Tata 1986; Mogg, Matthews & Eysenck 1992; Seamon et al 1984), but with the mixed results described by Tuohy (1984). Cueing was evident in the experiments of Bower (1987). He showed that material learned in one mood is better remembered in that same mood later (mood is a tricky term -- see chapter 8). Matthews (1993) refutes mood and memory network theory (using evidence from Clark, Teasdale, Broadbent & Martin 1983). In particular the lexical decision task does not show the proposed effect (in this task a string of letters is presented -- a decision whether they represent a real word or not must be made). Mood congruent words should be more rapidly recognised; they are not. Parrott and Sabini (1990) however found better memory of happy information in sad subjects (mood incongruent effect). A theory of cognition-emotion must be able to explain these varying results. Matthews suggests a resource allocation explanation.

In the cueing experiment a decision between two locations is necessary (e.g., is a dot prompt present in one location or another). The mood congruent location is given priority. In the cueing case an appropriate allocation **must** be made. It is forced by the design. In a lexical decision making task there is no comparable dilemma. Matthews concludes that "emotional states control how processing resources are allocated within the cognitive system" (p494). The comparable conclusion in boredom case might be that the feeling signals the need for a re-allocation of resources. The fact that mood-congruent information is preferred in a cueing task suggests adaptation. Thus anxiety could prime us to respond effectively to danger by increasing sensitivity. Anxiety disorder, panic, depression and pathological boredom could be the price some people pay for this general evolutionary advantage.

Boredom may be a special case of emotion. Dullness and disturbance to the sense of time imply a cognitive element. However in boredom there is an obvious lack of both awareness and interest. "Yet on close examination the very self-consciousness and the very self-observation of the dulling of one's mind bespeak of cognition while the unpleasurable quality of the state of boredom signifies that we are in the presence of an affective state" (Matthews 1993 p515). Lazarus (1991) considers the cognitive component of emotion. He takes the strongest possible position on the role of appraisal [a cognition] in emotion genesis. He sees appraisal as a necessary and sufficient cause of emotion, whereas knowledge is necessary but not sufficient.

"There is a clarity and parsimony in taking the position that cognitive mediation is necessary for emotion to occur. Otherwise we are forced to consider two principles of emotion generation, one operating through cognitive mediation, the other producing effects neurochemically without appraisal" (Lazarus 1991 p356).

If the neurochemical explanation that Lazarus rejects here were accepted it would imply a mind-body, and possibly a brain-mind split. LeDoux (1989), a neuro-psychologist, accepts this split when he says "affective computations can be performed without the assistance of cognitive computations" (p271). An appraisal (cognitive computation) is not necessary.

For Ortony and Clore (1989) a feeling can only be an emotion if there has been an some prior appraisal. Lazarus and Smith (1988) discriminate between types of appraisal. Primary appraisal gives the experience; secondary the evaluation (Hayes et al 1995 suggest further appraisals occur in memory). The emotional name attributed to a feeling summarises the output of the appraisal system. Boredom thus may be a summary term that encapsulated the appraisal that whatever has been happening it has not been worth the attention we have been paying to it. (i.e., this is an unpleasant experience; it is unpleasant because it is boring).

Appraisal can be thought of as an evaluation of significance from a personal standpoint (i.e., no personal stake -- no emotion). "At the core of the emotional system is thus a mechanism for computing the affective significance of emotion" (Lazarus 1991 p357). Some appraisals are likely to be within our volitional control and others less so.

The relationships between cognition [appraisal] and emotion -- if indeed they are separate processes -- must be bi-directional. Lazarus et al's view was that the direction we prefer depends where we decide to stop the processes to examine them (Lazarus, Coyne & Folkman 1982). They see the arrow of causation pointing primarily from cognition to emotion whereas LeDoux (1989) and Ortony and Clore (1989) have it pointing in the opposite direction. Lazarus et al's view is more logical.

An action can clearly occur before the registration of emotion. We dive into a ditch to avoid an oncoming lorry without pondering the many alternatives. We tremble with fear later when we have time to appraise the experience. Nothing in the Lazarus thesis [this author believes] forbids the appraisal circuitry being pre-programmed and thus capable of responding very rapidly to the smallest cues. This essentially is the 'affordance' argument (Gibson 1966; 1979). We may in effect know instantly the answer to the question 'Is this good or bad for me?'. Recognition and appraisal may be simultaneous thus "short-circuiting" part of the evaluative algorithm (Wilensky 1983 p 24-25).

Leventhal (1984) argues that we recognise important patterns and evaluate their emotional relevance instantly by comparing them with templates in memory. The process is often too fast for us to have any awareness of how it occurred. Hebb (1969 p249-250) takes the extreme position that "all mental acts are in this class ... they are not reportable or known directly by the subject".

The issue of 'personal relevance' is peculiarly awkward where boredom is concerned. Boredom is a state where personal involvement appears to be extremely low if not non-existent. This is very odd. We can only retain the 'personal relevance' thesis if we imagine there is some personal issue at stake in boredom but its content is somehow repressed. This is a reasonable assumption. Nothing may be happening when we are bored but boredom is not relaxing. This suggests the emotion overlays a state of tension. It could be that boredom is symptomatic not only of an appraisal, but also of a particular type of defensive appraisal (e.g., as proposed by Fenichel 1951).

Boredom might be not just be a particular kind of feeling. It might be a particular kind of feeling we have for particular kinds of reasons.

Chapter 11: Summary of the confusion

All that is certain in literature of boredom is the confusion. Boredom has not been satisfactorily defined. It is even unclear whether boredom is a mood or an emotion. Since mood is not consistently discriminated from emotion this may not matter much.

Boredom is complex and even a seemingly simple question such as 'what causes boredom?' is loaded. The assumption here is that boredom is caused by pre-existing phenomena. But boredom is far from being a mere effect. Boredom also causes other behaviours and behavioural definitions of boredom are no more consistent, coherent or convincing than logical ones.

Our evaluation of a situation is as important as the reality of that situation in determining whether we think it boring or not. It may be necessary for us to think 'this is boring' before we can feel bored. But this appraisal may also be sufficient to make us bored. Nothing is boring but thinking it boring makes it so.

Is boredom an emotion? The question is easily asked but the answers are mostly meaningless. Emotion itself has also proved impossible to define consistently and convincingly. Somehow the circle of definitional regress -- the defining of one vague concept in terms of an even vaguer one -- must be broken if progress is to be made.

Emotion is often contrasted with cognition. The link between the two putative systems then needs explaining. This is not parsimonious. One system -- consciousness -- could be sufficient to explain the state and the role of boredom. Boredom could be one of the prices we pay for consciousness. That price may be worth paying. Though clearly unpleasant, boredom may be maligned. It is useful as a form of communication; as a justification for behaviour; and as a defence against depression, meaninglessness and alienation.

Few issues are clear cut in boredom. It occupies an interesting position on the boundary of negative affects. It is certain that time perception is important in boredom. It is likely that appraisal is involved. It is probable that boredom is a form of adjustment. It is possible that some resource allocation mechanism is implicated.

SECTION 2: - THEORY CONSTRUCTION

Chapter 12: Rationale for observations

Only the confusion of boredom is clear. The literature offers conclusive justification neither for adopting, nor for rejecting, any particular definition or theory of boredom. Boredom theory, and indeed theorising about emotion generally, is neither coherent nor consistent. The arguments are certainly plausible and rational. But an irrational and implausible argument would be no argument at all.

Despite the confusion there is nevertheless some consensus. Two distinct situations are universally recognised as potentially boring. One is when nothing much is happening. The other is when many things are happening but none are interesting. At least there is agreement here. The fact that such antithetic situations should apparently generate the same emotion is a powerful signal that universal theory at a higher level is needed to explain the causal relationships.

The first two objectives of this thesis were:

1. - to explain why and how people become bored.
2. - to develop a scientific theory of boredom.

In principle direct observation might, in part, resolve the first objective. Naturalistic observation is the oldest of scientific methods and one particular suited to new theory construction. However the popularity of observation as <u>the</u> method has declined. Today it is rather difficult to find anybody who believes that "the scientist wanders through the world observing at random, and the facts of nature inexorably compel him towards generalisations and inductions" (Broadbent 1973 p32). Nevertheless observation is still the only way to decide whether phenomena really do exist in the world and are not mere fancies or linguistic inventions.

Psychologists are prone to theorise about behaviours that they "cleverly imagine for [themselves] ... extremely interesting in a debating sense, intellectually attractive, but which leaves [them] revolving round and round a limited area" (Warr 1971 quoted in Leach 1991 p4). Observation is an effective way of breaking out of such self-referencing spirals, such as the one in which boredom appears to be trapped. It is for this reason that psychologists from Bartlett to Broadbent have maintained that applied psychologists are far more likely to make major theoretical breakthroughs than their academic colleagues (Broadbent 1973; Canter 1985).

There are a variety of observational methods, each with its own distinctive advantages and disadvantages. Generally the more structured the observations are, the less likely a shift from entry theory. Poincarré's dictum that "method is the choice of your facts" suggests why this must be so. The choice of facts worthy of attention is dependent on theory. Method is tied by a theory whether the intention, or the end, is affirmation or a negation of that theory. The dangers of selectivity are extreme if previous research is the only source of information. Medawar (Medawar 1964 quoted in Phillips & Pugh 1991 p61) makes this point with particular force.

There is no generally accepted theory of boredom. There is thus no firm basis for selecting facts for consideration. Observation is thus, despite its obvious drawbacks (Schaffer 1985), an appropriate, even essential, method of constructing a focal theory.

Marine watch-keepers were observed for a number of theoretical and practical reasons. Their task involves remaining attentive for long periods while nothing unusual is happening just in case something does happen. Marine watch-keepers were studied ashore and afloat. A great deal was already known by this author about the behaviour of marine watch-keepers. In particular, the type of accidents to which they were prone had been studied (Bryant, De Bievre & Dyer-Smith 1988; Dyer-Smith & De Bievre 1987; Dyer-Smith 1988).

Chapter 13: Observation of mariners

Seafaring is more than a job; it is a whole way of life. Mariners live, eat and sleep at their place of work. The isolation, a social bane for the mariner, is a bonus for the social scientist. The seafarer is a captive aboard. There are fewer external influences than ashore, and the routine of the mariner's task decides their general behaviour. The ship is far more laboratory-like than other workplaces.

Marine watch-keeping is liable to induce boredom and listlessness and is indeed a "typically boring" situation (Welford 1965). Waiting for nothing to happen is the marine watchkeeper's main task.

Marine navigators were first observed in a simulator and then aboard ship. The simulator offered an opportunity to study the navigators' actual task in reasonable isolation.

<u>Observations in a marine simulator</u>

Behavioural studies that draw inferences about real world performance from simulator behaviour are seriously undermined by questions of validity (e.g., the subjects are aware they are under observation). Nevertheless, behaviour in a simulator is still behaviour. The observations are valid as examples of behaviour in a ship-like, watch-keeping situation.

Three particular aspects of simulator behaviour appear to relate to boredom:

1. Resistance to allocation of attention to stimuli after periods of relative inactivity.
2. Limited response or constrained solutions entertained following periods of relative inactivity.
3. Persons charged with the only continuous task (steering the ships) were invariably the most observant.

There are, of course, competing explanations for these observations. A psychodynamic explanation would involve anxiety, repression and avoidance. However, given the nature of the task (ship-control), a marine metaphor is particularly attractive.

Chappanis (1983) categorises control tasks in terms of their complexity. Control of a large ship exemplifies a complex task. The ship, because of its enormous inertia, responds only very slowly to movements of the rudder and alteration in revolutions of the engine. A large tanker may take over ten miles to stop in an emergency.

Simply being 'slow' does not imply system complexity but it is a key feature of complexity. Ship-control is complex since environment feed-back is often so slow that it has no value in practice (it becomes non-salient). The mariner acts and must accept the consequences of actions. Anticipation based on experience or 'feedforward' is more important than feedback.

The ideas of feedback and feedforward may be applied to mental operations. Any tracking task (e.g., steering a car) involves the effective use of feedback. Feedback is adaptive. Feedforward resembles human learnt response (Feldman 1966; Minsky 1961). Any such putative systems must somehow be integrated (Bernstein 1967). Perhaps emotions, like boredom, are a product of these integrative processes.

Observations aboard ship

During the winter of 1989 a UK Department of Transport (Marine) research project provided an opportunity [for this author] to observe the minutiae of bridge watch-keeping behaviour under varying conditions. The study, *One Man Bridge Operations at Night* (OMBO) addressed some problems of minimum manning on ships' bridges. OMBO has been widely reported in the international maritime press (Habberley, Taylor & Dyer-Smith 1989).

The official OMBO report dealt exclusively with the visual lookout behaviour. Boredom was not an issue. However the experience shed light on the processes of boredom generation and adaptive strategy. It led directly to the formulation of a testable theory of boredom. The details of the observations are given in appendix 1.

This author lived aboard a vessel trading internationally for 81 days. Data collection focused on the accurate recording of overt bridge watch-keeping behaviour in an objective, and detached manner as possible.

The subjects (N=10) were observed in various configurations of watch-keeping determined by this author. Much of the behaviour recorded was peculiar to the marine situation, and has either been elaborated elsewhere, or is of no interest here. The observations are summarised below in table 13.1.

Total observation periods	= 161
Average duration of a period	= 48 min (range 20-120 min)
TOTAL	= 7732 min (129 hr)
Conditions:	
Day (one person on bridge)	= D1
Night (one person on bridge)	= N1
Night (dual manning of bridge)	= N2

Table 13.1: Summary of observations aboard ship

The observations were distributed across all periods when the ship was on passage at sea, (i.e., the normal watch-keeping situation). The start-time of each observational period was selected from a set of random numbers.

	CONDITION		
TIME PERIOD	**D1**	**N1**	**N2**
00-0600	0	1345	1205
06-1200	1185	0	0
12-1800	1425	0	0
18-2400	0	1137	1360
TOTALS (min)	2610	2502	2620

* note: daylight hours 06-1800 hr

Table 13.2: Minutes of actual observation aboard ship

Summary of events (recorded behaviours or occurrences)

Behaviour on the bridge varied little between conditions. At some point within c96% of the periods observed the watchkeeper looked out of the bridge windows. A possible threat ship was in the vicinity c6% of the time and an alteration of course , the only substantial action ever undertaken, occurred in only c4% of the periods.

Actual movement -- other than of upper limbs for items within reach (e.g., radar controls) -- occurred during c18% of the periods. The watchkeeper was forced to move to and from his seat to fix the ship's position on a chart and to use the radio or to make tea or coffee.

Differences between day and night behaviour

Talking was the only behaviour that was significantly different at night. It was commoner at night ($t(42) = -3.67$, $p \leq .001$) since in condition N2 (see above) there were usually two people on the bridge. However conversation and all other actiivity showed a rising trend after noon.

Discussion

There was very little activity on the ship's bridge in all conditions. Coping strategies had evolved. The task -- if this is not a contradiction in terms -- was doing nothing most (+80%) of the time. "The job [navigational watch] is staying awake and alert". There was little complaint about the tedium. They accepted it. Perhaps only those who can tolerate the tedium remain in the profession.

The watches apparently passed easily for the subjects. "Bridge watches go quickly. Before you know it the six hours are over, and nothing has happened". Contrary to expectations everyone thought the day-watch more boring than the night-watch. There was no significant difference in actual activity. "If anything the day-watch is even more boring than the night. I just dream away the night, and the next minute it's morning".

The observations suggested these mariners have evolved effective withdrawal strategies. This withdrawal is less complete during the day when there is more visual stimulation and greater activity. If possible the limited tasks that had to be done were avoided. Plotting -- the only routine duty (c16% of time) -- was frequently error-ridden.

The mental load of normal, navigational watch-keeping appeared remarkably low (there has never been any serious suggestion otherwise). Nevertheless there has been serious discussion of the stress of marine watch-keeping and solutions proposed to the 'over-load' problem. Seafaring may be stressful at times. There is no evidence [from these observations] that it can be the normal mental load of watch-keeping that is stressful. During most watches observed, the watch-keeper was inactive, even quiescent. The visual field he surveyed was unstimulating. There was nothing to see but sea; on dark nights not even sea.

To detect changes in an essentially blank field is a very peculiar type of vigilance-task. Peripheral awareness is sufficient to detect even the most minor changes in such a field. The task is remarkably undemanding : " On the bridge you're on half-brain. Most of the time its like being in a dream ... I don't need my brain anymore".

The 'half-brain' remark suggests a withdrawal strategy (possible unconscious). Typically the watch-keepers, during this study, sat slumped in the pilotage seat. Sometimes they engaged in some distracting activity (e.g., letter writing). More frequently they appeared lost in some private fantasy. However minor, even trivial changes (e.g., a seagull sweeping past the bridge-windows at night) were noticed if the movement was abrupt. The switch from torpor to attention could be very sharp. The watchkeeper might jump in their seat. "What was **that**?- ah, just a gull" [answering his own question].

There were few occasions where any of the crew could properly be considered fatigued (the problem of fatigue may have been exaggerated in the past - May & Kline 1987). The watchkeepers were never observed sleeping on duty. The persistent under-load was soporific not fatiguing. The job was tiresome rather than tiring.

The crewmen slept for more than ten hours per day. In part this was a way of killing time rationalized thus: "I know I sleep a lot. I store it up like a squirrel". One individual's sleep pattern was studied in detail over 40 days. He slept 7-15 hours per day (mean 11.3 hr). For some sleep was an effective way of annihilating the experience of life afloat: "When you're asleep, time passes quicker". Again, deliberate disengagement, or withdrawal, is evident.

The staff aboard ship agreed life afloat, particularly watch-keeping, was boring. This boredom did not lead to a search for stimulation. Quite the reverse. The mariners avoided stimulation and reduced effort to the minimum consistent with passable performance on those tasks that were essential. Off duty they killed time with sleep.

Conclusion from observation of seafarers

Both ashore in the simulator and afloat on their ship mariners appear to have practised adaptive strategies. A key feature seems to be disengagement. This disengagement could be a form of defensive withdrawal. It could equally be a symptom of mental inertia. The mind, tasked with very little worthy of attention, slows of its own accord. These two explanations are neither jointly exhaustive nor mutually exclusive.

Chapter 14: A new theory of boredom

Allocation, capacity, involvement and engagement are recurring themes in the boredom literature. The observations suggest disengagement and mental inertia are important. Disengagement is a resource allocation concept that has developed from the limited capacity model (Broadbent 1958, 1971) to explain the effects of emotional states (e.g., depression on memory - Ellis & Ashbrook 1988, 1989; depression on cognitive task performance - Mandler 1982; Hamilton 1982). Keinan, Friedland and Arad (1991) argue that a resource allocation model can explain the effects of stress on cognition.

Keinan et al propose that the representation of stressors; the autonomic activity they elicit and efforts to cope; all demand capacity. Under stress conditions the free capacity available for other purposes is thus reduced. It follows from the Keinan et al argument (also Ellis & Ashbrook 1988) that effective overload can be generated even in relative low-load condition if stress is high enough. We deal with the overload by chunking of information (e.g., by combining, over-generalizing, disregarding dimensions) so as to reduce the capacity demand of processing. The limiting factor is the rate at which units can be processed.

Kienan et al tested their proposition experimentally. The first experiment used two conditions; *high stress* and *low stress*; with the subjects (n=101) timed on a categorisation task. The *high stress* group (parachutists waiting, kitted-up to board the plane for their first night jump) used significantly ($p < 0.05$) fewer categories in their task than others. The inference was that the stress of their situation was absorbing large amounts of free capacity and they reduced their categories to compensate.

In a further experiment an integration task was used (identify a word from decomposed halves). *High stress* was presumed to be induced by the threat (never realised) of a minor electric shock. This experiment is less convincing. Their conclusion that *high stress* does engender or enhance a tendency to chunk or integrate output was supported in both experiments.

Both Keinan et al's tasks were very simple. There was no other task competing for attentional resources. The apparent shift in cognitive strategy towards fewer chunks, they believed, could be accounted for by the level of stress. This conclusion is reasonable. All mentation, or indeed sensation, is likely to involve chunking to a greater or lesser extent. We are not aware of the individual firings of nerve-ends that aggregated or chunked give us the sensations of sight or smell.

If in the stress case the chunks are few but large, then in the boredom case they may be more numerous but smaller. Thus stress and boredom might be two levels of one phenomenon. This is Csikzentmihalyi's (1975) argument. Csikzentmihalyi imagined the mental system to be self-regulating, with an optimum performance range between the extreme states of boredom and anxiety [stress]. However if there is a capacity price to be paid for the emotion of stress (as Keinan et al 1991 maintain) then there might equally be a cost associated with boredom. In boredom effort might be expended in converting large chunks to small chunks so as to maintain an optimal level of stress. Boredom then causes stress and cannot simply be a different point on the same continuum as stress.

Csikzentmihalyi (1975) imagined that when demand exceeds capability, then anxiety (or stress) is felt. When the reverse was true, and capability exceeded demand,then boredom is felt. When demand and capability are aligned the positive sensation of 'flow' is felt. Thus a linear tension exists between the demands of a task and the capability available. However stress-boredom relationships are more often described in terms of the inverted-U curve.

Klapp (1986 p122) explores the U-curve argument thus; "Turn such a [Inverted-U] curve right-side-up and one has a picture of what I hypothesise is the situation with boredom: namely, that it is high at both end of the continuum from monotony to variety, or from simplicity to complexity, while there is most interest and least boredom in the middle range". Klapp imagined individuals to be involved in a continuous 'meaning search'. At any instant an individual will find themselves in one of the four quadrants of their 'information search space' (figure 14.1). They move through this space which contains all the possible locations (or ways of assigning meaning to information). The claim that this is so "for the simple reason that there is no place else to go" (p120) is extravagant. Within the logic of Klapp's own model this is so, but a model is only a model.

The Klapp model is interesting since it can contain within a two dimensional space (meaning - entropy/ redundancy- variety) many contradictory aspects of boredom. The model's components are easily understood from Klapp's own diagram (figure 14.1)

GOOD (FUNCTIONAL) REDUNDANCY	**GOOD VARIETY**
rules	discovery
skill	learning
codes	adaptation
ritual	invention
education **MEANING**	progress
history	games of chance
tradition	cosmopolitanism
memory	
identity	
souvenirs	
relics	
BORING REDUNDANCY	**BORING VARIETY**
banality	noise
cliches	equivocation
platitudes	ambiguity
monotony	irrelevance
tedium **ENTROPY**	trivia
restriction	faddism
formalism	information overload
rigiditiy	mistakes
dogmatism	confusion
parochialism	
stagnation	

Figure 14.1: Four sectors of information search (after Klapp 1986 p119)

For Klapp boredom arises in the two areas of high entropy (or low meaning). Klapp's 'meaning search' implies a resource allocation process.

Resource allocation strategy

Attention and allocation of resource are clearly related ideas though attention is not a necessary precursor of allocation of capacity. Part of the value of innate and habitual behaviours are the gains in efficiency made when attention is not an issue.

The allocation of attention under stress has been modelled by Sanders and Reitsma (1982 - following Posner 1978; 1980) using the analogy of attention as a spotlight; the spotlight being directed where a signal is expected. Sanders and Reitsma consider two hypotheses: *resource strategy* and *resource volume*. The former proposes that stress leads to a qualitative change in strategy. A de-arousing stress such as sleep or boredom (Hockey 1979) should cause a changing allocation of priorities such that important items may not get the attention they deserve. The alternative view (Navon & Gopher 1979) is that it is the total amount of resource available that is reduced in these conditions. Sanders and Reitsma's (1982) results were not significant, but tend to favour the latter *resource volume* hypothesis. It is perfectly possible that both mechanisms operate simultaneously.

Quantity (or volume) of processing capacity is a clear enough idea; quality of processing is not. Whether *power of processing* or *depth of processing* (Clifford & Prior 1980) are the same as quality, or practically indistinguishable from it, is an open question.

Most studies suggest no relationship between IQ - a power concept- and monitoring efficiency - a quality one (Colquhoun 1959; Mackworth 1950; Wilkinson 1961). The exception is Cahoon (1970). This quality-quantity issue is likely to prove important in the boredom experience. Two extreme poles of environmental boredom may be distinguished (as Klapp 1986 did). At the one pole 'nothing is happening' (a quantity issue) and at the other 'nothing of interest is happening' (a quality issue). Boredom may be associated with difficulty in processing quantity or quality or indeed particular combinations of both. The latter, interacting case, seems more likely since it is difficult to imagine any cognition that does not possess both quality and quantity.

Clearly there must be structural constraints on capacity allocation. In Kahneman's (1973) view an adequate theory of attention must incorporate both structural and capacity limitations. Qualitative explanations of such limitations exist (Schneider & Shiffrin 1977; Shiffrin & Schneider 1977). Shaw (1978) however is a rare example of a thorough quantitative investigation.

Shaw examined the probability of correct response on a vigilance task and showed that this depends on total capacity available and its allocation to particular visual field locations.

The process of resource allocation

A resource allocation model demands that in some manner an 'allocator' (or executive) must become aware (e.g., by feedback) of a possible need to allocate resource to a particular issue. The decision is then made, using an economic idiom, to 'invest appropriate capacity'. The investment decision may involve some trade-off between quantity and quality. Capacity, in the model imagined, is 'invested' not 'paid'. The decision to 'de-invest' and 're-invest' elsewhere can also be made. However if demand remains unchanged, allocation will naturally reduce as redundancies are identified and the system is attracted towards its lowest energy state. The emotion felt at any moment may serve as an 'executive summary' of the present state of allocation and the direction of movement (Morris 1992 p7 develops a similar argument).

Scherer (1984) suggests how the allocation of resource might be occurring. He proposes that there is an evaluation of the environment though Stimulus Evaluation Checks (SECs) involving cognitive processing. The Scherer model proposed a hierarchy of such checks: novelty (is it new?); pleasantness (approach or avoid?); goal relevance (is it important?). Emotions are thus, for Scherer, an amalgam of the outcomes of SECs (the model has this in common with Plutchik 1980). In this way all emotions are aggregates of simpler occurrences. Izard (1992), and Johnson-Laird and Oatley (1988) continue this reductionist trend claiming there are basic emotions of which all other emotions are variants. However, the logic of the resource allocation model renders the notion of basic emotions superfluous.

The resource allocation model suggests one root cause of all emotion -- a mismatch signal. Emotion may arise when the allocation of resource does not match the demands of the situation. The specific emotion felt will depend on the type of mismatch signal, its strength and the individual interpretation of the context. Specific emotional attractors may well draw the system towards particular states. In this model weak emotions may indeed be undifferentiated and appear to overlap each other or be aggregates of basic components. But an extreme emotion will be differentiated and incapable of disaggregation. Low level boredom, for example, could indeed resemble mild depression, but pathological boredom would be markedly different from deep depression.

The processes by which allocation of resources is made will, in any of the models discussed, frequently be unconscious (Kihlstrom 1987). Even when initially conscious, there will be an inevitable drift in the direction of automatization of procedures if conditions remain unchanged. The advantage to the overall mental system is that routinised processes consume few attentional resources. A computer metaphor might be that knowledge is 'compiled' and the representations changed. The sub-programs from then on may be called by name and the detail, no longer of interest, become unconscious.

Whether conscious, preconscious or unconscious, the efficacy of automaticized routines depends on the accurate assessment of demand. The speediest and most economic forms of human response involve the anticipation of future demand. By this means learned responses can become as fast as reflex actions. Feedback is slow: anticipatory feed-forward is swift. Again the computer suggests a metaphor; that of 'arrays'. Correct programming decisions on the type and size of such data-stores can enhance processing speed by orders of magnitude.

Given predictable stimuli and unchanging responses, task performance quickly requires diminishing resources as responses become automated. The efficiency, in speed of response and capacity allocation terms, of such mechanisms will always tend to push adaptation in the feed-forward direction. For most behaviours may be enacted without paying attention to them (Langer 1986), everyday life may be apprehended routinely (Berger & Luckman 1971 p37) and rule-governed behaviour allows rule-guided roles requiring minimal maintenance (Goffman 1971 p26-27).

The tendency is to reduce resource allocation to the lowest level suggested as appropriate by feedback. But in many circumstances we cannot reduce resource allocation in this way.

The lone night watch-keeper on his/her bridge is continuously un-reinforced by cues from the environment. The evaluation must be 'nothing is happening, nothing is likely to happen, it is appropriate to sleep'. To resist this drift takes effort. Thus the apparent paradox, earlier derived from the logic of Keinan et al's (1991) work, that boredom should be stressful can be resolved. Stress is generated by futile mental work done when bored. An example may illustrate this point.

Suppose one is sitting in a doctor's waiting room. This need not be boring. A book, a magazine or merely day dreaming may pleasantly pass the time. We may adjust allocation level to one that is appropriate to the circumstances. But if we are instructed to watch for a sign to be illuminated over a consulting room door and told we must enter that room immediately it shows or lose our place in the queue, then that is boring. An over-allocation of resource is forced upon us. We wait for an event that may happen sooner, but is likely to happen later.

Expectation clearly plays an important role in boredom genesis. The general importance of expectation in mentation has been known ever since Helmholtz's (1866) experiments on vision. Simpson (1992) draws attention to the common, yet still bizarre experience of apparent movement when stepping on to the first step of a stationary escalator. This amounts to an 'overshoot of habit'. Simpson extended Heisenberg's (1959) dictum that we perceive the world only as it is revealed to us and adds; "as it compares with our expectations".

Boredom might be associated with an overshoot of both expectation and allocation. This interpretation is consistent with Nowlis's (1966) rising boredom before lunch and at the end of the working day, and with Leary et al's (1986) suggestion that boredom could be a function of the effort to sustain focused attention. In these cases expectation, or attention, runs ahead of the actual state of the world. It is hard to imagine that this cognitive effort can be other than individually variable. There is a direct link suggested here between cognitive effort, mismatch and individual boredom proneness.

The resource allocation model can also explain boredom's role in repressive defence. In the healthy individual the more serious a threat the greater the resource they will allocate to counter it. If there is an awareness of the precise nature and extent of the threat then capacity will be focused as a spotlight (Posner 1978,1980; Sanders & Reitsma 1982). This of course is precisely what does **not** happen in the case of repressed threat to which boredom has been proposed as a reaction.

To focus awareness on a problem may increase the unpleasant feeling of threat. Several strategies might then be employed to deal with the situation. The allocated capacity might be absorbed in another distracting task that would redirect attention away from the real threat (i.e., displacement). The threat might be projected onto another, loosing nothing in virulence, but displacing the pain elsewhere (i.e., projection). Another way of absorbing excess activated capacity could be fantasy (or other such internal noise), or alternatively steps might be taken to reduce the amount of free floating activated capacity by sleeping or taking drugs (Dyer-Smith & Stein 1993). Runcie (1980 p109) described how marijuana was the boredom avoiding 'drug of choice' for his car plant workers; "If I smoke (marijuana) I can stare at a spot on the floor all day long and not get bored".

Rather than focus attention on alternatives, attention might be deliberately de-focused and experience rendered featureless and bland. The amount of free capacity activated would remain the same, but the effect would be to prevent the threat imposing itself on awareness. The undesired consequence would be that de-focusing prevents other, non-threatening, matters coming into focus. Concentration will become difficult. Experience will be bland and concentration difficult. Rich enjoyable fantasies will not rush in to fill the void. Fantasies will be depleted or absent. Consciousness will be diffused with un-focused sense of unease and dissatisfaction.

These predictions match the experience of boredom exactly. Most analysts regard the absence of fantasy as the most salient feature of boredom (Bergler 1945; Fenichel 1953; Hartocollis 1972). Boredom thus is quite distinct from sensory deprivation where primary processes and fantasy tend to dominate (Gill & Brenman 1959).

Chapter 15: The Inertial Resource Allocation Model of Boredom

A basic resource allocation model can explain much bored behaviour. However the model is considerable enhanced by incorporating the idea of mental inertia. The basic model suggests that if the appraisal is '*current allocation of resource is excessive*', then the executive instruction should be '*reduce allocation immediately*' (or 'shift down a cognitive gear'). However if the mental system has inertial properties then temporary over-runs are inevitable. For a period then allocation must exceed demand. Boredom could be 'a feeling associated with over-allocation'.

There is an obvious corollary to the mental inertia argument that offers a simple explanation for boredom induced errors of judgment. If, as the mental system winds down, a load is place on it by the demands of some novel occurrence, the direction of adaptation must be reversed. For a period, as the system now strives to overcome its own inertia and wind up again, allocation will lag behind the new demands of the situation. The instantaneously available capacity may not be adequate to meet the situation and apparent errors of judgment occur. These errors would not occur if the system were up-to-speed. Thus individuals will make errors of judgment that they would never make under testing conditions.

Such an Inertial Resource Allocation Model (IRAM) is consistent with the literature of boredom, the evidence of accident records and the observations made of mariners. Boredom in the IRAM is not a cause. It is an emotion that may be associated with a mismatch signal. Whether boredom (or another emotion) is felt or reported as felt, will depend on a variety of individual factors. However the behavioural consequences of mismatch may be predictable.

If the accuracy and inertia of an individual's allocative system are the main determinants of proneness to 'bored-type' behaviour then a method of measuring such proneness becomes practicable.

<u>Implications of an Inertial Resource Allocation Model</u>

The IRAM incorporates the general principles of cognitive economy, nulling, alignment and inertia. For the IRAM itself to deserve the status of a scientific theory, predictions that are particular, bold and non-obvious must be generated and tested.

The experience of boredom is unique and subjective, yet many associated features are agreed. These include the situations that commonly generate boredom (e.g., repetition, constraint), the emotions that are often entrained (e.g., apathy), and the characteristic behavioural consequences (e.g., errors of judgment). It has already been noted that the bored state is not necessarily associated with poor performance on highly practiced tasks nor indeed with lack of attention. A task may be boring, but a purely automated response may be unaffected until fatigue begins to take effect. A task may be attended to, yet boring. It may become boring when the appraisal is that the investment of attention in it is excessive and yet that investment cannot be withdrawn.

Over an extended period performance on tasks that entrain a potential, rather than actual, cognitive load (e.g., vigilance task) are affected in quite a different way to performance on highly practised tasks. Performance on vigilance-type tasks degrades over time. These tasks are quintessentially boring. Practised task performance is not degraded in this way.

The bulk of research to date has focused on vigilance, and particularly on signal recognition where the probability of a signal of interest is low. Generally the more complex the task; the less performance suffers (Alluisi, Coates & Morgan 1977; Howell, Johnson & Goldstein 1966; Craig 1979).

In a vigilance task the expectation of load should govern the extent of engagement (or allocation of mental resources). If the probability of target signal is low, then the likely allocation of resource will also be low. In a non-engaging task, a reduction of allocation of mental resources should occur over time as the monitoring system picks up signal redundancies. If we assume some measure of mental inertia, there must then be a problem in dealing with novel demand (as previously argued). This sort of situation occurs when an operative conducting a routine monitoring or vigilance task is called upon infrequently to tackle a cognitively demanding one. Such transitions may be particularly difficult for some people.

It is not just low-level operatives (e.g., night-watchmen, production-line workers) who are bored at work though industrial studies have concentrated on these strata. Perhaps the routinization of work here has meant that productivity gains at these levels have historically been seen as more attainable than elsewhere. Alternatively, or perhaps additionally, these lower level operatives are more easily pressured into co-operating with productivity studies than professional groups. But boredom can occur at any level of work. Scanning the academic literature might be considered high level work yet it can be remarkable boring. Quantities of dross must be sifted to find the few genuine nuggets of wisdom. Attention must be sustained in the face of the low expectation. continuously reinforced, of low reward. The intellect can be so dulled by this process that it is incapable of discriminating a stunning result from the mass of the uninteresting. Judgment can fail. The same principles might apply to all tasks at any level. Certainly the IRAM predicts this should be so.

It must be practically impossible for any task to command all the capacity (however defined) potentially available to an individual. In practice the FREE CAPACITY available must always be less than the potential capacity available since some capacity is already committed to contemporaneous tasks.

If FREE CAPACITY (C) is challenged by a load (T) -- the sum of all additional task demands -- that exceeds C, adaptations of various sorts must be made (e.g., queuing, filtering). This is the familiar over-load situation that is supposed to be one cause of stress. Stressful or not, the state must induce uncertainly. There must be some initial doubt about the efficacy of the choice of where and how to invest limited capacity (e.g., how to prioritise). It is unlikely that C will instantaneously match C at all times. Some mismatch (S) is likely so that:

$$S = f(T - C)$$

In any case where the perceived demand (T) is less than the available capacity (C) an allocation of some quantity of mental resource (r) should be made. Presumably this allocation is, at least in part, based on experience and knowledge (implicit or explicit) of what capacity investment is appropriate in such situations. If the task is perceived as important, initial over-allocation is likely to occur ($r > T$). Feedback provides information about the appropriateness of allocated mental resource (r) and adjustments are presumably made to bring allocation in line with current task demand (T) so that:

As $r \Rightarrow T$ .... so $S \Rightarrow 0$

Homeostasis, we will assume, is the teleological end-state where the mismatch (S) of task demand to allocated capacity is minimum ($S \cong 0$).

A particular, additional logic is imagined to operate in allocative processes. In the language of economics there is likely to be a 'discounting of information ahead of time'. If initially an under-allocation or over-allocation of capacity has occurred. some mismatch must initially be experienced until adjustments have been made. This adaptation must take time (t) [dark-adaptation of the eye might be an appropriate metaphor].

Effort is presumably needed to sustain the level of r above that reinforced by feedback T (when $r > T$) and sustain the mismatch S and counter the drift towards a lower energy state ($S \cong 0$).. The mismatch effect is then:

$$S = f\,(r - T)$$

This equation [it is believed] models the situation typically described as boring. The boredom potential of a situation is directly related to the mismatch (S). The boredom experienced by any individual will be proportional to the effort they must exert to sustain the mismatch (S). When this mismatch is sustained for a period (t) boredom (B) is generated:

$$B = f * S \times t$$

Some simple physical metaphors may illustrate the implications of the model more clearly.

Metaphors of boredom

If we imagine FREE CAPACITY in use as a volume of air within a balloon, then as the demands of a task rise that FREE CAPACITY must be inflated to match the demand. This requires both time and effort. Once inflated, effort must continue to maintain pressure. If we cease blowing, the balloon rapidly deflates back to the low energy state. Boredom could be the feeling associated with the effort required to maintain inappropriate over-allocation of resource.

To avoid the effort (and boredom) of keeping the balloon inflated, we may elect to tie off the balloon's neck. This removes the continuous effort problem, but substitutes another one. If we subsequently must adjust the volume of the balloon by further inflation or deflation we must first untie the knot. We have increased the inertia of the system (inertia is only the tendency of a system to remain in its current state). This metaphor might model the way feelings of boredom can be removed by a blocking-off, though the underlying tension remains (an idea important in psychodynamic theories of boredom - Fenichel 1953). The mariners' withdrawal strategies might involve such represssion. However the price of blocking-off boredom in this way is paid in increased adaptation time when the situation changes or even the complete loss of the ability to adapt.

A further physical inertial metaphor may illustrate another property of mental processes implied by the IRAM. Flywheels of all sorts show inertial properties. If we hold a bicycle wheel by its spindle-ends and spin it rapidly it is easy to keep it pointing in the original direction of spin (the gyroscopic effect). However if we try to turn the wheel-spindle in a horizontal plane and point it elsewhere peculiar things happen. Turning the spinning wheel takes considerable effort and a pronounced and immediate wobble develops. The precise direction of the plane-of-spin becomes difficult to control. The system is not out of control, but it is controllable only within limits and then with considerable effort. This might also be true of mental processes. Once 'up to speed' in a particular 'direction' they may be difficult to reorientate mental processes.

This fly-wheel metaphor may help explain two common effects of boredom. While smoothly operating, in a practised manner, on a repetitive task we encountered no particular problems. However if the task changes in some way then there is a period when not only is effort required to accommodate these changes, but also behaviour can become erratic. Mean performance may remain roughly the same, for the oscillations of performance average to the mean performance (as do those of the bicycle wheel). However mean performance is misleading. The wobble in the alignment of mental resource may make the individual prone to errors of judgment.

The mind is clearly neither a balloon, fly-wheel nor indeed a computer. Yet the mind is a system, and though unique, nevertheless can be expected to share some properties in common with other systems.

Two measurable and predictable properties of adaptive behaviour emerge from the development of the IRAM so far. In situations that require task switching after periods of habituation those prone to bored-type behaviours should:

- be generally slower to adapt than others
- become progressively more erratic than others

These putative features of boredom related behaviour were investigated by experiment.

Task switching behaviour is adaptive. The most effective way of dealing defensively with boredom is mental disengagement or withdrawal (the sealing of the balloon metaphor). Disengagement behaviour was the most notable feature of the observations of the mariners. The same idea is central to psychodynamic interpretations of boredom. The very word, bored, implies low engagement and a desire for even lower engagement or complete disengagement. There is direct link suggested here between boredom and other forms of withdrawal. The striking resemblance of boredom to depression was commented on earlier (chapter 3). Both poor work performance and absenteeism might both be symptoms of the same form of withdrawal.

The IRAM thus generates predictions of disengagement behaviour that are particular, bold and non-obvious. Furthermore these predictions are either testable by experiment or measurable in the workplace. The IRAM predicts individual variations in adaptation time in a switching task. It further predicts that performance on such tasks will relate to other withdrawal behaviours (e.g., absenteeism).

SECTION 3: TESTING THE NEW THEORY

Chapter 16: Mapping the experimental parameters

The Inertial Resource Allocation Model (IRAM) predicts task disengagement over time. The first step in designing the requisite experiments was to map their essential features using the method devised by Guttman (1954) and elaborated by others (Dancer 1990).

The mapping sentence method is a useful way of defining, confining and refining concepts so that empirical investigation may proceed. Definition has been discussed at length elsewhere. Although definitions are ultimately arbitrary (Toulmin 1961) they are nevertheless useful and for experimental procedures essential. Guttman (1950) held that definitions must be expressed in terms of empirical observations or operations performed on empirical data. This is a familiar argument particularly relevant to psychometrics. Guttman's unique contributions here were the practical methods he devised to construct definitional frameworks for the social sciences (generically called Facet Theory).

A facet (as described by Dancer 1990 following Guttman) is a set of attributes that "belong together" (p368) and "represent underlying conceptual and semantic components of a content universe". Each facet, in this method, must be comprised of at least one element. The particular advantage of the method is the ease with which these elements may be selected so that collectively they comprise a non-overlapping, mutually exclusive but jointly exhaustive, set that describe the area of interest (the content universe). The method has a particular and highly developed vocabulary and characteristic methods of analysis (e.g., non-metric multidimensional scaling), but it would be a digression to describe that particular universe since only the mapping sentence method will be used here.

The IRAM proposes that disengagement will be induced by repetition, expectation and the passage of time, and this will be detectable as slower and more erratic performance on a switching task. The focus of the theory is performance on tasks requiring engagement when the overall mental demand (the context) is non-engaging or boring. Though attention is not a core theoretical issue it is clearly a constraint. Disengagement would be impossible to measure if an individual was initially paying no attention to a task. It would be extravagant to claim that inattention was caused by boredom.

If a task is being attended to then an obvious cause of declining performance over time is fatigue. Boredom is clearly neither inattention nor fatigue though it is associated with both.

With the key issues identified, the key features of the study could be mapped. The process of mapping sentence construction is readily apparent in practice. The content universe of the experiments conducted may be described thus:

<u>The core mapping sentence was:</u>

"A person demonstrably attending to and competent on similar, simple tasks who is not becoming fatigued will, over time, disengage from those tasks in a characteristic manner".

This core mapping sentence was exploded to explore the logic of the research design. This suggested elements that might be manipulated, measured or controlled.

"A person demonstrably **ATTENDING** to

- showing no significant decrease in vigilance over time

and **COMPETENT** on

- clearly able to do the task in question

SIMILAR, SIMPLE TASKS

- tasks that are alike in most respects
- tasks that are learned quickly and easily

and not becoming **FATIGUED**

- showing no progressive slowing in reaction time

will **OVER TIME**

- time into the tasks

DISENGAGE from that task.

- demonstrate an inability to readjust to changes in cognitive load.

in a **CHARACTERISTIC MANNER**.

- show a pattern of disengagement that remains similar across tasks

Expressed in a different way the central proposition is that:

"IF a person is attending to a task AND IF they are clearly able to do it AND IF they are not tiring THEN over time they will disengage from it in a characteristic manner".

Chapter 17: The experimental procedure

The IRAM predicts there will be individual variation in disengagement behaviour. Some individuals should maintain complete engagement with a repetitious task while others become rapidly detached. A procedure was designed to discriminate individual behaviours. Differences in behaviour, the theory suggests, should predict susceptibility to boredom's effects.

This study is not concerned with the specific conditions under which people become bored. Such an enterprise would, almost certainly, be futile. All activities can become boring with repetition. Perhaps all activities can be interesting under certain other conditions. All people are bored sometime and conceivably some people are bored most of the time. The focus here is how individuals react to potentially boring situations, and whether there is any consistency in that pattern of response.

Boredom should not be stable across situations. Individuals do not always react identically in similar situations on different occasions. Understanding and interpretation of the significance of context play a part in boredom genesis. So too do more basic matters, as consideration of other emotions clearly demonstrates. An individual may be paralysed by fear on a cliff-face, but be exhilarated by the speed of their motorcycle. Similar specific considerations must be expected to play a part in boredom.

Individual boredom susceptibility is not conceptualized in the IRAM in the same way as that 'boredom factor' said to be found in self-report questionnaires (e.g., scales of boredom proneness or sensation seeking). If there is any awareness within an individual of a more or less stable 'self' then of course self-report must reflect it (Thorndike & Hagen 1969). It is not surprising that reported proneness is stable.

However 'felt boredom' is both changeable and transitory. The IRAM predicts the pattern of behavioural adaption will remain stable.

Any pattern of individual behaviour is likely to be most obvious across tasks that are similar. That pattern is likely to be relatively, rather than absolutely, obvious. Thus across a series of similar tasks we might expect different individual levels of disengagement in each. But we might also anticipate that those who disengage most in an early task would also tend to disengage most in subsequent tasks. If some rank-order stability were evident over time and across conditions then it would clearly be possible to compare such ordering with other facets of an individual purported to be stable (e.g., boredom proneness).

It would greatly strengthen the case for the IRAM model if a detected pattern could be directly related to some independently established criterion measure. It would be rather less useful to demonstrate some coincidence with other psychometric measures (Richardson 1991).

Any procedure for investigating the implications of the IRAM must measure process as well as product. Boredom is a cumulative not an instantaneous effect. The ideal experimental procedure must allow several observations to be made on every subject over some period (Barlow & Hersen 1984). The general confounds of within-subject design do not apply here. The focus of interest **is** behavioural instability. Order-effects and carry-over effects would be deliberately created not extraneous and inconvenient.

There are both advantages and disadvantages in such and approach. Drew and Hardman (1985 p80) have drawn attention to the historic difficulty there has been in generalizing across populations when a few subjects (perhaps only one) have been thoroughly studied with a time-series design. In the current context, the variable and erratic outcomes of boredom (the performance wobble) was not anticipated to be regular and periodic, and thus could not be handled in a conventional time-series manner. However it was possible that behaviour could be chaotic. If that were so then patterns would not be seen instantaneously, though they might emerge out of time-averages.

Inattention and fatigue are generally the simplest explanations of performance deterioration over time. If neither accuracy nor speed of recognition deteriorate in a prolonged vigilance task then it is reasonable to deduce that attention is sustained. Similarly if there is no overall decline in response time then it might be inferred that there is no fatigue effect. It was fully appreciated that learning would operate in the opposite direction to any fatigue or inattention effect. Thus fatigue could occur but effectively be masked by an increasing automation of response. This would only pose a serious inferential problem if the effects could not be separated out.

A procedure was required that could measure the effect of repetition and the passage of time upon task-switching performance. This requirement placed a particular constraint on the design of the experimental tasks. The task **must** necessarily remain essentially the same throughout. Any decrement in performance must be attributable to the passage of time and the experimental manipulations **not** to fluctuating levels of absolute difficulty or the novelty value of new tasks. This constraint presented an apparently impossible design challenge. The ideal experimental switching-task must change and yet remain the same.

The procedure developed involves a task that is styled a *Mental Agility Test*. This name accurately represents the factors measured yet disguises its underlying motives. The name the *Smith & Wesson mental Agility Test* (SWAT) will be used to describe this core component of the experiments. The name derives from those of the authors:

Martyn Dyer-Smith (the author of this thesis and designer of the experiments) and David Wesson (the programmer).

Smith & Wesson mental Agility Test (SWAT)

SWAT is built in QuickBasic to run on a standard PC with colour monitor. Subjects respond with the presses of a key. Two types of task are used:

- a low load vigilance task (target shape recognition)
- a high load cognitive task (simple puzzles)

The vigilance task sets the context in which the puzzles must be done. The question of cognitive environment of mental activity here is crucial. Mental activity does not occur in a cognitive vacuum. To say mental activity sets the context for other mental activity is no doubt a truism yet an issue that has attracted surprisingly little attention. Even at the point of waking from sleep, thought can hardly be described as instantly exploding into a blank mental field. Any new cognition arises into an environment already replete with cognitions. That is, in the IRAM language, the currently allocated *free capacity* is engaged though there may be adjustments going on. The vigilance procedure in SWAT creates a common cognitive ground into which puzzles emerge. All subjects are engaged in the same vigilance task, and thus arguably engaging similar faculties at the time the puzzles are posed.

The order of events

First a subject recognises and reacts to the appearance of a particular shape on a computer screen (the vigilance task). They then must deduce whether this target shape is displayed in the *correct place* (cognitive puzzle task). The two tasks run concurrently (a dual-task time-share paradigm).

Cognitive load is imposed and manipulated by means of simple puzzles that require a subject to:

- infer a simple rule
- remember a simple rule
- apply a simple rule

'Simple' and 'complex' are not absolutes but degrees of relation or measures of contrasted difficulty. Task difficulty is a major determinant of behaviour yet is a particularly tricky confound since it is not an intrinsic property of a task. Difficulty may only be inferred from performance on a task. A task cannot be labelled simple or complex without reference to a performance criterion. Kantowitz and Knight (1977) elaborated this argument in their discussion of the *Potency Principle*. If the capacity required for two different tasks is the same to achieve identical performance then the two tasks are equally difficult. It seems likely that performance should increase monotonically with resource capital invested. This conjecture prohibits an absolute definition of task performance difficulty. It is not possible to say, for example, that the difficult task took longer. From this analysis it is inferred that it must be more difficult <u>because</u> it took longer.

Puzzle difficulty and puzzle solving ability are not issues of theoretical interest here, and it was thus sufficient to control or render difficulty effects unsystematic. The puzzles used within the experimental procedure were simple enough to be readily learned by any normal adult thus avoiding any confounding floor effect.

The general features of the SWAT procedure can be summarized (Table 17.1) in terms of the factors of interest, the nature of the task used to access them, and the type of measurement taken.

FACTOR	TASK	MEASUREMENT
Attention/ Fatigue	vigilance: identify target amongst dummies	response speed response accuracy
Engagement	infer, remember and apply a rule	solution accuracy solution speed variability in speed

Table 17.1: Characteristics of the experimental task

Features of SWAT

The basic vigilance/ recognition task that confronts a subject within SWAT is very simple. Indeed it is thought to be the simplest that can be designed to meet the design specification (various other designs were trialed and rejected).

In SWAT a target shape is always present at the bottom of the computer screen. Shapes appear singly on the main screen in a seemingly random manner. Some are target shapes; the majority are dummies. The screen is divided into quadrants. The shapes appear singly in one of these quadrants, as illustrated (figure 17.1).

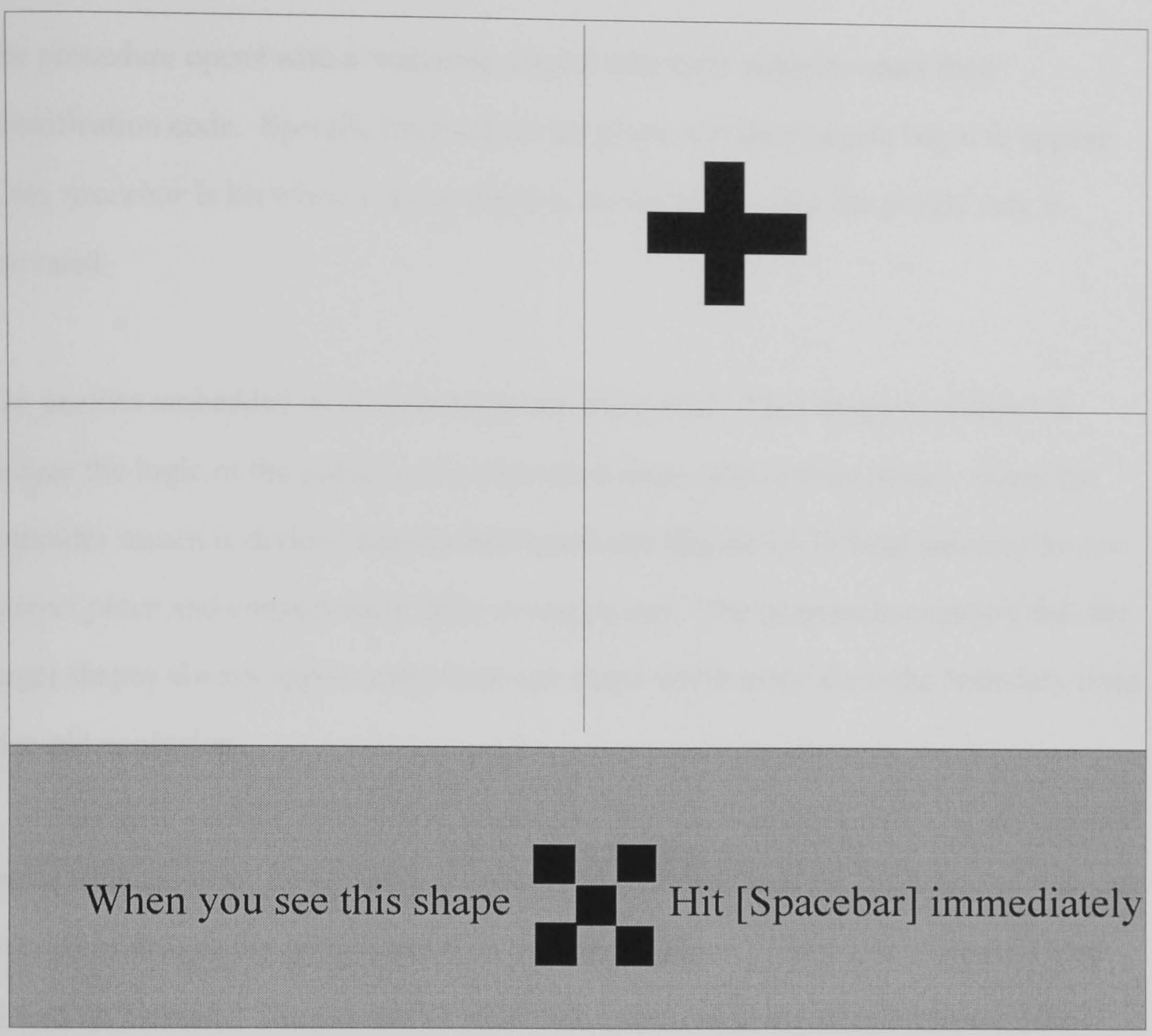

Figure 17.1: Basic SWAT vigilance task

The timing of shape appearances, positions, and durations on screen are all varied within set limits. These variations are determined by a fixed set of random numbers. This arrangement gives the appearance of randomness in all material respects. Yet the randomness is precisely controlled and the test is identical for all subjects in any particular experiment.

Subjects respond with simple keystrokes. There are only 3 options. The *spacebar* for the recognition task; the Y key (for yes) and N key (for no) for puzzle questions. These are the only keys enabled.

The procedure opens with a 'welcome screen' where the subjects enter their identification code. Specific instructions are given and then targets begin to appear. If the *spacebar* is hit when a target shape is on the screen then the puzzle task is activated.

The puzzles embedded in the procedure are inferential. They require a subject to deduce the logic of the position of a presented shape (the *correct place*). Since the computer screen is divided equally into quadrants (figure 17.1) there can only be one *correct place* and consequently three *wrong places*. The programme ensures that the target shapes always appear more than one shape width away from the boundary lines to avoid confusion.

Initial trial and error judgements are rewarded with feedback on performance that can be used to deduce the pattern and thus the *correct place*. There is thus a small load placed on memory. The manner in which the questions about the pattern are asked and the form of the feedback provided are varied systematically to provide the desired task switches. However the base task always remains the same, to deduce the *correct place*. Thus the procedure meets the stringent, ideal conditions already discussed. The task changes yet essentially remains the same.

The changes were induced thus:

- By the manner in which the question is asked; either positively or negatively
- By the nature of the feedback on the answers provided; either on the task or on subject performance.

The precise form of the switches can best be described diagramatically (figure 17.2).

Form of question		**Form of Feedback**
Positive Was the object in the **correct** quadrant?		On performance Your answer is **correct/wrong**
	X	
Negative Was the object in the **wrong** quadrant?		On task The shape was in the **correct/wrong** place

Figure 17.2: SWAT - forms of question and feedback

This 2 x 2 design generates 4 basic conditions of the basic task (Table 17.2). There is no *a priori* reason for considering any condition more or less difficult than another. Nevertheless the need to move between conditions represents a cognitive shift or gear-shift (Louis & Sutton 1991).

	TYPE OF QUESTION	
FEEDBACK	POSITIVE	NEGATIVE
ON PERFORMANCE	*Condition 1*	*Condition 2*
ON TASK	*Condition 3*	*Condition 4*

Table 17.2: The four conditions of SWAT

Each iteration of the task was embedded in a different context of time and place within the overall task (e.g., sooner or later: condition 2 questions between a condition 3 & 4, or between condition 1 & 3).

The order of conditions presented within the experimental task were varied to produce subtly different experiments. Within all experiments the training phase (if present) was identical. The condition order varied between experiments, but was identical for all subjects.

The experiments were in two parts:

1. Training phase - subjects were trained on the task and their ability on it assessed.
2. Test phase- the main dependent variables were measured.

Each version of the procedure followed similar logic:

- Five conditions were used in an ABCDA pattern. The conditions BCD effectively form a treatment that separates two identical A-conditions.
- An effective baseline was established by using a relatively lengthy 'training' phase. The length of the training phase was established by piloting and set at twice that required by pilot subjects to learn the experimental task.

The order of events are represented diagramatically in figure 17.3.

Point

0 - Test starts with opening screen

0-30 - The 4 conditions of the training phase

30-65 - The five conditions (ABCDA) of the test phase

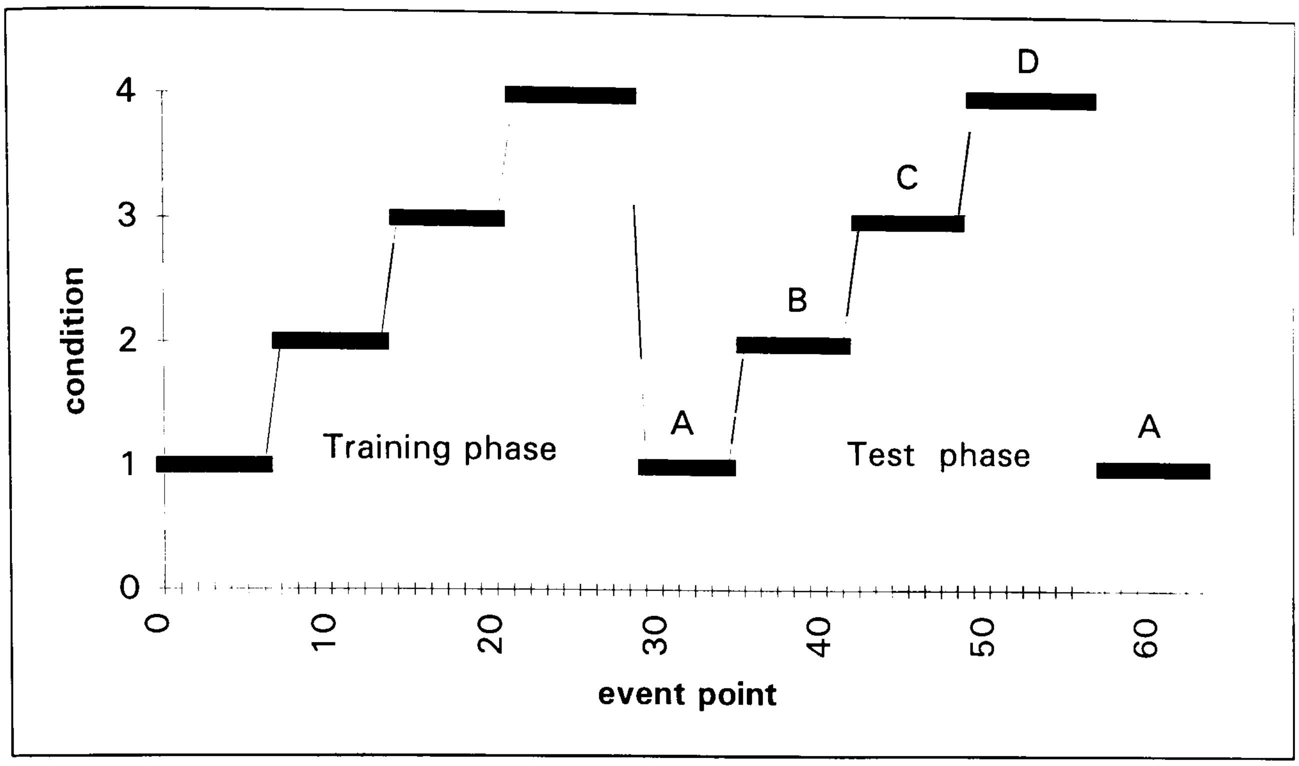

Figure 17.3 Conditions in the SWAT procedure

Subjects throughout have to contend not only with the typical target identification and response of the vigilance task, but also with systemic fluctuations of context-task to new-task discrepancies. These later fluctuations are experienced as mental shocks. The extent of the shock is readily measured.

Training phase

There is an initial four part training phase (PRETEST) within which subjects learn the task. The task itself is very simple. Indeed it is thought to be the simplest that can meet the design criteria. No subject was unable to understand it. However the rate of learning was not identical for all subjects and the differential is calculated (as CAPACITY). A low CAPACITY score reflects difficulty in learning the test. During this training phase a confirmatory quiz (POSTTEST) is employed to check that learning has indeed taken place. There is clearly a certain probability that any particular answer might be guessed correctly by chance. The probabilities of accurate guessing are cumulative and low (p = .035). The confirmatory POSTTEST quiz reduces this probability to less than .001. In experiments two and three only one such PRETEST was taken. It preceded whichever was the first experiment run. The main function of the PRETEST is to prepare subjects for the main test.

During the training phase, wrong answers or erroneous keystrokes prompt an audible. as well as a visual warning e.g., if the N key is hit in place of the spacebar a 'beep' sounds and this message appears:

"The spacebar is the long key at the bottom of the keyboard"

An experimenter remained with the subject throughout the first two phases of the training. Any questions or difficulties were dealt with immediately.

Design features (following the terminology developed in Warm & Jerison 1984)

First Order Factors

Modality - The experiments were loosely coupled (Elliot 1960). The subjects were free to watch the computer screen or not. The training phase (PRETEST) was more tightly coupled by providing auditory feedback which, by its nature, does not require directional attention.

Signal conspicuity - The amplitude and duration of the target shapes were key factors within these experiments. A series of investigations (Frankman & Adams 1962; Mackworth 1968) have shown how signal amplitude may compensate for arousal and habituation both of which are critical elements in vigilance decrement. Both amplitude and duration were varied randomly (within limits) to eliminate any systematic effect.

Event rate - The background event rate is a particularly important factor in determining performance efficiency. Several studies have shown that the quality of sustained attention is inversely proportional to the rate of presentation of natural events (Parasuraman, Warm & Jerison 1979). Results seem to imply that the detection of a signal in such conditions is largely determined by what is going on when no signal is presented. The balance of opinion has been that background event rate dominates as a prepotent psycho-physical factor in sustained attention (Mackworth 1968; 1969). Mackworth differentiated habituation from adaptation or fatigue, showing that responsiveness can return with a qualitative or quantitative change in stimuli. Habituation, in her view, is driven by repetition and thus accumulates more rapidly at a faster event rate than at a slower one.

SWAT held event rate and probability of critical signals constant within each experiment thus preventing possible confounds that have pointed out by others. However event rate varied between experiments.

Second Order Factors

Uncertainty - Dember and Warm (1979) designated temporal and spatial uncertainty as the major second-order factors. Uncertainty can be judged by experience. Both temporal and spatial uncertainty were present, but controlled within the SWAT experiments.

Complexity - The consensus is that vigilance decrements are missing in complex tasks (Alluisi et al 1977; Craig 1979; Howell et al 1966). The SWAT task is very simple and absolute complexity not considered an issue (there is no agreed definition of complexity even among mathematicians).

KEY VARIABLES

The detail of the raw data recorded are given in Appendix 2B. The output from data files generated by the procedure was used to compute these variables for analysis.

CAPACITY -- The composite score derived from the first portion of the test used to measure how well the subject performed at solving the 'correct quadrant' puzzle.

Capacity is primarily interesting as a measure of relative ability on this specific procedure. Subject ability could thus be compared and normed against random or systematic patterns of response. Other boredom studies have used proxies for ability (e.g., army rank) or measures of general ability (e.g., Intelligence). The use of a specific measure obviates inferences about the relationship of a proxy or general ability to this specific task.

DILIGENCE -- The balance of correct answers to quadrant questions asked during the main part of the test.

DILIGENCE was computed as +3 for each correct YES answer, +1 for each correct NO answer. A penalty of -1 and -3 is exacted for the respective wrong answers (these weightings neutralize the computed differential probability of correct answers achievable by random responses).

DILIGENCE was intended to capture the motivational component of performance. Low DILIGENCE suggests a random or systematic response to the puzzle questions whereas low CAPACITY signals an inability to solves the puzzles.

REFLEX -- The mean of the time in seconds between the 'correct' shape appearing on screen and the subject's response (hitting a key) during the main part of the test.

REFLEX is intended as a measure of both attention and fatigue. If REFLEX is erratic that could signal attentional difficulties. If it increases over the period of the test that could signal fatigue. If it decreased that might suggest conditioning.

THINK -- The mean of the time in seconds between the appearance of questions about 'correct quadrant' and a subject's response (answering the question) during the main part of the test.

Changes in THINK over the duration of the test is the key issue in the experiments. This speed of puzzle-solving was hypothesised to change in particular ways over the course of the test (see chapter 21). The anticipated increase in THINK immediately after the switch to a new form of the puzzle is analagous to the extra effort needed to overcome the gyroscopic inertia of a revolving bicycle wheel (as argued in chapter 15).

A THINK time is not necessarily recorded for every *correct shape* appearance. The question about the quadrant only appears after a correct identification of the target shape. If a subject does not react to the correct shape then the puzzle test does not appear and no THINK is recorded.

VARIABILITY - The variance of THINK time for the subject across the main part of the test.

Increasing VARIABILITY over time is the key prediction of the IRAM. Misalignment of mental resource should lead to variable performance. It is analagous to the difficulty of precise control (the 'wobble') induced when the direction of rotation of a bicycle wheel is changed.

ERRORS -- The number of shape recognition errors committed by a subject during the main part of the Test.

A high error rate is likely to signal inattention. It could equally indicate some more basic difficulty such as poor visual discrimination.

A set of instructions was written for experimenters (Appendix 2A). The precise protocol used is given as Appendix 3.

The SWAT procedure incorporates key aspects of a boring situation, but it is designed so that features of the situation may be varied easily. Just how boring each condition is cannot be known. It cannot even be inferred from behaviour (c.f. Kantowitz & Knight's 1977 argument about task difficulty). But just how bored an individual becomes in particular situations **<u>is</u>** potentially knowable.

Chapter 18: Details of the experiments

Three variants of SWAT were used. These are named experiments 1, 2 & 3 for convenience. They are not independent experiments. The same set of hypotheses are common to all. However it would be misleading to call the three variants 'alternate forms' since key parameters are different.

Experiment 1 involved all subjects in a session 60 minutes long. Following the computer task (less than 30 mins), the subjects were questioned about attitudes to work (see chapter 20). Experiment 2 and 3 were shorter than experiment 1. They were taken consecutively during a further session 4-6 months after the first. This latter session was c50 minutes long. It began with a computer task. Subjects then completed a questionnaire (see chapter 20). A futher computer task followed, and finally they completed the biographical data form.

For the second session (experiments 2 & 3) the design was balanced. Half the subjects received experiment 2 first; the other half experiment 3 first. The early experiment began with the training phase. The latter task omitted this phase.

The range of possible experimental settings within SWAT is infinite. Some variables have upper and lower limits, but others such as the time a shape is on screen, may have any value above zero. The actual settings used were decided on both practical and theoretical criteria. Subjects were only available in one hour blocks of time. Within this constraint the appropriateness of the other settings was established by trial with student populations. Although the experiments all conformed to the pattern ABCDA -- that logic was established in chapter 17 -- the order of presentation of conditions varied between experiments according to the schedule in Table 18.1.

	Condition		
Presentation pattern	**Expl**	**Exp2**	**Exp3**
A	1	3	2
B	2	4	1
C	3	1	4
D	4	2	3
A	1	3	2

Table 18.1: Order of conditions in three experiments

The last test (A) is a repetition of the first (A). There was one constraint. Condition 4 could never be presented as 'A' since it was always the last condition used in the training phase. If condition 4 were used in the first position (A) then there would be no switch at the beginning of the test.

The number of repetitions of the puzzle in each condition was fixed within each experiment (e.g., 7 repetitions in experiment 1). In theory 30 repetitions in each phase would have been ideal (a 30 x 30 F- test would then yield a critical value of F ratio A-A of around 1.88). However such a lengthy procedure proved totally impractical. The pilot showed that no one was prepared to complete a test of that length. The actual pattern of shape presentation within each phase is given in appendix 2. It is not useful to calculate the actual event rate since it is itself dependent on the rate of subject response. If a subject's response is slow that necessarily delays subsequent shape presentations.

The three experiments are technically very similar. Experiment 1 is the most important. The variations in 2 & 3 are introduced to test the hypotheses that an individual performance signature would be evident across variants and over time.

Chapter 19: The subjects

The choice of subjects posed an interesting question. Who, in their right mind, would consent to be a subject in a programme designed to bore them? This is not a unique issue. Analogous situations are encountered elsewhere particularly in medical research. Pressure can sometimes be brought to bear (e.g., in student studies), or appeals made to altruism and avarice (e.g., payment in common-cold research). Students were indeed used in the pilot studies, but not in the main study. They were volunteeers from a cohort of general management students and there was no reward for participation or penalty for non-participation.

There are serious difficulties in generalizing from students to the population at large. Additionally there were two specific reasons for rejecting students as subjects in this study. Firstly, the focus of interest from the onset had been on work-related behaviour. Secondly, there are no obvious measures of student behaviour that can be used to estimate boredom susceptibility. There is no theoretical justification for using course grade, and student absence from scheduled lectures is best explained by the existence of more attractive options (e.g., staying in bed, completing an overdue assignment).

Two work populations, marine watchkeepers and clerical staff, were both accessible and of particular theoretical interest. These two groups lie at the extremes of Klapp's (1986) notional continuum of boredom (discussed fully in Chapter 14). Samples from both populations were used. In principle, if a link exists between disengagement and work record, it should be found most readily where the nature of that work is boring. The work of both groups was boring. The work of the seafarers was discussed earlier. Observations of the clerks' job were also made.

The seafaring subjects were attending a short training course at marine college. The clerical group worked for a government agency. Both samples were chosen randomly from pools of volunteers. The clerical workers were more accessible than the seafarers and could be revisited as a group and work record data collected on them. An important motivational point may have been that although the experimental task was boring so, too, was the everyday work of the clerical staff.

The clerical task

Clerical work is boring in a very different way to marine watchkeeping. Marine watchkeeping is essentially a vigilance task (and thus generically boring according to Welford 1965). The difficulty with vigilance is maintaining attention when very little is happening. Clerical work, particularly data-entry, is by contrast pressured and continuous. Data-entry conforms to Blauner's (1964) description of the most unsatisfactory work; it "is not intrinsically interesting and yet requires rather constant attention" (quoted in Molstad 1986 p228).

A flexi-time regime operated at the clerks' place of work, but otherwise individuals were closely monitored. The individual working hours and work-rates of data-entry staff, were continuous available to supervisors via computer. The operators 'logged on' whenever they began working on their machines. They had to 'log off' when they left a machine for whatever reason (e.g., to visit the toilet).

Individual output was continuously compared with that of the group average. It was apparent to some that their continuous efforts to reach and exceed this average were collectively self-defeating. Any increase in individual performance inevitably raised the group average. The clerks had to make 'effective use' of 75% of the working day. That is to be 'logged on' and inputting data at or near the group average rate. Though most could meet and even surpass this target, they generally considered it excessive.

The observations confirmed the view of data entry work as stressful (Grandjean 1987). The workload was high, unvarying and continuous. The periodic breaks taken did not conform to those recommended as appropriate by Haider, Kundi and Weissenbock (1980), and indeed appeared to contravene the relevant EC Directives.

The sample

It was calculated, using pilot data, that 12 subjects would be required for paired comparisons between *early conditions* and *late conditions* (A-A), and 46 to demonstrate adequate external correlations (the definition of 'adequate' is to some extent arbitary). The larger number (46) was used in further calculation. The base number was inflated to 52 (+10%) for safety. This was also the subject number suggested by rule-of-thumb (Rudestam & Newton 1992 p65) and power analysis (Edwards 1950 p92). It was anticipated that, given the nature of the experiments -- three extremely boring tasks -- a high subject attrition rate would be experienced. The initial subject figure was inflated to 120 to allow a margin of safety. The characteristics of the sample are summarized below in Table 19.1.

	CLERKS	MARINERS
Data-entry	48	-
General clerical	41	-
Total	**89**	**31**
Male	19	31
Female	70	0
Mean age in years (SD)	32.3 (10.2)	24.3 (1.6)
Work start year (range)	1981 (25 years)	1987 (2 years)
Mean hours per week (range)	31.7 (27)	-

Table 19.1: Subject characteristics

The seafarers took the SWAT test at individual computers within a large computer laboratory at their college. The clerical subjects were allowed time out from their workplace during office hours without penalty and made the short journey (less than 1000m) to a laboratory within a building well known to them. Thus for all subjects the experiments were set within a context of both place and time that was unremarkable. Within limits the subjects had been doing familiar things before the experiments began and had expectations that similar things would follow.

Chapter 20: Other measures and overview

All subjects were interviewed at the first meeting prior to experiment 1 using a fixed schedule intended to access the subjective experience of work, but without predefining the terms of reporting that experience. One constraint was applied. Neither the word 'boring' nor any of its derivatives (e.g., boredom), associates or synonyms (e.g., tedium) were ever used by interviewers. Such language would clearly be leading.

The content of the interviews was encoded later for analysis. All subject questions were answered in full. Nothing was withheld from them. If subjects asked questions about the experiments themselves, these were described as measuring *'Mental Agility'* and elaborated as 'something akin to speed of thought'. There was no intent to deceive. A discussion around the meaning of emotion might well have proved interminable.

At the conclusion of the programme of work everyone was asked if they had found the experiments boring. Only one subject did not find them boring. This subject's file was unusable. Only 10% of the subjects however volunteered the description 'boring' without any form of prompting.

Work performance data on 8 criteria were extracted in encoded form from the last Staff Appraisal reports of 102 of the subjects by Personnel Department staff (using the proforma in appendix 4). Such data can be treated as interval level since the appraisal itself was designed to assess staff and not merely rank them. Although the output, accuracy and absence assessments were based on objective data (i.e., computer log of work, actual days lost) the general limitations of performance appraisal must be admitted (Hellriegel, Slocum, & Woodman 1992). It known for example that raters with low self-esteem are particular prone to inaccurate assessment of their staff. Leniency, central tendency and the so-called 'horns' and 'halo' effects may all deteriorate the data. These limitations had to be accepted since this information was strictly confidential, and direct access to the record or the raters was not possible.

Questionnaire items

Theoretical interesting questionnaires scales were trialed with an exploratory intent.

The Boredom Proneness Scale (relevance discussed in Chapter 7)

The Boredom Proneness Scale (Farmer & Sundberg 1986 discussed in Kass & Vodanovich 1991) was the closest -- in the sense of what it purports to measure -- to the factors of interest here. The reliability of the true-false version of the scale is reported thus. Internal Consistency was given as .79 by Farmer and Sundberg (1986) and .73 by Ahmed (1990). The 7-point version's consistency was reported at 0.83 by Vodanovich and Kass (1990). Test-retest reliability was put as .83 (Farmer & Sundberg 1986) after one week and 0.79 after two weeks (McGiboney & Carter 1988; Vodanovich, Verner & Kilbride1990).

Augmenter/reducer scale (relevance discussed in Chapter 4)

The augmenter/reducer dichotomy (Herzog & Weintraub 1977) was of some theoretical interest. The argument that incoming stimulation is treated in two different ways by individuals, depending on their internal needs, is theoretically interesting. Again the internal consistency of the scale is .9. Construct validity was also adequate (if concurrent validation is acceptable as a measure).

Locus of Control (relevance discussed in Chapter 7)

The Internal-External (I-E) scale (Rotter 1966) is a 29 item forced-choice questionnaire that measures generalized expectancies about how reinforcement is controlled (externally or internally). The scoring is in terms of the total number of external choices selected so that a high score describes an external expectancy. Test-retest reliabilities of .60 and .78 are reported over a one month interval.

Biographical information items

Several items of biographical information were collected using the schedule in appendix 9 (adapted from Wilkinson 1995 - refered to as BIODATA in the analysis). The items were selected atheoretically to capture the widest practicable spread of individual background, experience and preference.

Difficulties with the questionnaires

Like so many such scales, items showed pronounced signs of the special populations they were designed to study (mainly American college students). The language of some items was frankly absurd in the contemporary context (e.g., "I am a swinger"). The 28 items of the expanded scale used by Farmer and Sundberg (1986) was initially less of a problem than the 45 item Reducer/Augmenter scale (Herzog & Weintraub 1983). In a pilot some substantial problems arose. The main difficulty was inconsistent interpretation of items as signaled by these behaviours.

- the sense of the item was questioned
- the item was skipped by more than one subject
- a limited understanding was voiced
  (e.g., "What is delinquent behaviour?").

Items were eliminated and the instruments used with an exploratory, not a hypothesis testing intent. It was realised that these adaptations must effect the psychometric properties of these scales But neither their validity nor reliability were crucial to this study. The intention was that if interesting features were noted then these might be pursued more rigorously later (e.g., by postal survey). The additional data was also insurance against null findings from the experiments. These exploratory questionnaires and the biographical information form were administered by a researcher 'one-on-one' to eliminate any misunderstanding and to ensure comprehensive coverage.

Several methods were used in this study. Background theory was drawn from the literature and interpreted in the light of experience of accident investigation. A focal theory was generated from observation and subsequent reconsideration of the literature. This process allowed a testable data theory to be generated and tested by experiment.

Chapter 21: Research hypotheses

The core research hypotheses were embedded within the mapping sentence (see chapter 16). Piloting and other research suggested additional hypotheses.

The core mapping sentence was:

"A person demonstrably attending to, and competent on similar, simple tasks who is not becoming fatigued will, over time, disengage from those tasks in a characteristic manner".

Demonstration of an effect

The key proposition of the IRAM is that there is a disengagement effect that varies individually. If no such effect was demonstrably then the thesis must necessarily fall. The theory was bold. It could readily be falsified.

Individual performance on simple, repeated tasks may vary for many reasons. A practice or learning effect should be expected. Disengagement is thus hypothesized to be working in the opposite direction to learning. The IRAM predicts that though mean performance may remain stable or improve over time due to learning, the overall trend will be towards increasing variability in behaviour. Any such trend might easily be explained by fatigue or lack of attention. If such explanations might be discounted then the IRAM interpretation of events could reasonably be supported.

Associates of the disengagement effect

The IRAM predicts that generally slower adaptive processes and increased variability over time will relate to other behaviours that have been linked to boredom. The difficulty of defining boredom has been elaborated at great length elsewhere

(Chapter 2). However the term 'boredom' will continue to be used here as a convenient summary label.

Nine hypotheses (listed below in Table 21.1) were tested. Eight are derived directly from the IRAM. The ninth is of theoretical interest, though not predicted by the IRAM.

1.	There is no fatigue effect over the duration of the test
2.	The subjects are sufficiently motivated to complete the task.
3.	There is an improvement on the task (learning) over the duration of the test.
4.	Individual disengagement behaviour increases over the duration of the test.
5.	Subject behaviour is consistent across similar experiments.
6.	Individual differences are more significant than between group differences.
7.	Individual patterns of disengagement relate to work performance
8.	Individual patterns of disengagement relate to absence from work
9.	Ability on the SWAT test relates to the extent of disengagement

Table 21.1: The nine experiment hypotheses

Note: Strictly speaking hypotheses 1-3 are necessary empirical conditions for the testing of the key hypotheses.

SECTION FOUR - RESULTS

Chapter 22: Overview of results

Results are reported in the following four chapters (22-25). The characteristics of the data are established here (chapter 22) prior to the testing of hypotheses (chapter 23). The dynamics of subject behaviour are described in chapter 24 . Some specific results are elaborated in chapter 25.

Overview

One hundred and twenty subjects took part in the study. However not all of the computer files they produced could be analysed. Files became unusable for a variety of reasons. Some early subjects reacted in unanticipated ways (e.g., hitting several keys at once) which 'scrambled' the data. These problems were technically easy to overcome. The main source of data loss was 'human error' on the part of this author. While using a file compressor he accidently overwrote good files with bad copies thus irrevocably destroying the record. Such misfortunes are inevitable in field work and had been anticipated in the power calculations. Table 22.1 summarizes the output from the experiments.

	Usuable files
Experiment 1	99
Experiment 2	61
Experiment 3	62

Table 22.1: Summary of experimental output.

Experimental data -

Key aspects of experiment 1 data are presented below in table 22.2. The pattern for all experiments is similar.

VARIABLE	MEAN	S.D.	DISTRIBUTION	*K-S z	Prob
CAPACITY	4.65	1.93	Normal	1.3	.06
DILIGENCE@	1.94	2.56	Normal	1.5	.02
REFLEX	0.71	0.20	Normal	1.4	.04
THINK	3.11	1.07	Normal	1.4	.05
VARIABILITY	2.51	2.17	Normal	3.1	.0005
ERRORS	1.08	1.90	Poisson	1.8	.003

Table 22.2: Key features of the experimental data

* note 1: Kolmogorov-Smirnov 'goodness of fit test' (2-tailed).

@ note 2: This distribution may be bimodal (see appendix 11B)

Work performance data

Performance data on 8 criteria were extracted from the previous year's staff appraisal on a proforma (appendix 4). A 7-point scale was used for each criterion.

The limitations of these data (Hellreigel et al 1992) are evident in the summary (appendix 5). 'Leniency' could explain the positive skew of the ratings and 'central tendency' the restricted range of some criteria. It not surprising that *absence* and *attendance* show the most satisfactory range since the most objective data (e.g.. actual days lost) were used in these two assessments. It is impossible to know the extent, or even direction, of the more subjective effects. Nothing was known of the raters other than they had been managerial grades. Judgments might have been skewed by their personality or the personality they ascribed to the rated. Overall impressions may easily be dominated by the attribution of one positive (halo effect) or negative trait (horns effect) to the rated (Reber 1985).

The relationships between work related variables were calculated as Pearson's r (appendix 6) and a factor analysis conducted (appendix 7). Two factors (orthogonal to each other) account for 73% of the variance. This suggests that the raters are making coherent judgments. One factor relates strongly to work performance (named PERFORMANCE) and the other to absence (named DISTANCE).

Nothing was known of the reliability of the staff appraisal data. Any unreliability must limit the correlations achievable (the maximum coefficient possible being the square-root of the reliability). Thus unreliability here works against the researcher.

Interview and biographical information

The interview data were encoded for analysis as was the biographical information. The correlations between these items and the experimental data are given in appendix 10.

The experimental data appear to meet all parametic assumptions. The sample is relative large (N = 99) and drawn at random from a pool. The distributions of the variables are mostly near normal and the variance homogeneous. The experimental measures are at the ratio level.

Chapter 23: Testing the research hypotheses

The nine research hypotheses were developed in chapter 21. The formal statements of statistics, and decision rules are given in appendices. Here only the hypotheses, and relevant decisions will be discussed.

<u>Research issue 1</u> - To demonstrate that there is no fatigue effect. (appendix 11A)

Individual REFLEX is recorded by a key hit. The number of hits varies individually. Across the entire procedure -- training phase + test phase -- the mean number of hits in experiment 1 was 63 (range 58-67). REFLEX was regressed on *order of key-hit* . The average slope of the regression lines was negative (-0.002). Only two individual slopes are unlikely ($p \leq .01$) to have come from a distribution with a mean of zero or less.

REFLEX then is generally stable. The vigilance task does appear to perform its function of capturing subject attention. There is no significant fatigue effect.

<u>Research issue 2</u> - **To demonstrate that subjects are sufficiently motivated to complete the cognitive task** (appendix 11B).

DILIGENCE measures persistence with the puzzle-task (whereas CAPACITY shows the speed with which the puzzle-solving task is learned). DILIGENCE is a relative term allowing between-subject comparisons to be made. Actual subject behaviours can also be compared with random or systematic behaviour.

The distribution of DILIGENCE scores approximates the normal in all experiments, but appears to be bimodal in the longer experiment 1 (histogram in appendix 11B). There is a possible transition point at zero. Zero is the score generated by random response.

The scores of some subjects are lower than those achievable with random or systematic strategies (see appendix 11B). It could be that they are becoming progressively de-motivated. An analogy might be with a person sitting an IQ test who fails, perhaps from lack of interest, to complete it effectively (e.g., responding randomly or marking every left-hand item).

<u>Research issue 3</u> - To demonstrate there is an overall improvement on the task (learning) over the duration of the test. (appendix 11C).

The first and the last condition presented are always identical within an individual experiment (the **A**-BCD-**A** pattern). The performance (THINK time) of subjects reduced between the first presentation and the last in experiment 1, 2 & 3 ($t = 5.51$, 10.95 & 8.63, $p \leq .0005$). Learning appears to occur.

<u>Research issue 4</u> -To demonstrate individual disengagement behaviour increases over the duration of the test (appendix 11D).

For all subjects the VARIABILITY in the early presentation of a condition was not significantly higher than in the later presentation. However for the clerical group the difference was significant at $t = -3.20$, $p \leq .002$, but only in the longer experiment 1.

The small differences in results between the groups (mostly insignificant - see research issue 6 below) could have been caused by the conditions under which the test was taken (see chapter 19). Conditions for the clerical staff, other than the date and time they came to the laboratory, were identical . The seafarers were all tested on the same day, but on many machines. There may have been minor differences in machine performance (e.g., stickiness of keys).

<u>Research issue 5</u> - To demonstrate subject consistency across similar experiments (appendix 11E).

Kendall's coefficient of concordance (W) was calculated for all experimental variables across the three experiments. W was significant ($p \leq .008$) in all cases

Variable	**(N)**	**W**	**$\chi 2$**	**D.F.**	**significance**
CAPACITY *	2	.7914	71.2301	45	.0076
DILIGENCE *	3	.5337	70.4506	44	.0069
REFLEX *	3	.8387	113.2234	45	.0000
THINK	3	.6613	89.2773	45	.0001
VARIABILITY *	3	.5618	75.8447	45	.0027
ERRORS	3	.5659	76.3924	45	.0024

Table 23.1: Kendall's coefficients of concordance (W) across three experiments

<u>Note 1</u>: (N) = the number of experiments in which this variable was measured
<u>Note 2</u>: Kendall's W (coefficient of concordance) is similar to Spearman, but whereas the latter may consider only two sets of rankings W may encompass any number of ranks (Siegel 1956 p229- 238).
<u>Note 3</u>: * also significant with Hotelling's T^2 suggesting that the pattern of these behaviours across experiments remains the same (Kanji 1993 p39).

<u>Research issue 6</u> - To demonstrate that individual differences are more significant than between group differences (appendix 11F).

The only significant group difference (clerks-mariners) is on REFLEX ($t = 4.45$, $p \leq .0001$). This is possibly explained by the mean age differences between groups (8 years). There was no evidence of male-female differences detected within the clerical group (the mariners were all male). However only 21% of the clerical subjects were male. .

<u>Research issue 7 & 8</u> - To demonstrate that individual patterns of disengagement relate to work performance and absence (appendix 11G).
The IRAM proposes that disengagement behaviour is signalled by increasing THINK and VARIABILITY. These variables should correlate negatively with measures of job performance and positively with measures of absence (job performance data was only available for the clerical subjects).

The correlations are all in the predicted direction and most are significant (see appendix 11H). There were no theoretical grounds for suspecting significant correlations with items 4-6; *Level of Knowledge, Use of the Working Day* or *Customer Service*. For items 4 & 6 the mean correlations were an order of magnitude lower than for the others. THINK however does correlate significantly with item 5, *Level of Knowledge* ($r = -.34$, $p \leq .001$).

The apparent bimodal distribution of DILIGENCE in experiment 1 (appendix 11B) suggests that some subjects were unable or unwilling to complete the task (discussed above in research issue 3). The correlations differ markedly between those of high and low DILIGENCE (see appendix 11H). Zero DILIGENCE is the score expected by random hits and the obvious transition point from low to high mode. It is reasonable to assume that those who score higher than zero on DILIGENCE and make fewer than two recognition ERRORS are more highly motivated than others. The correlations are given below for this *motivated group*.

	OUTPUT	ACCURACY	VERIFY	ABSENCE	ATTEND.
THINK	-.4025**	-.4074**	-.4067**	.2804	.3461*
VAR.	-.3095*	-.4787**	-.4035**	.3490*	.3395*

* $p \leq .05$ ** $p \leq .01$ (2-tailed)

Table 23.2: Work to experimental data correlations for motivated group

The high inter-correlations of job performance data suggested factors (appendix 6). These account for 73% of the variance and here are named PERFORM -- comprising work related items and DISTANCE -- comprising absense related items (the formulae are given in appendix 11I). These factors relate to the experimental variables thus:

	PERFORM	DISTANCE
CAPACITY	.4603**	-.3086
DILIGENCE	.3116	-.2666
REFLEX	-.2491	.3014
THINK	-.5050**	.3054
VARIABILITY -	-.4433**	.3478*
ERRORS	-.3281*	.0557

* $p \leq .05$ ** $p \leq .01$ (2-tailed)

Table 23.3: Correlations of experimental data and work factors

Multiple regression of the experimental variables on the two work related factor enabled a predictor -- named here *Mental Agility* -- to be calculated (appendix 11J). *Mental Agility* correlates thus with the two factors.

	PERFORM	DISTANCE
MENTAL AGILITY	.62 **	-.44 *

* - $p \leq .005$ ** - $p \leq .0005$ (2-tailed)

Table 23.4: Mental Agility as a predictor of work-related behaviours (motivated group)

<u>**Research issue 9**</u> **- To demonstrate whether ability on the test determines disengagement** (appendix 11K).

There is a significant correlation ($r = -.2137$, $p \leq .05$) between VARIABILITY and CAPACITY, and thus the suggestion that those of greater ability are least variable.

Chapter 24: The dynamics of subject behaviour

The results discussed in chapter 22 & 23 relate to measures that are recorded at the end of the SWAT procedure. They are terminal values. Thus THINK is the mean of an individual's puzzle-solving times across <u>all conditions</u> of an experiment. These terminal values were used to test the research hypotheses (in chapter 23). The way in which these terminal values are produced is also important.

It was anticipated (chapter 15) that any pattern of behaviour emerging in the experiments might not be instantaneously obvious. The evidence for a characteristic bored performance curve has been equivocal (chapter 2). VARIABILITY is the measure most closely associated with boredom by the IRAM. The curves of VARIABILITY (see Figure 24.1) suggest a general boredom curve might not exist.

Individual VARIABILITY curves are unique and consistent across experiments. However the **group mean** curve for all subjects is flat, and completely disguises individual variation. Since the distribution of VARIABILITY is markedly normal (K-S $z = 2.09$, $p \leq .0005$) this pattern is expected. The average of individual signatures should produce the group mean of such a distribution. The pattern here suggests a plausible explanation why deteriorating performance has not been consistently associated with boring conditions in previous research. It is possible that more attention has been paid to aggregated mean performance than to individual variability of that performance.

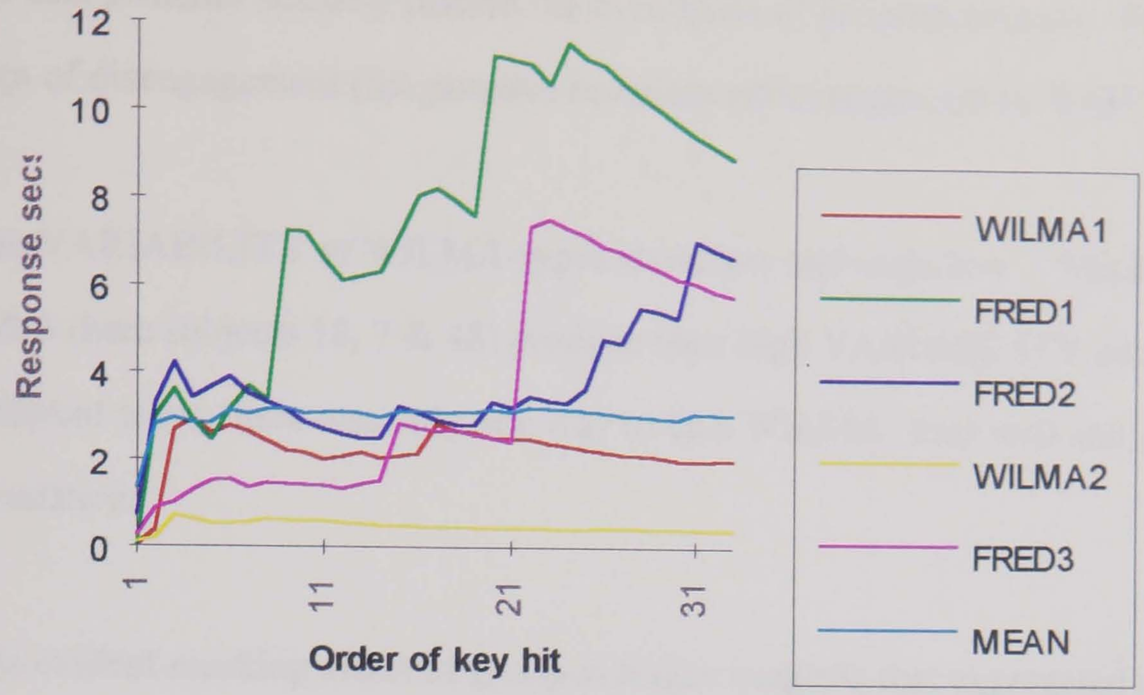

Figure 24.1: VARIABILITY against order of puzzle

* Note: Order of key-hit is prefered to time for comparisons between subjects since the length of a test depends on response times.

The mean (all subjects) VARIABILITY is clearly seen in Figure 24.1 to settle very rapidly to its terminal value. Two individual curves never rise above the group mean. The remaining three curves terminate well above that mean. The terminal value relative to the group mean is a convenient descriptor of a curve. For convenience individuals producing curves of the former type that never rise above the group mean will be termed WILMAs. The latter will be called FREDs. Nothing sexist is implied in the terminology. The names are taken from popular 1960s cartoon characters with extreme behavioural traits.

WILMAs are more interesting than FREDs. SWAT is designed to be boring; it is boring. The performance of extreme WILMAs is quite singular. WILMAs (here subjects 11 & 1 in experiment 1) demonstrably maintain attention. WILMA2 (subject 11) is apparently unaffected by the tedium of the tasks. The shock load of the task the task switches scarcely disturb the even tenor of her performance. There is no sign of disengagement (the putative boredom effect measured by VARIABILITY).

The VARIABILITY of WILMA-types starts low and stays low. Whereas FREDs 1, 2 & 3 (here subjects 18, 7 & 48) produce their high VARIABILITY patterns in different ways, there was only one way to be a WILMA: start well and stay consistent.

The evident masking effect of group averages suggests that aggregated performance is of limited value where boredom is concerned. The emphasis must be on individual performance patterns. Two further subject records are compared below in Table 24.1.

	WILMA	**FRED**
SUBJECT No.	(65)	(18)
CAPACITY	5.0	4.9
REFLEX	0.55	0.64
THINK	0.71	5.12
VARIABILITY	0.16	6.61
RANKED VAR.	(2)	(95)
ERRORS	1	1

Table 24.1: SWAT output for two extreme performers

These two subjects, again from opposite tails of the VARIABILITY distribution, also differ significantly on THINK. This is not surprising since VARIABILITY is variance of THINK. Both subjects show comparable ability on the test variance of THINK. Both subjects show comparable ability on the test (CAPACITY), and speed of response (REFLEX). They were concentrating in a similar way (i.e., few ERRORS). The way in which their terminal VARIABILITYs becomes so different is readily seen when the dynamic record of performance is inspected. Figure 24.2 shows individual responses of the WILMA type against time into the test.

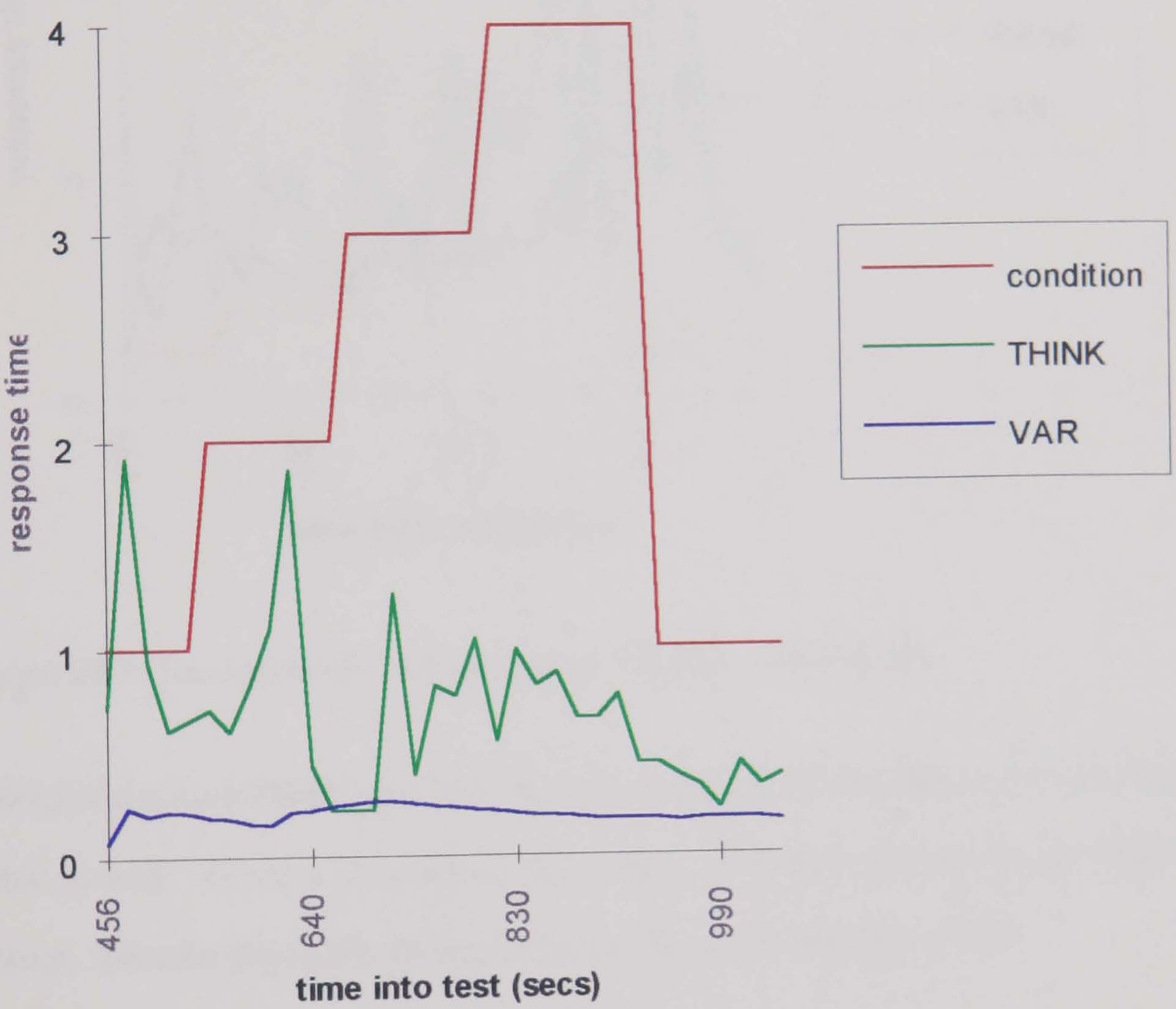

Figure 24.2: Exceptionally good performer (WILMA - subject 65)

The step-wise progression of the conditions is obvious. Within both Figure 24.2 and Figure 24.3 (below) the last phase is identical to the first (the ABCDA logic). There is no significance in the numerical label of condition or magnitude of its representation on these graphs. FREDs graph (Figure 24.3) has been vertically compressed to accommodate more extreme ranges of THINK.

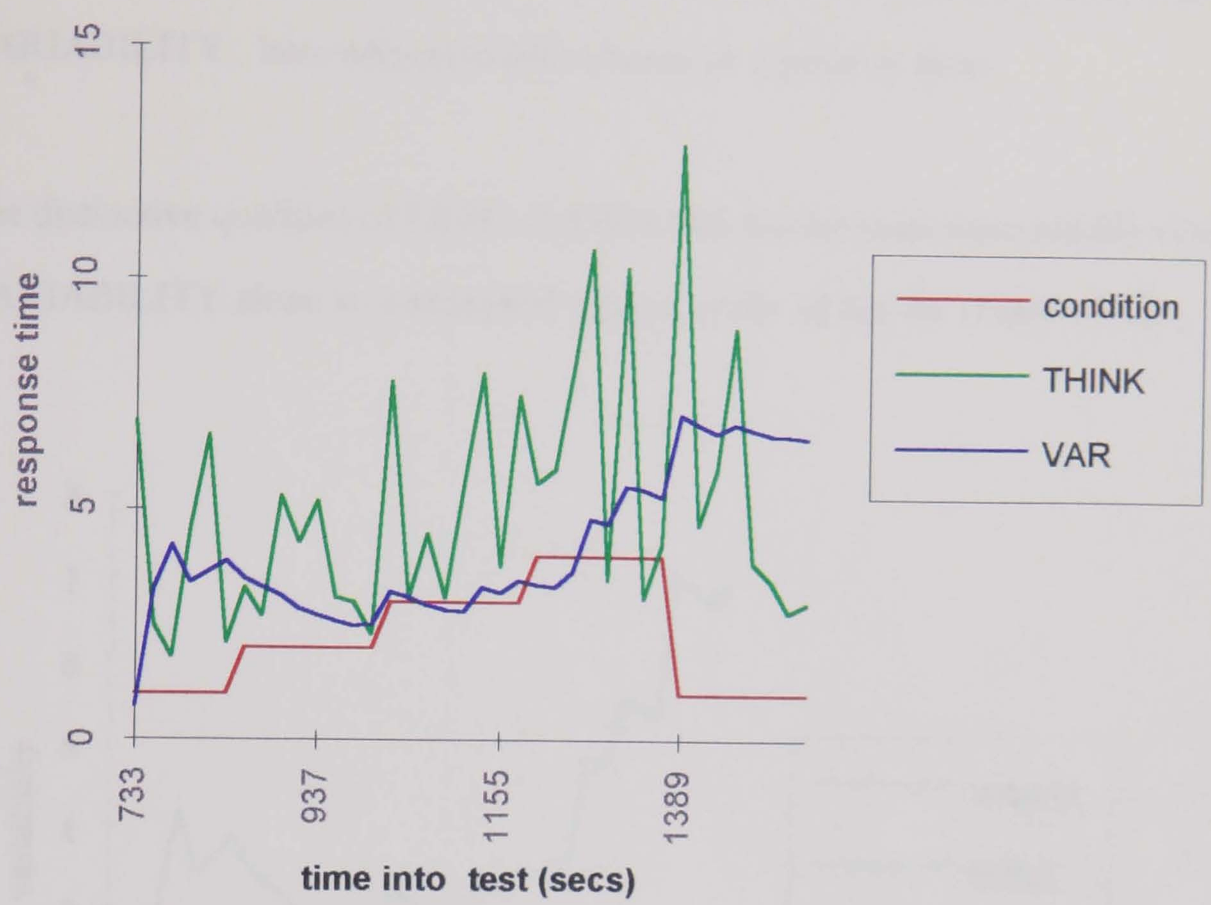

Figure 24.3: Exceptionally bad performer (FRED - subject 18)

REFLEX for both FRED and WILMA fluctuates in the middle of the test, but is stable overall. There is no evidence that either of these two subjects, or indeed any subject, became physically fatigued during the test (see chapter 24).

The THINK signatures are very different. FREDs is very 'spiky' and this is reflected in the large VARIABILITY score. His VARIABILITY increases steadily throughout the test declining slightly towards the end. THINK for FRED shows very distinctive peaks. One is particularly marked at the changeover from condition 2 to 3. This is the point where a mental shock (the puzzle switch) was delivered. This pattern of THINK (as previously argued) could also go some way to explain the lack of consistent evidence that reported boredom is associated with poor performance (Jerison 1977; Hopkins 1990). FREDs mean THINK (4.2s) effectively disguises the peaks and troughs that are occurring (max 9.6 secs; min 1.2 sec.). FRED can be eight times slower on occasion than at others. This fluctuation is conveniently expressed as VARIABILITY, here accumulated variance to a point in time.

The distinctive qualities of FRED and WILMA can be seen more readily when VARIABILITY alone is considered against *order of key-hit* (Figure 24.3).

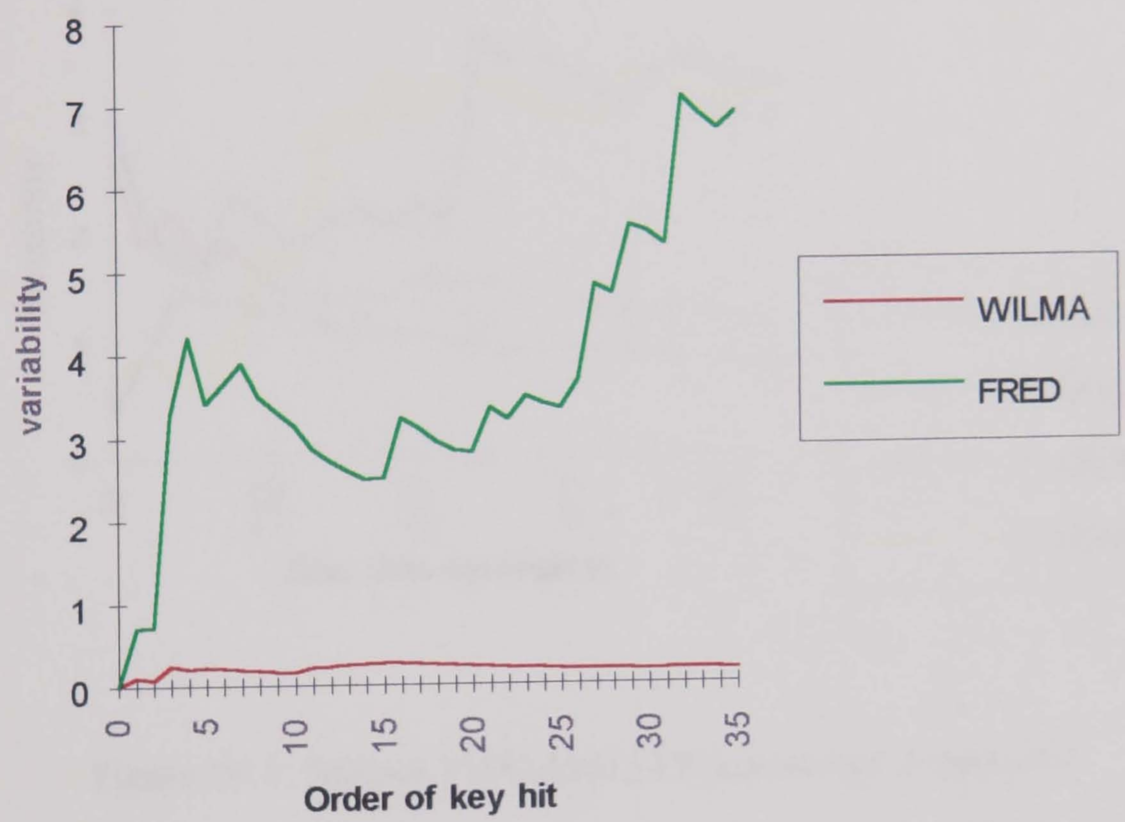

Figure 24.3: Comparative VARIABILITY - good and bad performers.

WILMAs VARIABILITY initially climbs and then steadies. The IRAM interpretation is that her allocation of capacity was requisite by key-hit 5. By then it was sufficient to absorb periodic shocks without measurable disturbance. By contrast FRED's VARIABILITY continues to rise long after WILMA's has stabilized.

There was evidence of an individual pattern of behaviour -- a signature -- for individuals across experiments. This signature is again clearest when individuals from opposite tails of the n-distribution are considered. A consistent pattern of individual VARIABILITY across experiments, and in working life, is predicted by the IRAM (tested in chapter 24)..

Two subjects (ranked 26 & 73 on VARIABILITY in experiment 1) are compared across experiments in Figure 24.4 (below).

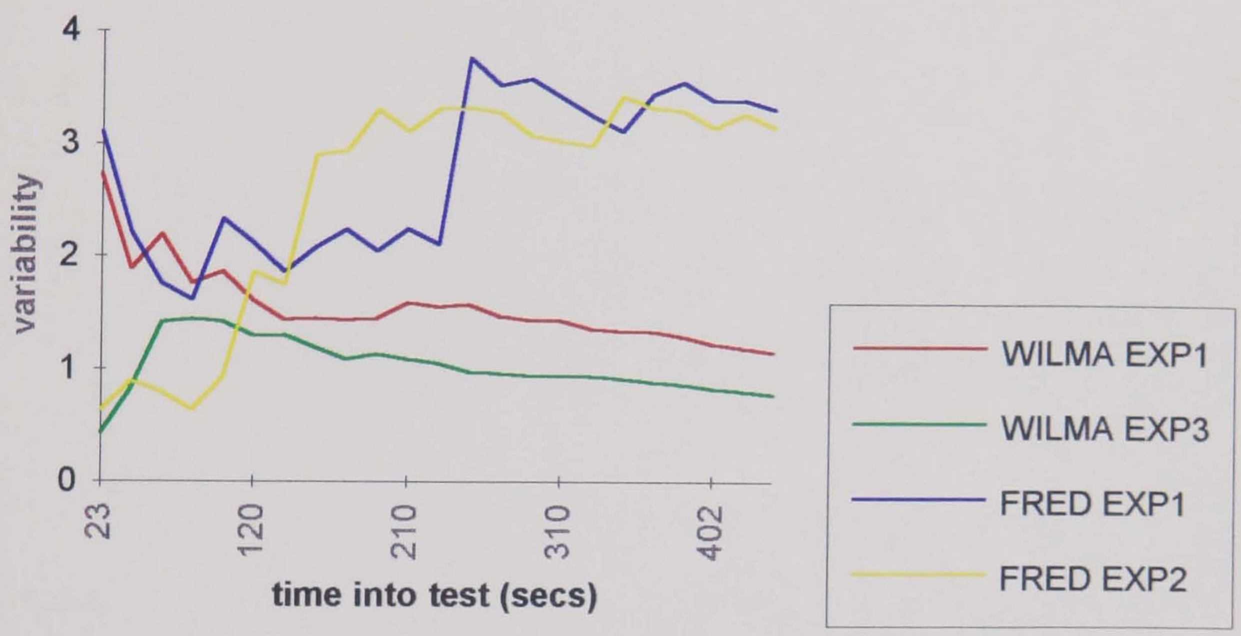

Figure 24.4: Subject VARIABILITY across two experiment

The VARIABILITY scores for the two subjects (43 & 3) in experiments 1 are given with their scores in experiments 3 & 2 respectively (for equal periods of time). There appears to be some consistency of behaviour. Over time an individual's VARIABILITY scores appear to converge to a particular value.

The evidence of the dynamic record certainly tends to support the IRAM. There is some evidence of an individual performance signature. This signature may show

The evidence of the dynamic record certainly tends to support the IRAM. There is some evidence of an individual performance signature. This signature may show some consistency over time and between different variants of the SWAT task. The masking effect of the group mean may explain the lack of conclusive evidence for a characteristic bored performance curve.

Chapter 25: Additional results

Some further observations must be noted before they may be sensibly discussed. These concern both the nature of the data and relationships between items of data that were not predicted.

The nature of variability

Disengagement, the central theme of the IRAM, was operationalized in the SWAT procedure as VARIABILITY. This score aggregates all the variability in THINK times across an experiment. The switches of condition within SWAT were designed to induce this variability. At the point of switch THINK does become particularly variable. The differences between the first two responses after a change of condition and subsequent responses is substantial ($t = 40.5$, $p \leq .0005$). Changes of condition do indeed deliver 'shocks' (as discussed in chapter 24 and illustrated in figures 24.2 and 24.3).

The terminal value of VARIABILITY correlates strongly ($r = .97$, $p \leq .0005$) in all experiments with the variability within *late conditions*. *Late condition* variability could have been used as a measure of disengagement. However the terminal value is a more robust measure since it is calculated off all data points.

Familiarity and consistency

The predicted effects of decreasing THINK and increasing VARIABILITY from *early conditions* to *late conditions* were found and these were significant when the procedure was administered under identical conditions (research issues 3 & 4 chapter 23). This combination of findings is particular striking given the nature of these two constructs.

Since VARIABILITY is the variance of THINK, the arithmetic expectation might be that as THINK reduces so too should its variance. The smaller the range of THINK times the lower is the likely variance. Thus instant response would imply zero variance. However the reverse is the case (see figure 25.1).

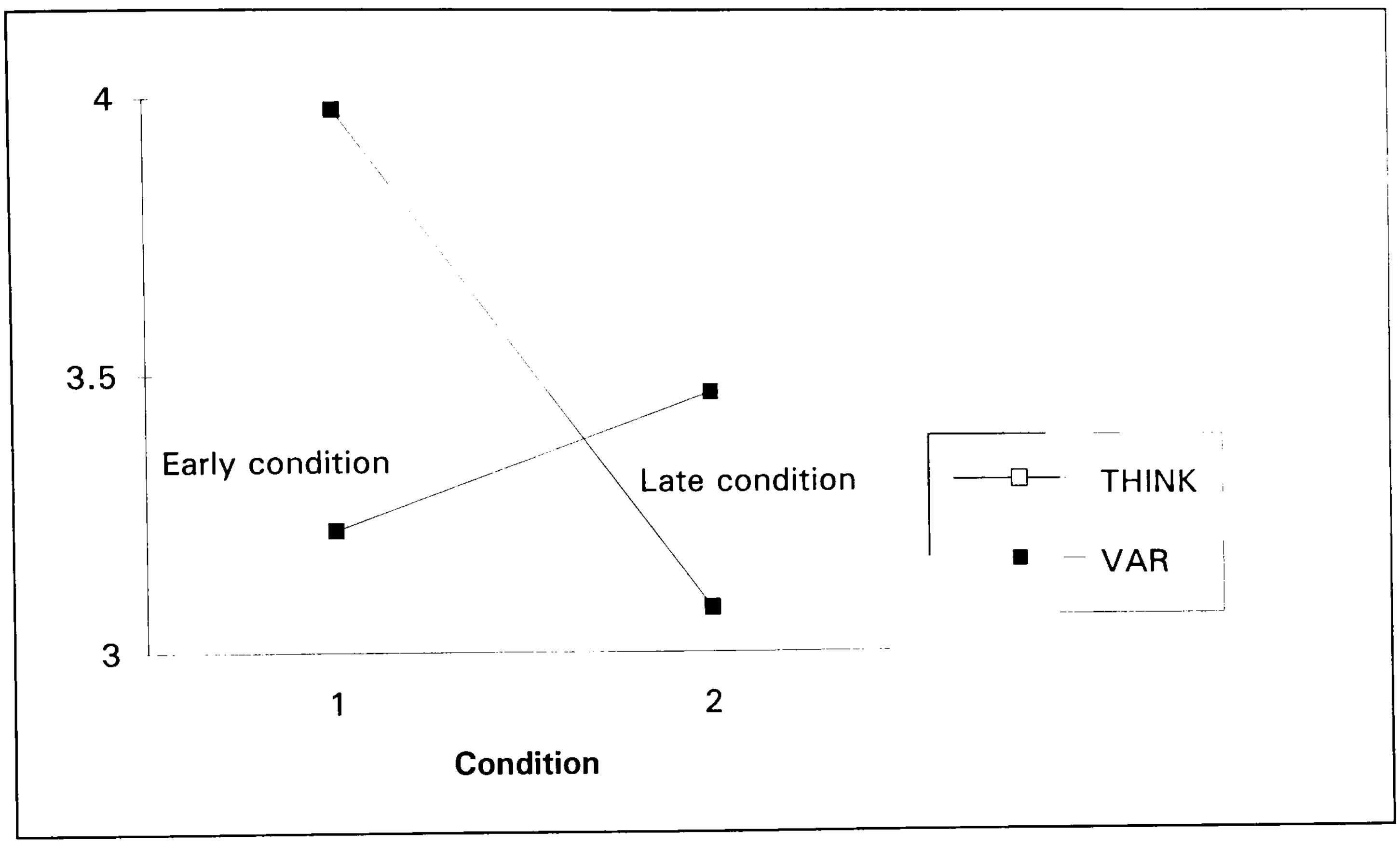

Figure 25.1: VARIABILITY and THINK time relationship

<u>Note</u>: 1 = mean within early conditions

2 = mean within late conditions

Mean performance improves with familiarity but consistency suffers. This result, predicted by the IRAM, could explain key aspects of bored behaviour and inconsistences in literature (e.g., expert error, doubts about the bored performance curve).

Relationship between variables

The relationships between the experimental measures -- calculated as Pearson product-moment correlations -- are displayed in table 25.3 (below) .

	DILI	REFLEX	THINK	VAR	ERRORS
CAP	.50**	-.08	-.14	-.21*	-.04
DILI	-	-.05	.08	.04	-.11
REFLEX		-	.21	.20*	.45**
THINK			-	.66**	.10
VAR				-	.13

$* \ p \leq .05$ $** \ p \leq .01$ (2-tailed)

Table 25.1: Correlations between experimental measures (Pearson's r)

Note: VARIABILITY (VAR) is the variance of THINK.

The significant relationship between REFLEX and ERRORS ($r = .45$, $p \leq .01$) may reflect the well known trade-off between speed and accuracy implicit in response tasks such as SWAT. However there are so few errors overall -- 46% of subjects made none -- that this might be an incautious assumption.

REFLEX is stable within and consistent between experiments. Its main associate is age ($r = .4$, $p \leq .001$). Possibly the correlation of experimental output with work performance could be explained by age (as accidents have been). However there were no age to work performance relationships.

The age-REFLEX relationship may explain the only significant between-group difference found. The mean REFLEX of mariners is faster than that of clerks ($t = 4.45$, $p \leq .0001$). The clerks were on average eight years older than the mariners.

DILIGENCE's negative ($r = -.40$, $p \leq .05$) relationship to age was unexpected. It is surprising that the data-clerks have generally slower REFLEX. It might be expected that they would have some advantage in a key-hitting task.

REFLEX and fatigue

The inference that the vigilance task is performing its function of capturing and maintaining attention (for most subjects) is reasonable given the evidence (Research issue 1 - chapter 23). However the 'no fatigue' conclusion is clearly not the only possibility.

Fatigue might have occurred, but been compensated for or screened by an increasing involvement of anticipatory feed-forward. This criticism has been levelled at other response time studies from the 1878 studies of Donders onwards. A resolution in this study is neither possible nor necessary. Overall effective attention is being maintained.

In principle REFLEX could be disaggregated. The reaction-time component could be separated from other components (e.g., decision-making). For this reason the design of SWAT includes an option to use the 'mouse'. The subjects in this option kept both mouse-buttons depressed and reacted to the puzzles by releasing the left or right button (instead of the Y or N key). This obliges all subjects to keep their hands in the same position. Since they do not need to move their hands to the appropriate key, one source of variability is eliminated. Unfortunately, a new and more troublesome source of variability is introduced. Pilot subjects found the decision whether to release the left or the right mouse-button unmanageably difficult. The difficulties observed might be promising as an independent line of investigation.

Like the *correct/wrong quadrant* decision, the choice *left finger/ right finger*. is both extraordinarily simple in principle yet difficult in practice to make consistently well.

The mean performance of subjects on the SWAT task did, as anticipated, improve over time. The mean THINK time fell from the *early conditions* to *late conditions*. The improvement in THINK may reflect the growing importance of anticipatory feed-forward. This interpretation is entirely consistent with the IRAM. A *chunking* explanation (see chapter 20), by which a summary X is stored rather than $A + B + C$, is equally appropriate. However there is no reason to suppose these explanations are either collectively exhaustive or mutually exclusive.

Interview data

The correlation between CAPACITY and positive statements about work was significant but negative ($r = -.32$, $p \leq .01$). The belief that those of higher ability have more problems with boring work appears to be supported. However self-report here does not tally with managers' assessments of the work records. CAPACITY correlates positively with the manager's assessment of overall work performance ($r = .46$, $p \leq .01$). This latter relationship could reflect some task relevant ability measured by CAPACITY that is more important than motivation. It could equally be that those of higher CAPACITY are better equiped to favourable impress the raters than others (see discussion of the limitations of appraisal data in chapters 20 and 22).

Correlations do not always allow us to choose between competing explanations for a relationship. Difficulties are pronounced here with the self-report items. The correlation between self-reported absence and absence as recorded on the annual appraisal by managers, though significant, is unimpressive ($r = .3$, $p \leq .01$). The view of either managers or clerks or both might be inaccurate or biased.

Alternatively, or additionally, either party may have committed recording errors. In this study the relationship between a subject's sex as recorded by them on the biodata form and their sex as noted by the researchers was not perfect (r = .9). These discrepancies were eliminated by double-checking..

Questionnaire items

The biodata questionnaire produced many significant correlations (appendix 11B). Those of higher CAPACITY preferred maths and science at school to the arts (q10). The SWAT procedure is one of applied logic -- albeit at a low level -- so this relationships appears reasonable.

Those who preferred doing many tasks at once made the most ERRORS (q11). These ERRORS could be a consequence of the impatience that they also report (q29). The strongest suggestion emerging from the biodata was of a link between mistakes and impatience. This is scarcely novel.

There are difficulties in interpretating both the interview and biographical item correlations. These interpretations are guided by no particular theory, the correlations are not generally substantial, and the data have the same potential limitations as performance appraisal ratings.

SECTION FIVE - DISCUSSION

Chapter 26: Overview of significant findings

The model of bored-type behaviour tested in these experiments was derived from both the literature and observation. Earlier work appears to ignore boredom's dynamic nature. The dynamic concept of mental inertia is at the heart of the IRAM. The new model augments the general resource allocation model and the theory developed remains consistent with extant research linking cognition, emotion and motivation. The IRAM suggests performance variability as a behavioural indicator of a mismatch state. The indicator -- operationalized in SWAT as VARIABILITY -- appears to be both sensitive and robust.

Boredom is generally defined as an affect, yet this study has concentrated on the measurement of behaviour. There is a possible discrepancy here between definition and measurement. However this is not a substantial criticism since definitions of boredom have been shown to be so unhelpful.

Variability is proposed as an indicator of resource mismatch. This mismatch is <u>sufficient</u> to cause bored-type behaviours and is <u>necessary, but not sufficient</u>, to give rise to the feeling of boredom. That feeling is a form of appraisal vulnerable to distortion by a number of factors (chapter 10).

Variability is measured in the SWAT procedure and inferred from work behaviours. Here both variability and work behaviour are taken as proximal rather than distal indicators of boredom. A direct logical link is forged between them. However there are alternative explanations of this link.

Motivation might well determine both work and test performance but this argument is no simpler, clearer or more convincing than the boredom account. Motivation is no better defined than boredom. It is certainly reasonable, though probably tautological, to suggest that those who go absent from work are the de-motivated. It is not reasonable to claim that those who do badly on the test are de-motivated. The results show that REFLEX does not increase over the duration of the test while mean puzzle-solving speed (THINK) decreases. If subjects become de-motivated, both should increase. There is no evidence here to support a motivation explanation.

The DILIGENCE measure was introduced as a particular indicator of perseverance with the task. Precisely defined DILIGENCE is preferred here to the general notion of motivation. DILIGENCE could be considered as a special measure of motivation on this particular task (SWAT). DILIGENCE did not predict bored behaviours. The key indicator of bored behaviours was VARIABILITY.

VARIABILITY should discriminate the characteristically *bored* from the *engaged*, but should not discriminate the *motivated* from the *de-motivated*. If the term 'motivation' is meanful it must imply some behavioural consistency. The *motivated* should be consistently good performers; the *de-motivated* should be consistently poor performers. Motivation implies consistency or low variability. Boredom, by contrast, is associated with inconsistency or high variability.

Mental Agility includes weighted measures other than VARIABILITY. Some of these measures may have a motivational component just as others (e.g., CAPACITY) may have a cognitive ability component. *Mental Agility* is a composite predictor of behaviour that explicitly recognises the multiple and interacting causes of work-related behaviour.

Whether increasing performance variability over time is a true measure of boredom cannot, in principle, be resolved. Such a resolution requires concurrent validation of some sort. Either measure of felt-boredom must be accepted as accurate or self-report of the actual state of boredom trusted. The former approach is not only theoretically dubious, but currently impossible. No accepted measure exists. The boredom proneness scale (Farmer & Sundberg 1986) used here is, like other contenders (e.g., Zuckerman's sensation seeking scale or the Eysenck personality inventory), a putative trait measure. No scale measures actual boredom. The latter self-report approach is equally flawed. Self-reported emotion may be effectively unquantifiable (c.f. James 1908) and between-subject comparisons meaningless. Is someone 'bored to death' more bored than another who states they are 'bored out of their mind'?

External evidence for the value of any measure is essential (Kline 1992; 1993). The external evidence that the IRAM does indeed measure aspects of boredom comes from the correlations of experimental results with particular performance on, and absence from work generally regarded as boring. The measures of performance and absence used here were recorded independently by staff of the agency involved in appraisals conducted prior to the experimental programme. The measures are both external and independent of the researcher and his preferred hypotheses. Variability and disengagement are the key ideas in the IRAM model. Their closest logical counterparts among the criterion measures of work performance are *actual absence* and *accuracy of work*. Absence, whether accidental or intentional, is clearly a form of physical disengagement. Accuracy clearly requires application or mental engagement. These work features show the strongest and most consistent correlations with VARIABILITY (see table 26.1) though the innate unreliability of such work performance measures must be born in mind.

Results below are given for all clerical subjects and separately for those who appeared to maintain their motivation as signalled by making fewer than three ERRORS and scoring higher on DILIGENCE than can be expected by random answering.

	(n)	***Accuracy***	***Absence***
All Subjects	89	-.35 **	+.26*
Motivated Group	52	-.48 **	+.35*

* $p \leq .05$ ** $p \leq .01$

Table 26.1: Correllations of VARIABILITY with key work criteria

It is possible that the pattern of results could be explained by the nature of the work done. However there is no evidence to support this argument. Data-entry clerks should be faster and more accurate since key-hitting is a feature of their working life. But data clerks were no more accurate and were marginally slower than other clerks (4% slower on average as measured by REFLEX).

Motivation, though plausible, can be discounted as an explanation of performance results. There are few convincing alternative explanations for the *absence*-VARIABILITY link. Depression might prompt absence and variability might link with depression. However depression was not measured here and it is a less parsimonious explanation than the IRAM.

The IRAM aligns particularly well with appraisal views of cognition-emotion (Lazarus 1991; Ortony & Clore 1989) where an emotion summarizes the output of the appraisal system. The model and results are also consistent with control theory (Lord & Levy 1994) and the proposal that an emotion is a signal (Mandler 1982) or a 'call to action' (Frijda 1970). The idioms of information theory can easily be applied to the SWAT procedure. The shock-effect at the task switches is not exactly analogous to Kagan and Rosman's (1964) 'distracting noise', but the conclusion is similar. The decrements in performance seen at these points are not caused by a shortage of free capacity (the task is too simple), but rather by inaccurate allocation. Damrad-Frye and Laird's (1989) view that boredom is a metacognitive judgment about attentional activity is supported.

The results also align with earlier claims of boredom's association with poor job performance and absence (Caplan et al 1975; Pinneau 1975; Drory 1982; Gardell 1971; Saito et al 1972). Superficially the conclusions are similar to Wyatt et al's (1937). A characteristic performance curve was found. But that curve was individual not task related. It is Viteles's (1932) position rather than Wyatt et al's that is vindicated.

The findings also suggest that judgment -- in this case the very simple one of correct quadrant -- is eroded by the same conditions that generate boredom. This might explain errors, accidents and some classes of expert error. It also suggests why it has proved so difficult to measure such erosion. The key is expectation.

In test situations -- interview, psychometric testing, simulation or actual work sample -- the expectation is that whatever happens there it will be important. The task commands attention. Nobody, for example, is placed under test in an expensive simulator and then left merely to handle routine matters. Something demanding is expected to happen. An individual's resource allocation will consequently be close to maximum in such conditions. The test situation is geared to measure the maximum performance that should result. Boredom-related errors of judgment are almost impossible to induce in such conditions. It is only in the familiar, unchallenging conditions that resource allocation falls in line with expectation. The reality of daily work often creates such conditions, but when a measure is introduced, conditions are changed.

The difficulty of directly measuring boredom's effects has constrained researchers to measure hypothetical, boredom associated traits. The scales constructed, however, do not consistently relate (Ahmed 1990). This current enquiry has proceeded from a quite different notion of boredom. The existence of traits, or the examination of trait scales, has not been important here. It is neither possible nor important to reject such trait scales, but no evidence was collected that suggests they are useful. Similarly these experiments offer no specific evidence for rejecting models of complex emotions built up from more basic ones (Plutchik 1980; Johnson-Laird & Oatley 1988). The IRAM, however, may render these accounts superfluous.

The IRAM may subsume most explanations of the boredom-stress relationship (Buck 1988; Csikzentmihalyi 1975; Deci & Ryan 1985; Locke & Latham 1990; White 1959). However it is <u>not</u> consistent with contemporary arousal theory (Mikulas & Vodanovich 1993, p4). Arousal theory proposes people act to maintain optimal levels of arousal. If arousal gets too high (e.g., fear, hunger, information overload) then action will be taken to reduce that arousal (e.g., escape, eating). If arousal is too low (e.g., boring) then action will be taken to increase arousal (e.g., seek a less boring situation). This argument is both logical and intuitively reasonable. Unfortunately it is probably false. It was clear from the observations that the explanations people give for their behaviour in boring situations just cannot be reconciled with the action component of arousal theory. The bored do not necessarily seek stimulation. They may do the complete opposite. The extremely bored avoid stimulation. Being bored is the adaptive (or perhaps maladaptive) behaviour. This conclusion has important theoretical and practical implications that will be discussed later (e.g., should stimulation be provided for the bored?).

The IRAM of boredom can only accommodate arousal theory if the action component is dropped. An individual may be challenged or bored within any stimulation band yet be unable or unwilling to respond. Motivational or personality attributes may well contribute to such restrictions. The IRAM can explain not only why the bored do not necessarily act to decrease their boredom, but also their depleted fantasies (Bergler 1945; Fenichel 1951; Hartocollis 1972; Gill & Brenman 1959). The spotlight analogy (developed in chapter 14) suggests why concentration should become difficult in deep boredom while unease and dissatisfaction should be diffuse.

The findings do support the IRAM but to be convincing the model must clearly be integrated into a general theory of Mind. In particular, the processes of allocation and the nature of the resource allocated require elaboration.

Chapter 27: Boredom as an aspect of consciousness

Resource allocation can provide a unifying, centripetal principle implicated in all processes of the mind. The centrifugal principles in psychology are obvious. The mind is, for convenience, disaggregated into sub-systems. But then the interaction of parts requires explanation. Lord and Levy (1994), for example, offer a control theory prototype that integrates the separate notions of motivation and cognition. Elsewhere Lazarus (1991) examines the relationship between cognition and emotion. And motivation, cognition and emotion are just three of the putative aspects of the mind. But there is no universal agreement on what any of these sweeping terms mean (see chapter 8). Viewing the mind as a collection of semi-autonomous processes may create more difficulties than it resolves. Boredom may be an amalgam of processes, but an alternative is to view it as a symptom (following Brenner 1953) or a particular aspect of consciousness.

Consciousness has enjoyed a "chequered history" (Reber 1985). Sometimes it has been centre stage; sometimes virtually banned from serious scientific discussion. But "that consciousness is back on the academic agenda after nearly a century in exile, there is little doubt" (editor's introduction 1994, *Journal of Consciousness Studies*, 1(1), p4). If there is just one consciousness, then the way in which aspects of that consciousness are labelled (e.g., motivation) may be largely a matter of convenience. For if motivation, emotion and cognition are indeed separate systems then the links between them must be intimate. The choice of direction of the main causal arrows may well depend on where we decide to stop the processes to examine them (Lazarus et al 1982).

If individual consciousness is finite then decisions about allocation of that resource must somehow be made. Negative feedback, as suggested by control theory, may be important here. Somewhere there must be awareness of whether the current allocation of resource is appropriate or not. Here it has been argued that emotion is the sensation registered by negative feedback when resource allocation is inappropriate. Emotion's function then is to prompt action. In such a control model, cognition (appraisal or evaluation), emotion (mismatch signal) and action (adjustment of resource) are indeed aspects of one adaptive system.

Evolutionists, such as Dawkins (1993), have consistently regarded consciousness as an adaptation to the environment allowing refined responses to develop. Pain can be seen as one aspect of consciousness. It urges avoidance action. Plants have no pain receptors and no need of consciousness. Dawkins suggests that each species may have its own unique *pleasant-unpleasant* axis that decides the emotions experienced. Her studies of chickens showed, for example, that even the very hungry chicken is loath to squeeze through a 9cm. gap. The same chicken readily pushes through the same gap for an opportunity to scratch around and enjoy a dust bath. The chicken's hierarchy of interest [she concludes] has 'dirt-scratching' as a higher ranking item than 'feeding'. In principle there seems no reason why Marler's (1984) dimensions of emotion -- pleasantness, arousal and attention -- should not equally apply to animals. Darwin (1871) long ago demolished the thesis that only humans had emotions. The 'evolutionary usefulness' argument for consciousness or emotion is perhaps incomplete. It is perfectly possible that the emotions are mere by-products of the unconscious biological activity of the brain (i.e., epiphenomena) . However the more likely view is that emotions evolved for a purpose but their generation, like that of sentences, is a consequence of processes of which we can give no introspective account. "Not only are minds inaccessible to outsiders; some mental activities are more accessible to outsiders than to the very 'owners' of those minds!" writes Denett (in Gregory 1987 p162).

This notion of ownership was a focus for James (1908); "It seems as if the elementary psychic fact were not thought or this thought or that thought, but my thought, every thought being owned" (p153). Earlier, speaking of personal consciousness, James remarked that "its meaning we know so long as no one asks us to define it, but to give an accurate account of it is the most difficult of philosophic tasks". It remains so. We know without effort that we are bored. Explaining precisely why we are bored is often perplexing.

Labelling processes as motivation, cognition or emotion may be convenient yet ultimately unimportant. An analogy might be how physicists find it more or less useful to describe a particle in terms of mass or energy, while still recognizing that these ideas are interchangeable. This thesis cannot resolve these grander issues in comprehensive way.

The situation has unfortunately developed that what is central in everyday conceptions of consciousness (e.g., sensations, feelings) is peripheral in most contemporary theories of it (Humphrey 1993). Humphrey makes the point (more completely elaborated in his book *A History of the Mind*) that sensations are not so much things we observe, as things we do. They are the products of our own active responses. The IRAM of boredom fits well with this view. It views boredom not as an entity, but rather as a sensation registered when the allocation of resource is excessive. Consciousness, in this analysis, must involve some higher level action deciding the allocation of resource (a similar argument is made by Morris 1992).

A simple computer analogy may be useful. The metaphor may be employed without any implication that the mind is some sort of animated computer. The model's usefulness lies in the simplicity with which possible relationships within consciousness may be described. Issues of allocation are clear within a computer.

It is convenient to describe the computer as having three overlapping functions accomplished by memory, monitor and executive respectively. These functions might map on to consciousness thus:

- FREE MEMORY (RAM) - allocatable as capacity for thinking
- MONITOR (IO.SYS) - scans the internal and internal environment
- EXECUTIVE (ROM) - directs and allocates all functions

Analogous normal functioning under various conditions of consciousness is described below in table 27.1.

	EXEC	**MONITOR**	**FREE**
DEATH	OFF	OFF	OFF
DEEP SLEEP	OFF	ON	OFF
DREAMING	OFF	ON	ON
THINKING	ON	ON	ON
COMA	severe dysfunction	severe dysfunction	ON
BOREDOM	inefficiency	inefficiency	ON

Table 27.1: Consciousness continuum

Types of dysfunction

Dysfunction of the EXECUTIVE is complete dysfunction -- inability to control mental processes. When the EXECUTIVE is seriously interfered with, coma or unconsciousness results. Severe dysfunction of the MONITOR is hallucination and sensory loss. The MONITOR can clearly be interfered with in many ways (e.g., by drugs). Boredom could involve some a mild dysfunction of the MONITOR.

<u>Relationships within consciousness</u>

The EXECUTIVE can shut down the processes of the MONITOR, but not vice versa. Deep sleep is the EXECUTIVE shutting down the processing of sensory input. There is every reason to think the MONITOR is active in deep sleep. Some sort of filter presumably operates. Load noise, smoke and other alerting signals will wake the individual. It is reasonable to suppose that MONITOR routines themselves require FREE MEMORY (this is clearly implied by both Kahneman 1973 and Keinan et al 1991).

The EXECUTIVE may function automatically or by attention (will) and suggestion. It performs a management function. It does not perform thought; it merely allocates resources. It is not necessary to imagine the EXECUTIVE as having content. In normal states the EXECUTIVE is always functioning since there is always mental activity associated with any and all levels of physical activity even autonomic functions. Therefore at some low levels of functioning even an increased breathing rate would increase mental activity.

In a dream state the EXECUTIVE puts the MONITOR on to auto-pilot with filters in place for alarms. MONITOR output is largely ignored. FREE CAPACITY is permitted to process ideas as they bubble up as the products of internal activity and residual ideas. The EXECUTIVE does not direct dream states. That is what discriminates dreaming from thinking. The difference between deep and dream sleep would depend on whether FREE CAPACITY was being used. Whatever functions sleep and dreaming fulfill -- an issue of some controversy -- the EXECUTIVE is not, in this analysis, usually directing it.

The states experience by meditators fit within the framework proposed. Such states are very different to sleep, and are particularly interesting from a boredom perspective. The conditions, to an external observer, appear ideal for generating boredom. The meditator sits and apparently does and thinks of nothing. This is the objective (whereas contemplation is a redirection of thought). Meditation should be boring, but it is not. The IRAM can explain why. Meditators reduce their allocation to the minimal demands of sitting and doing and thinking nothing. Meditators refer to the state of *restful alertness* - a seeming contradiction in terms. Despite nothing apparently happening, the situation is not boring. The EXECUTIVE has instructed that no processing in FREE CAPACITY should occur. The MONITOR is clearly in the alert mode, but is not allowed to trigger processing in FREE CAPACITY. The purpose of the mantra or chant or concentration on the act of breathing (depending on variant of practice) might conceivably be to block out the possibility of further FREE CAPACITY being drawn into activation by the exclusive focussing of the EXECUTIVE on simple, repetitious tasks or sensations (e.g., breathing). There is little or no un-designated FREE CAPACITY active and consequently there is little or no perceived boredom. Atkinson and Sewell (1988) believed that the beneficial effects claimed for meditation could be achieved by short-term isolation. Isolation reduces the input of sensations. The IRAM suggests there could only be benefit if an individual can rein back effectively on FREE CAPACITY in use. This explanation of meditation fits very neatly with Becher and Kanter's (1984) findings of better performance on vigilance tasks (detection without false alarms) for meditators than either non-meditators or novice meditators.

Boredom, in this computer analogy, comes about when the EXECUTIVE cannot cut back FREE CAPACITY exactly in line with a slackening demand. Adjustments may be inaccurate or slow. Both conditions may cause the sensation of boredom. The presence of excess, activated FREE CAPACITY makes the mind agitated. If this were not so boredom would be relaxing. It is not. It is a strain. The mind is like a car with the choke stuck open in a neutral gear.

This computer analogy suggests that boredom results from inefficiencies of the MONITOR or of the EXECUTIVE, not from a deficiency of capacity. If the total amount of FREE MEMORY available related to the popular psychological construct of intelligence, then the efficiency of allocation is close to the idea of *Mental Agility* developed here. Individuals who are <u>not</u> prone to boredom might possess an efficient MONITOR and EXECUTIVE. They detect and rapidly trim excess allocation or reassign it to background processes (e.g., daydreaming or thinking). One difference between ourselves and other animals might be that we have very large amounts of FREE CAPACITY available and thus far greater scope for misalignment.

This conception of boredom places it at the centre of the functioning of consciousness. Mikulas and Vodanovich (1993) have arrived independently at [what appears to be] the same conclusion from another direction. They propose boredom as state of being or consciousness, that should form <u>the</u> central, integrating construct for psychology.

Chapter 28: The nature and process of resource allocation

The IRAM clearly is a *top-down* model. Feedback and feedforward are important, but the controller (or EXECUTIVE) is central. 'Expectation' is the conclusion reached by the EXECUTIVE about the likely development of future chains of events. Experience informs us that given certain conditions, some events are more likely than others (the role of habit here was discussed at length in chapter 2). The EXECUTIVE's key role is to ensure that the system is operating in a way that will accomodate these likely events.

The IRAM focuses on *selection-for-thought* (Posner & Rothbart 1991) rather than *selection-for-action* (Allport 1989). Boredom is driven not so much by decisions about 'what to think about' as by 'how much to think about them'. It is difficult to see how these two issues might be convincingly separated. Certainly the SWAT procedure cannot distinguish between an under-allocation of resource and a misallocation of resource.

Conditions can clearly arise where the quantity of resource allocation is maximal, but the type or quality of resource is inappropriate. A mismatch would certainly then exist, but its effect might be unpredictable. Even if *quality* and *quantity* really were different aspects of resource, and could be effectively separated, there is still likely to be incalculable trade-offs occurring between them.

The vigilance component of SWAT was designed to capture attention (chapter 16). It is reasonable to assume that it involves rather different mental processes to the puzzle task. Target recognition (REFLEX) was on average four times faster than puzzle solving (THINK). It is difficult to imagine how a slower process could control a faster one directly (Lord & Levy 1994 p342) though it could trigger it. Two (or more) quite different types of resource could be involved here. Perhaps these might be arranged in some hierarchy (Jaques 1953:1956a & b ; Newell 1990; Piaget 1954). How can processes functioning on different time scales be integrated in real time to produce smooth responses?

The issue of time-functioning has been pursued by Jaques concentrating on the long time scales of decision making (1-20 years - Jaques & Cason 1994 p96) and at the other extreme of human action by Newell (months down to the level of 100 microseconds - Newell 1990, p122). The scale of the responses measured with the SWAT procedure all lie within Newell's *cognitive band* of 10s to 100ms. The instantaneous balance in these responses between *quality* and *quantity* of any resource allocated is not know. However the overall significance of the experimental results suggest that such a discrimination may, in practice, be unimportant. The key issue appears to be the overall adaptive speed of the individual. Once a mismatch is detected, how quickly and efficiently is it overcome? The speed and efficiency of response were measured in output terms (e.g., as response time and variability). The precise origins of mismatch and the particular resource invoked to correct it can only be conjectured here.

Others have suggested how allocation of a particular resource might occur (Scherer 1984; Plutchik 1980) and how this might determine the particular emotion felt (Izard 1992; Johnson-Laird & Oatley 1988). These issues have been discussed elsewhere (chapter 14). However if *quantity* and *quality* need not be separated out to produce good predictions, a higher order model of emotion is attractive.

Both linear (Csikzentmihalyi 1975; Buck 1988; Deci & Ryan 1985; Locke & Latham 1990; White 1959) and curvilinear models (Klapp 1986; Tuohy 1984) describe emotion within two dimensions. Boredom might however be more usefully modelled in more (Zeeman 1976). In theory there could then exist any number of psychologies depending on how many dimensions were included (Lewin & Heider 1936 did attempt to incorporate many dimensions). However Zeeman suggests (Zeeman 1976 p79) that a four-dimensional explanation -- the three dimensions of ordinary space and the fourth time -- is both necessary and sufficient to describe all behaviours. Time is implied in the term 'inertia' but time itself might have two aspects (i.e., clock-time and psychological-time; Jaques 1982).

The central thesis of Zeeman's experiments with his 'catastrophe machine' was that physical systems tend towards a state of *minimum energy*. This is an identical notion to the 'nulling principle' discussed in chapter 9 with respect to mental energy. The presence of either type of energy can only be deduced from the effects or potential effects of this energy. Thus physical energy may be a function of *velocity* and *mass* or may have a *potential* value. None of these values are set. A small, fast moving body may have the same energy as a more sluggish large body. So too mental energy need not be tied to particular *quality* or *quantity* parameters. A limited application of specific resource might achieve as much as a larger amount of more general resource. Similarly a *minimum energy* level can be arrived at by reducing both *quality* or *quantity* of resource involved.

Zeeman discussed 'attractors' that draw behaviour towards the *minimum energy* level (this fit very well with Freud's 1957 p120 point). "Mood [or emotion] as a stable state suggests that the mechanism is an attractor" (Zeeman p76) . Low energy does not imply that an emotion, like anger, is without force, but merely that its stability is high or its tendency to transmute into something else is low. In a high energy state small perturbations in initial conditions can lead to large differences in terminal state. Will a dog in the grip of two emotions -- rage and fear -- cower or will it attack? It is a difficult prediction wrongly assigned by generations of postmen and women.

Zeeman used the example of a starving dog exactly placed between two bowls of food to illustrate his point. A pure stimulus theory approach might suggest that a point could be found, halfway between the bowls, where the dog will be paralysed by the tension induced by the equal attractions of each bowl. This is absurd. The least likely outcome is the high energy one where the dog starves through indecision. Whatever the outcome, it will be in the direction of low energy. Which bowl the dog chooses may depend on some minuscule variation in environmental conditions (the now familiar 'butterfly effect' first proposed by Lorentz and central to the theory of chaos - Gleick 1987).

This energy view predicts some important features of emotion. If 'attractors' pull any emotion towards a particular conclusion then low intensity emotions should be superficially alike, but intense emotions must be very different. Thus mild depression might not be like slight boredom; it might be identical and indistinguishable from it. However, deep depression will be very different from pathological boredom. Thus the basic emotion model (Johnson- Laird & Oatley 1988) might account for the shallower emotions almost perfectly, but be far less convincing for extreme emotions. From the energy perspective, the shallow emotions can appear to be aggregated in the way Johnson-Laird and Oatley propose, because they are undifferentiated. This should not be true of deep emotions.

The energy view might explain aspects of experimental results. Initially the degradation of the highly variable FREDs into dysfunction may be smooth, but at a certain point there is often (figure 24.1 FRED 2 & 3) a sudden increase in the VARIABILITY. It could be that at this point an emotion was triggered and began to act as an attractor drawing out bored behaviours. The singular resistance to disengagement of the WILMA-type might be the consequence of their possessing a very weak, or indeed no boredom 'attractor'.

If an individual has a powerful boredom 'attractor' then the effort to counteract drift into disengagement will be greater than objective conditions suggests should be necessary. The decision of some people not to exert effort to counter boredom (e.g., the bored seafarers, Fenichel's pathologically bored) then begins to look highly rational. If there is an expectation of no return on any future effort, and knowledge that even a great effort will not guarantee escape from the pull of a boredom 'attractor', then the preferred solution might be to trim effort.

It has not been possible in this study to decide the precise nature of the resource or the resource allocation processes implied by the IRAM. However the differences found between individuals in adapting to fluctuating load can usefully be explained in mental energy terms.

Chapter 29: SWAT as a test

Significant relationships between *Mental Agility* and work related *performance* (r =.62, $p \leq .0005$) and *distance* (r = -.44, $p \leq .005$) were found. In principle the procedure might be useful for predicting these and other behaviours. However the measure must be considered in a particular way since it has little in common with rating, ranking or free response measures. The measuring instrument is rationally defined and the measures are direct. In consequence SWAT validity issues have a distinct slant.

Reliability

Reliability is generally approached through determining what gives rise to the variability of test scores. Do differences in scores arise from factors which should not be part of the measurement? Three key sources of inaccuracy are:

- the test situation
- the person being tested
- the test itself.

Features of the test administration, such as distracting noise or activity, can affect the accuracy of the test's measurement. Similarly, a person's state of health, motivation and general familiarity with the assessment situation can all influence his/her results, yet not be related to what the test is attempting to measure. Finally, features of the test itself, can also contribute to inaccuracies in results. Any of these factors may make an unwanted contribution to the scores obtained.

SWAT error is probably best considered by taking Cureton's (1971) alternative to the Spearman formula where error is disaggregated. The true score (T) is assumed to be unchanged across conditions. It is the error (E_S + E_C) that fluctuates and alters the observed score (X). The proportion of X that T contributes is the reliability.

$$X = T + (E_S + E_C)$$

E_S instability error

E_C consistency error

The instability error (E_S) arises as a consequence of situational factors (e.g., stress, boredom). The consistency error (E_C) has many causes. An initial test may affect subject performance in subsequent tests (i.e., by familiarity with the procedure). The IRAM styles bored behaviour as adaptive. There must be inconsistency and instability in behaviour over time. The relative degrees of instability and inconsistency in responses are the issues of interest. The conventional axis of interest is reversed in SWAT. The value of 'T' is not interesting. The sources of error are interesting.

A second reliability measure is internal consistency. This answers the question: `Do the different parts of this test measure the same thing?' In its simplest form split-half reliability is calculated. An alternative method is to assess the extent to which all the questions hang together, through formulae such as the Kuder-Richardson 20 (KR20), or the more generalised Cronbach's coefficient alpha. Again the situation with SWAT is quite different. The questions do not merely hang together; they are essentially the same question asked again and again. The internal consistency is in a sense absolute. It is this comprehensive internal consistence that allows the inconsistences of people to be measured.

Test-retest reliability was not assessed in this study. Strictly speaking experiment 2 & 3 were not alternate forms (see chapter 18). Yet the self-consistency of subjects is high. The ability to do the test -- measured as CAPACITY -- was the only variable measured in an identical way in all experiments. CAPACITY was stable (Hotelling T^2 $F(1,48) = 13.8$, $p \leq .0005$). A key question (chapter 23, research issue 5) answered was the degree to which subjects would maintain their rankings in three different experiments 4-6 months apart. There was consistency in rank across experiments (Mean Kendall's $W = 0.7$, $p \leq .003$) for all variables and for the composite predictor *Mental Agility* ($W(11) = .59$, $p \leq .05$). Is this level of stability high or low? The answer depends on how transitory mood or emotion is judged to be. For the two experiments (2 & 3) conducted within the same one hour session, the relationship was strong (Spearman $\rho = .75$, $p \leq .0005$).

Validity

Arguably the most important consideration in test usage should be validity A test does not have validity; rather it is the conclusions that are drawn from the test's results which have validity. Validity refers to the extent to which those conclusions are appropriate, meaningful and useful. Consequently a test can be valid in some situations but not in others. To be more precise, a test can be more valid in some situations than in others, since validity is not an all or nothing quality; rather, it is a matter of degree. Validity can be thought of in many different ways.

Construct validity

A psychometric instrument is usually designed to measure a hypothetical quality or trait (Reber 1985). However the quantities (e.g., REFLEX) measured in SWAT are not hypothetical. They are precisely defined and exactly measured. The measures are tied to the specific instrument. This is a powerful argument in its favour

(Campbell 1983 p203). The hypothetical element in SWAT concerns the possible relationships between these measures and boredom. Whether this is a reasonable assumption or not has been discussed in detail elsewhere (chapter 26). Are these ideas theoretically coherent? That judgment may turn around issues of purpose and outcome.

Campbell (1993) refers to *validity for understanding* (theory related) and *validity for decision making* (criterion related). In the first meaning the measure itself (see Campbell's discussion of Cronbach et al 1963 in Dunnette 1983 p204) can be taken as "synonymous with much of the construct validity notion". If the theoretical coherence is judged as high then Campbell's *validity for understanding* must also be high. SWAT conforms to the "so-called classic validity model" (Campbell p205) for judging v*alidity for decision making* (i.e., two n-distributed scores were related linearly, etc.). However statistical significance -- here product moment correlation -- is not the same as either practical or scientific significance. Again, how just how significant a given level of significance is taken to be depends on context. The *absence* related correlations to SWAT measures are weaker, but theoretically more interesting, than the stronger work *performance* correlations. There are some obvious grounds for believing that a key-hitting task might determine some aspects of clerical work (though data entry clerks were slower than general clericals). But it is difficult to explain the absence relationship with alternative theory.

Content-related validity

The case for SWAT is strengthened if the tasks done within it are judged similar to work tasks. SWAT here has much in common with job-samples or simulations. The behaviour of interest is 'how people perform when faced with a boring repetitive task'. To this end people are given a boring and repetitive task to do and 'how people perform when faced with a boring and repetitive task' is measured directly . It is, in a sense, a test of itself. Since SWAT is computer based it clearly has maximum content validity when the work behaviour of interest is 'how people perform when faced with a boring or repetitive task on the ubiquitous VDU and keyboard'.

Face validity

This is not strictly a form of validity since it has no bearing on the worth of the conclusions drawn from test scores. *Face validity* refers to what the test appears to measure to the casual observer. The feedback from subjects -- the vast majority of whom found it very boring -- suggests the *face validity* of SWAT is high. Doubters should volunteer as SWAT subjects. They will rapidly be convinced SWAT is boring.

Criterion-related validity

It appears that there is a rapid degradation of some people's ability to switch effectively between tasks in SWAT. That degradation seems to predict other behaviours that are thought to be associated with boredom. The inference that the degradation itself is linked to boredom is reasonable, but cannot be proved. But proving that link may not be important from the *decision making* or criterion perspective (discussed above). The important question here is whether or not SWAT can predict aspects of work behaviour. There are grounds for thinking it may (see chapter 26).

The IRAM directly predicted the relationships between VARIABILITY and work *accuracy* and *absence*. Alternative ability or motivational explanations are possible (again discussed in chapter 26). It is impossible to resolve the issue of motivation here. No subject was offered any reward for taking part in the experiments. The sole benefit was time-out from more boring options. In any work selection context motivation is likely to be high. The precise effect of high motivation on SWAT can be found empirically.

Level and method of measurement

Psychometric measures often use many questions or items. Individual normative judgments are aggregated and an accumulated score is in some way normalised. However, in SWAT, each 'item' is a quantity (e.g., REFLEX = .97s, THINK = 3.5s). Moreover there is no need to assume or force scores into the n-distribution. Such distributions arise naturally in the data (appendix 6). Interval level data is the highest attainable by questionnaire. Often ordinal or even nominal judgments are aggregated and treated as interval data. The basic SWAT data is **ratio level**, the highest level possible. All mathematical operations are permissible.

The SWAT procedure is computer-based and maximally objective. Little variation in administration is possible. Variables and statistics are automatically computed. However it may be important that conditions are identical for all subjects under test if comparisions are being made. The small differences found between subject groups (mostly insignificant) may well have been caused by varying conditions (see research issue 4 chapter 23). Such variation might be environmental (e.g., the comfort of the seat or the ambient lighting) or technical (e.g., stickiness of a computer key). The safest and simplest option is control of these by testing under identical conditions.

Faking and bias

It is difficult to fake high scores on SWAT, though it is easy to fake low and appear to be slow thinking and error prone. There is one way of producing an artificially inflated score. It requires iron discipline, a watch counting seconds, and divided concentration between the second hand and the computer screen. This deceit is far more demanding than the test itself.

The possible sources of cultural bias are few within SWAT. The dialogue boxes use few words (81) of simple English. The special meaning of any word (e.g., quadrant) is explained both on screen and by the administrator. The dialogue itself is of no particular interest, and would readily translate into any language without altering the nature of the test. It would be surprising, indeed, if the questions themselves could have some hidden, culturally varying meaning. The training phase is monitored (by the administrator) to ensure complete understanding. Nobody can move forward until they have demonstrated they understand the task.

Clearly the severely technophobic might have difficulties, though only three keys (Y, N and SPACEBAR) are ever used. Nobody who took part in this study had difficulty actually seeing the targets, reading the screens or finding the appropriate keys. However it is clearly possible that some special disabilities (e.g., dyslexia and partial sightedness) might render the results invalid.

Despite SWAT's intrinsic 'fairness' sensible decisions must be made. It is absurd to expect that meaningful comparisions can be made between groups of computer literate native English speakers and computer naive non-English speakers. All shades of absurdity exist between these extremes.

SWAT then may have a future as a testing procedure. Indeed it has been adopted by ASE-NFER NELSON for further development. In principle it has many advantages. Only further independent validation can decide whether these exist in practice.

Chapter 30: Implications, applications and speculation

The model tested in this study was derived from the literature and observation. Both the model and the results obtained are consistent with antecedent theory. The IRAM aligns especially well with appraisal views of the emotion-cognition link. Those ideas are directly traceable to Freud and stated most emphatically by Lazarus and his various collaborators and Ortony and Clore (1989). Lazarus (1991) declared that appraisal was both necessary and sufficient to generate emotion. The IRAM view is that, in the absence of mismatch, emotion would be redundant.

Previous research in the boredom field had been handicapped by the use of static measures. This was seen as a serious flaw. Boredom [perhaps all emotion] is dynamic by nature. Perhaps the static view is a the main reason why neither an adequate definition nor a credible measure of boredom has been developed (Fisher 1993).

The measures used here were developed from a fully articulated theory of boredom. The theory directly suggested the instrument. The instrument is both sensitive and robust. The debate was moved from the realm of self-report into that of direct behavioural measurement. Direct measurement has many advantages, not least that the data so generated are open to alternative interpretations in a way that questionnaire items or self-report are not.

The clear inference of these experiments is that the processes of adaptation to repetitive tasks are a characteristic of individuals. This characteristic might have a genetic root but that question cannot be resolved here. This same characteristic might also influence other aspects of adaptive behaviour.

Education is one area where adaptive, and particularly maladaptive, behaviour is important. The possibilities of the IRAM and SWAT appeal to some educationalists. Difficulty in correct allocation of resource might be a cause of learning problems. High VARIABILITY could link with high truancy/absence and poorer work in school children, just as it did with *absence* and *performance* for the clerks. Those with less efficient processes might benefit from briefer, more intense classes.

Other maladaptive behaviours such as vandalism (Hoover 1986) can be seen as a way of dissipating excess allocated capacity. The IRAM, however, suggests a corrective approach counter to the conventional. The provision of stimulation alone for the bored or under-stimulated is, of itself, not only futile but probably counter-productive. That tactic merely reinforces the idea that whenever the boredom is felt, stimulation will or should be provided by the environment. A more constructive goal might be to educate an individual to allocate their resource more efficiently. Enhancing awareness of the innate complexity of whatever activity is routinely available is more sensible than routinely increasing activity. Current attempts to 'help' the boredom by providing stimulation may be doomed. Job enrichment or enlargement, extra activities for pilots, recreational equipment for ship crews, youth-clubs and television for adolescents may all be counter-productive. Mere stimulation only draws attention to, and exaggerates, the reality of the current mismatch of allocation. The analogy of another adaptive strategy illustrates this point.

There are two effective strategies for moving around in the forest at night. If lights are avoided, dark adaptation occurs. Alternatively a torch may be used. The former is a natural, individual strategy independent of external support. The latter is dependent on continuous provision of light delivered by the illuminating torch. The beam of the torch picks out the detail of a small part of the potential field, but obscures the general picture. Anyone who is active in a natural environment at night uses the torch sparingly and then only for detail (e.g., to read a map). Similarly, to accommodate to low levels of general stimulation takes time and practice. But as with the forest at night, there is always something significant happening that could be made the focus of attention. The stimulation cure for boredom is akin to continuously replacing the torch's batteries. It may not be an antidote. It could be an aggravator frustrating adaptation.

Orstein's (1970) work on time-sense supports this argument. Ornstein noted the time paradox that whereas an experience containing relatively many events seems shorter when it is experienced, it is remembered as longer (and vice versa). A film metaphor illustrates why. The faster the action, the higher the required film speed and more footage is coiled onto receiving spool for any event. The spool is analagous to memory. If all memories re-run at standard speed then the action filled event will be draw out . However the film-speed must be appropriate to the event rate. Packing a period with events merely because the film-speed is high is inane. Packing the lives of the boredom prone with meaningless events may be equally crass. It may habituate them to unsustainable levels of stimulation and prevent them learning to adjust flexibly. Intense and intractable boredom is the likely consequence.

Can individuals be educated to allocate their resources more effectively? Either the techniques of meditation or the technology of bio-feedback might be effective here (Bercher & Kanter 1984). Since fewer and fewer people are needed to operate modern industrial systems perhaps we should educate as much for indolence as for industry.

The IRAM has also proved of interest to clinicians. Disengagement might increase early in any degeneration of mental functioning. A computer analogy suggests why. The computer can generally run programmes when the hard-disk has suffered minor fragmentation, but these run slower than on a perfect machine. Optimization routines (such as *Norton Speeddisk*) improve matters by localizing, or rendering contiguous, the sectors to be scanned. In a sense they reduce the 'agility' required of the computer reading heads. Similarly injury or abuse may damage the 'hard-disk' so reducing *Mental Agility*.

The link between substance abuse and boredom has often been made (Hamilton 1983; Orcutt 1984; Wasson 1981; Zuckerman 1979; Zuckerman 1987; Johnson & O'Malley 1986; Pascale & Sylvester 1988; Paulson, Coombs & Richardson 1990; Watt & Vodanovich 1991). This can also be explained by the IRAM. If excess capacity is habitually allocated by an individual, then alcohol, for example, might be a chemical solution. The chemical may in effect 'lop off' allocated capacity producing a desired regression. A behavioural consequence should be difficulty with both parts of SWAT. An experiment with alcoholic intake as an independent variable is simple to imagine. The IRAM predicts that those prone to abuse alcohol or other substances will have low *Mental Agility*. Treatment success should be signalled by a steady improvement in *Mental Agility*.

At the other extreme there might be behavioural consequences of particularly efficient resource allocation. This author has noted that successful entrepreneurs seem to demonstrate a striking ability to focus their available mental resources. Focus, suggesting as it does an act of will or concentration, may be a misleading idea. It could be that entrepreneurs' processes are generally more coherent (like WILMAs). Coherence -- a cognitive notion -- creates the possibility of focusing.

The coherent light of the sun can be focused; the diffuse light of a florescent tube cannot. A form of SWAT delivering high rates of event is being used to investigate the hypothesis that coherence predicts business success.

Some aspect of mental functioning appeared to be degraded by boredom. The IRAM predicted that it was the ability to adapt that was lost. SWAT measured that overall adaptability which was operationalised in *Mental Agility*. The measure may be relevant far beyond the boundaries of boredom. For adaptability is a universal ability and a key feature of consciousness.

Chapter 31: Summary

Fisher had concluded in 1993 that "there is no agreed definition of the construct [of boredom], or well-developed instrument for measuring it, and there is no comprehensive theory of its causes". In truth the situation is far worse than she admits.

The construct of boredom is not merely vague; it is incoherent. Self-report of 'felt-boredom' is unreliable in every respect. It cannot be consistently discriminated from other emotions, nor is it reliably associated with specific behaviours. The feeling is undifferentiated and liable to entrainment by other feelings. Boredom is happily offered as an explanation, justification and consequence of behaviour. Boredom is probably not a specific emotion, though it may be a side-effect of other repressed emotions. The expression 'boredom' then is best considered as a rubric that sums up a variety of loosely associated negative feelings. It is not a specific term. It is certainly not a scientific concept.

The absence of an agreed definition of boredom had concerned Fisher. We can now see that an absolute definition of boredom is unrealisable, and the adjectival form 'boring' is necessarily relative. No situation can be considered interesting or boring by definition. A situation can be labelled as 'boring' by the individual involved, or inferred to be boring by others observing behaviours that the situation elicits. These assessments may or may not coincide. Boring or interesting properties are not intrinsic.

Notwithstanding the lack of definition many unfortunate behaviours have been associated with the 'state of boredom'. This study focused on those 'boredom-related behaviours' and explained them in terms of misallocation of mental resource.

It has been shown here that all that is known of such 'bored-related behaviour' may be subsumed into one higher order model.

The core propositions of this <u>Inertial Resource Allocation Model</u> (IRAM) are:

- \- mental functioning tends to seek the lowest possible energy state.
- \- the processes of mental resource allocation are not instantaneous. There is some inertia in the system.
- \- temporary mismatches of resources allocation and demand are inevitable in such an inertial system.
- \- 'boredom' is one interpretation of the feeling associated with an over- allocation of resource.

The predictions of the IRAM were tested by experiment and generally supported. In particular it was shown that the inertia in mental resource allocation could be measured; that it was individually variable; and that it related directly to other behaviours that have been associated with boredom. These predictions were bold, meaningful and neither tautological nor self-evident.

The conclusion of this research are that:

- Misallocation of mental resource is a <u>sufficient</u> condition for inducing bored-type behaviour. When the allocation of resource is not accurately aligned with task demand, characteristic variability in behaviour is likely.

- Misallocation of mental resource is <u>necessary, but not sufficient</u>, to induce 'felt-boredom'. A state of misallocation must exist, but 'felt-boredom' is one possible internal appraisal of the significance of that mismatch. This appraisal may manipulated by the individual for their own purposes, including the need to accommodate the views of others. The same mismatch might be interpreted as boredom, depression or alienation depending on context.

Fisher remarked on the lack of a well-developed measure of boredom. The measure developed here reliably assesses the underlying mismatch of resource that the IRAM predicts is related to bored behaviour. It was the creation of the measure (SWAT) that allowed the individual nature of mental inertia to be demonstrated.

The situation then has been transformed since Fisher's 1992 commentary. Her concerns are shown now to be largely redundant. Since a definition of boredom is not possible, and instrument would be superfluous. A more specific theory and approach is proposed. A measurable and operationally defined feature of mental functioning -- mental inertia -- can explain the phenomena of interest once associated with boredom.

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SECTION SEVEN - APPENDICES

APPENDIX 1: EXPERIMENTAL VARIABLES RECORDED

A. The procedure recorded the following variables:

CYCLE	--	Counts each time a flash appears on screen
PHASE	--	Marks when complexity levels change. Phases 1 to 4 comprise the Capacity Test (or training phase) 5 onward the main test.
NUMS	--	Absolute count of number of shocks (changes) given.
TEST	--	Counts each target flash that appears on the screen
COMPLEX	--	Records which condition (1 to 4) is active.
QUAD	--	Records the Quadrant which is "correct" for this test.
DELAY	--	Records the delay between flashes in the Capacity Test
FLASH	--	Records the flash time the shape is on screen in the Capacity Test.
DELAYT	--	Records the delay before shape is flashed in the main test.
FLASHT	--	Records the flash time the shape is on screen in the main test.
TIME	--	Records the actual clock time of flash.

The following are subject response variables:

REFLEX	--	How long after flash before subject hit a key.
THINK	--	How long subject took to answer questions
SSCORE	--	Accuracy of reflex hitting key at flash: 1 Correct match of shapes 2 Incorrect match of shapes 3 Correct, hit after flashtime 4 Incorrect, hit after flashtime 5 No hit when match was made
QGUESS	--	Correctness of guess about 'right' quadrant 1 Target in correct place, correct guess 2 Target in correct place, wrong guess 3 Target in wrong place, correct guess 4 Target in wrong place, wrong guess
QUIZ	--	Answer to Posttest Quiz. 1 = Correct, 0 = Wrong.

APPENDIX 2: SUMMARY OF SIMILARITIES AND DIFFERENCE between experiments.

Experiment	Repetitions	Condition
1	7	1
	7	2
	7	3
	7	4
	7	1
	Events	34
	Mean Duration	694 secs
2	5	3
	5	4
	5	1
	5	2
	5	3
	Events	24
	Mean Duration	368 secs
3	5	2
	5	1
	5	4
	5	3
	5	2
	Events	24
	Mean Duration	368 secs

Similarities and differences

1. The vigilance task is identical though the targets are changed.

1. The cognitive task is identical in all experiments and phases - "deduce the correction position of the shape, remember it and report when asked".

2. The response method is always the same (SPACEBAR, (Y) YES or NO)

3. Experiment 2 & 3 have different settings to experiment 1 (as above) but otherwise differ only in the number of shapes used and presentation order of shapes.

4. Five shapes were used in experiment 1 and three shapes in experiments 2 & 3.

APPENDIX 3: EXPERIMENTAL PROTOCOL

These instructions were written for the assistants.

GENERAL INSTRUCTIONS
Your task is to ensure the smooth running of the programme. So far as you are able put the subject at their ease. Tell them exactly what will happen, answer any questions and keep the programme running smoothly. REMEMBER THESE FOLK ARE ALL VOLUNTEERS.

Make sure "NO ENTRY" SIGN is NOT up on the door (you want the subject to come in).

Open SWAT - Type S

Disconnect the phone
The blinds must be down and closed

Answer any subject question immediately and as directly as possible. Some standard answers are given here. There is only one absolute constraint. NEVER mention the word "boredom" or any of its derivatives or synonmys (e.g., boring, tedious). The topic so far as the subjects or the management are concerned is "WELFARE AT WORK".

Subject enters

"Hello ....Your name is?" ----------- "I am (give your name)".
Take their coat, direct them to chair in front of the computer.
Put up the "NO ENTRY" SIGN.

"Thanks for coming along. Did you go to the talk I/Martyn gave?"
"I am from Newcastle Business School and we are studying some aspects of people's welfare at work. In a minute I going to ask you to have a go at a simple computer task which is part of our study. It is not a difficult and takes about 20 minutes. You just have to answer YES or NO to a series of questions. If you don't know the answer to a question, just guess. I will help you to start with. Is that OK?".
"Have you any questions?
"If you do have a question at any time just ask away ?"
"Can I ask you a few questions about the work that you do just to start off? "
* Ask the standard set of questions and record data on individual subject sheets.

"OK, that's fine. Now we would like you to do a very simple computer task. All you have to do is watch for a shape to appear and then hit a few keys. We are interested in how you respond. Try and go as quickly as you can without making too many errors. If you give a wrong answer to begin with the machine will BEEP. I will stay with you until I am sure you have got the hang of it and then I will leave you alone. I will be across the way in (give the number of the room and point to it position on the layout card on the desk). Come over if you finish early or if there is any problem".

"Can you make yourself comfortable"

Make sure they are comfortable - get them to adjust the controls etc "Please adjust the brightness and the contrast to what feels best for you"

"[if applicable] Can you tell me you staff number? (this is also printed on the subject list). [with other subjects assign them the code from the sheet]. Enter the code for them and hit RETURN".

[if they have forgotten their number enter last name and first initial] check later against the record or phone personnel for their number].

[If anyone queries why you need the number say "this is the only way we can keep track of you and tie up your results with our other measures" (This is true). If they refuse to give their staff number then say "I could give you a code of our own" [resistance here may signal that they regret volunteering. If they show any sign of unease then ask them if they really want to continue and let them go if necessary. We have plenty of volunteers. We have no reason to pressurize anyone].

"OK are you ready to begin. If you have any questions about anything just ask me. I will just stay where I am and take a few notes for a while. Is that OK?. When I am sure you have got the knack of the test I will leave you to finish on your own. I will be across the way in room _____ [or alternative]". Point again to the card on the desk.

If everything seem to be fine and the subject has no questions then hit RETURN for them.

The test begins

When the first of the POST-TESTS occurs ("is it 1,2,3 or 4?")
STOP THE TEST.
"Can you just stop there. You seem to be doing fine. I am going to leave now".
Leave the room
PUT UP THE "NO ENTRY" as you leave

This test takes around 20 mins

When the subject has finished this test and you re-enter
TAKE DOWN THE "NO ENTRY"sign (ready for next customer).

Ask "What did you think of the test?". Record if they mention the word "boredom" or any of its derivatives or synonmys without prompting.

Thank them in an appropriate manner and say;

"We will be in touch with you later".

NEXT CUSTOMER ARRIVES - GOTO top of this page.

APPENDIX 4

FEED BACK SHEET

Purposes of this record sheet :

We are interested in the correlation between the predictions of the model we are using and individual work record. These correllations will be calculated and this record destroyed.

Instructions for use:

We ask you to make your best estimate of the performamce attained by the individual concerned. If you are unable to make a judgment on a criterion or if that criterion does not apply to the job in question then leave a blank.

STAFF NUMBER:								

☒ = please mark as applicable	VERY POOR	POOR	BELOW AVERAGE	AVERAGE	ABOVE AVERAGE	GOOD	VERY GOOD
Work Output							
Work Accuracy							
Verification Accuracy							
Use of the working day							
Level of knowledge							
Customer Service - internal or external							

Attendance

Days absent per annum *	More than 30 days	26 - 30	21 - 25	16 - 20	11 - 15	5 - 10	less than 5 day off
From the Record							
Criteria of attendance	warning justified	poor	some cause for concern	average	good attendance record	exception-ally good attendance	
Managers View of attendance record							

*** absence here is sub-clinical. A car accident, an operation, child-birth etc. would not count as absence**

APPENDIX 5: STAFF APPRAISAL summary data

Variable	Mean	7- POINT SCALE Range	Minimum	Maximum
D1 WORK OUTPUT	4.88	4.00	3.00	7.00
D2 WORK ACCURACY	4.91	4.00	3.00	7.00
D3 VERIFICATION ACCURACY	5.00	4.00	3.00	7.00
D4 USE OF THE WORKING DAY	4.30	3.00	4.00	7.00
D5 LEVEL OF KNOWLEDGE	4.89	4.00	3.00	7.00
D6 CUSTOMER SERVICE	4.36	4.00	3.00	7.00
D7 DAYS ABSENCE	5.76	6.00	1.00	7.00
D8 MANAGERS VIEW OF ATTENDANCE RECORD	4.32	6.00	1.00	7.00

APPENDIX 6: INTERCORRELATIONS OF JOB PERFORMANCE MEASURES

	D2	D3	D4	D5	D6	D7	D8
D1	.8247**	.8740**	.4117**	.7481**	.3230**	-.0029	-.0120
D2		.8272**	.3848**	.7084**	.3986**	-.0955	-.0671
D3			.3941**	.7673**	.2440*	-.0543	-.0548
D4				.4535**	.4651**	.0419	.0230
D5					.2874**	.0461	.0770
D6						.1290	.1696
D7							.8610**

* - p < .05 ** - p < .01 (2-tailed)

APPENDIX 6: INTERCORRELATIONS OF JOB PERFORMANCE MEASURES

	D2	D3	D4	D5	D6	D7	D8
D1	.8247**	.8740**	.4117**	.7481**	.3230**	-.0029	-.0120
D2		.8272**	.3848**	.7084**	.3986**	-.0955	-.0671
D3			.3941**	.7673**	.2440*	-.0543	-.0548
D4				.4535**	.4651**	.0419	.0230
D5					.2874**	.0461	.0770
D6						.1290	.1696
D7							.8610**

* - $p < .05$ ** - $p < .01$ (2-tailed)

APPENDIX 7: FACTOR ANALYSIS OF WORK RELATED ITEMS

FINAL STATISTICS:

VARIABLE	COMMUNALITY	*	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
		*				
D1	.83916	*	1	3.87643	48.5	48.5
D2	.83542	*	2	1.93699	24.2	72.7
D3	.84811	*				
D4	.37768	*				
D5	.75193	*				
D6	.35953	*				
D7	.90141	*				
D8	.90019	*				

A varimax rotation was converged in 3 iterations.

ROTATED FACTOR MATRIX:

	FACTOR 1	FACTOR 2
D1	.91510	-.04183
D2	.90790	-.10556
D3	.91433	-.11002
D4	.60333	.11690
D5	.86601	.04428
D6	.51406	.30866
D7	-.00907	.94938
D8	.00395	.94877

FACTOR TRANSFORMATION MATRIX:

	FACTOR 1	FACTOR 2
FACTOR 1	.99990	.01442
FACTOR 2	-.01442	.99

APPENDIX 8: THE INTERVIEW SCHEDULE

1. What type of work do you do?

2. How old are you?

3. When did you start working at this agency?

4. When did you start your current job?

5. When did you start work today?

6. How many hours do you work per week?

7. What are the best things about your work?

8. What are the worst things about your work?

9. How many days have you been sick this year?

STAFF No
[redacted] :-

D-

PLEASE FILL IN THE CIRCLES OF THOSE CHOICES THAT APPLY

Make one response per question unless otherwise indicated.

This first section is collecting general background information.

1. Please indicate your sex
   - O Female
   - O Male

2. Indicate your age group
   - O Under 20
   - O 20 - 29
   - O 30 - 39
   - O 40 - 49
   - O Over 50

3. What was your family status in your parental home?
   - O Only child
   - O Oldest of several
   - O Youngest of several
   - O Middle child

4. Indicate the nature of the main wage earner's occupation in your parental home.
   - O Professional
   - O Skilled
   - O Semi skilled
   - O Unskilled

5. Which of the following best describes your current status? **(mark all that apply)**
   - O Unemployed
   - O Full time student
   - O Part time student
   - O Home maker
   - O Administrative worker
   - O Professional worker
   - O Other - pleased specify

6. What has been the nature of your main occupation for the past five years?

- O In full time employment
- O In full time education
- O Home maker
- O Unemployed
- O Other - please specify

7. Do you have a car drivers licence?

- O Yes
- O No

8. Over the past 12 months, please indicate the amount of disruption, to your work or studies, that has occured due to illness.

- O Less than a week
- O Between 1 and 3 weeks
- O More than 3 weeks

9. Are you left handed or right handed?

- O Left handed
- O Right handed

10. When at school, which subject were you **most** interested in?

- O Science
- O Mathematics
- O English
- O History
- O Art
- O Other - please specify

This section is concerned with work related activities

11. Which of the following **best** describes your work style?

- O Work on one task at a time
- O Work on several tasks at once
- O Work on many tasks at once

12. Which of the following **best** describes your approach to work scheduling?

- O Tackle tasks as they arise
- O Tackle tasks in order of priority
- O Tackle the easy or short tasks first

13. In what sort of project do you work best?

- O Large team
- O Small team
- O Group of 2 or 3 people
- O Individual

14. What is your strategy when working on a long and demanding task?

- O Work at it until complete
- O Work until tired
- O Work in short spells
- O Work until bored
- O Something else - please specify

15. In which of the following media do you **prefer** to work?

- O Words
- O Pictures
- O Numbers/symbols
- O No preference

16. Please indicate the noise level of the surroundings in which you **work best**

- O Very quiet
- O General working noise level
- O With a musical background
- O Irrelevant

17. When aquiring a new work skill do you practice until

- O Nearly perfect
- O Adequate
- O Bored with practice
- O Something else- please specify

18. Which of the following activities **best** describes your approach to an unfamiliar problem ?

- O Guess a solution and check it works
- O Eliminate non feasible solutions
- O Attempt to deduce the solution from the information given
- O Attempt to relate to a similar known problem

19. Which of the following **best** describes your needs when undertaking a new activity?

- O Careful supervision
- O Some supervision
- O Minimal supervision
- O Other - please specify

20. When learning to use an unfamiliar piece of complicated equipment do you-

- O Read the instruction manual
- O Experiment with the controls
- O Get someone to demonstrate it
- O Other - please specify

This section is collecting information on your interests, activities and hobbies.

21. What type of music do you **prefer**?

- O Do not like music
- O Classical
- O Country
- O Jazz
- O Pop
- O Other - please specify

22. Which of the following do you do regularly (ie more than once per month)? **(mark all that apply)**

- O Attend a quiz
- O Compete in a sport
- O Visit a museum
- O Play chess or bridge
- O Go to the theatre
- O Go to the cinema
- O Participate in theatrical production
- O Go to the pub
- O Other - please specify

23. When spending an evening relaxing at home, which of the following activities have you actually done on **more than two occasions** in the last four weeks **(mark all that apply)**

- O Do a crossword
- O Do a jigsaw
- O Draw a sketch
- O Paint a picture
- O Play a musical instrument
- O Listen to music
- O Read a novel
- O Use a computer
- O Watch a video
- O Work on a hobby
- O Other - please specify

24. What is the **main** source of your current affairs knowledge?

- O TV
- O Radio
- O Newspapers
- O Magazines
- O Other people
- O None of these

25. How do you normally communicate with friends or relatives who do not live locally?

- O Telephone
- O Letter
- O Other means- please specify

26. Choose the style that **best** describes your initial approach to starting a jigsaw puzzle.

- O Edges first
- O Colour matching
- O Pattern matching
- O Spreading and sorting all pieces out
- O No specific style

27. Which of the following activities have you been involved with in the past 3 years? **(mark all that apply)**

- O Local government or politic
- O Parent teacher association or school governing body
- O Sports or social club management
- O Youth leadership

The final section is collecting information about how you perceive yourself in relation to colleagues who are doing a comparable job or following a similar course of study.

28. Which of the following statements <u>best</u> describe you?
    - O More a talker than a listener
    - O As much a talker as a listener
    - O More a listener than a talker

29. How would you describe yourself?
    - O Very patient
    - O Patient
    - O Slightly impatient
    - O Impatient

30. Would you say you are:-
    - O More a 'doer' than a 'thinker'
    - O As much a 'doer' as a 'thinker'
    - O More a 'thinker' than a 'doer'

31. Compared with other people how do you rate your ability to remember the names of people you have just met just met?
    - O Very good
    - O Good
    - O Quite good
    - O A little weak

32. Compared with other people, how do you rate your problem solving ability?
    - O Very good
    - O Good
    - O Quite good
    - O A little weak

33. Compared with other people, how do you rate your creative ability?
    - O Very good
    - O Good
    - O Quite good
    - O A little weak

34. Compared with other people, how do you rate your mathematical ability?
    - O Very good
    - O Good
    - O Quite good
    - O A little weak

35. At what time of the day are you <u>most</u> alert?
    - O Morning
    - O Afternoon
    - O Evening
    - O All the time

THANK YOU FOR TAKING THE TIME TO COMPLETE THE QUESTIONNAIRE

APPENDIX 10: CORRELATIONS OF BIODATA TO EXPERIMENT 1 RESULTS

	CAPACITY	DILIGENCE	REFLEX	THINK	VARIANCE	ERRORS
Q1	-.0517	.1187	-.0444	-.2070	-.1480	.0416
Q2	.0596	-.3204*	.4215**	.1930	.1049	-.0276
Q3	.3795*	-.0183	.0767	-.1139	-.3165*	-.0990
Q4	.2015	.1262	-.1096	.1843	.0158	-.3196*
Q5	-.1722	-.0995	.1629	.0600	.0701	.1403
Q6	.1881	.1813	-.2432	.0469	.1590	-.1227
Q7	-.1889	-.2406	.2509	.0303	.0079	-.0743
Q8	.0831	.0784	-.1151	.0146	-.0525	.0708
Q9	.0210	.1118	.0226	.2195	.2038	.1782
Q10	-.3920**	-.1645	-.1775	-.2022	.1421	.2102
Q11	.0340	-.2942	.0083	.2275	.2245	.4013**
Q12	.0527	.0437	-.2303	-.0615	-.1771	-.0006
Q13	.3036*	.0818	-.2569	.1971	.1420	-.0411
Q14	-.0495	.1815	.0193	-.1324	-.0953	-.0480
Q15	.1694	.0681	.1111	.1796	.1732	.1388
Q16	-.3278*	-.3279*	.0361	-.1201	.1977	.3294*
Q17	-.2437	-.2003	.0897	.1281	.2001	.2983
Q18	.0795	.1284	-.0552	.0421	.0798	-.0820
Q19	.0206	-.1468	-.1876	-.0081	.0623	-.0340
Q20	.0418	.1599	.1085	.0755	.2651	-.0136
Q21	-.1326	.0440	.1135	.0566	.1968	.1616
Q22a	-.0652	-.0693	-.2483	-.1996	.0107	-.0098
Q22b	-.0898	.1987	-.1074	-.0186	.0407	-.0175
Q22c	-.0465	-.0299	-.1108	.1559	.1689	-.1192
Q23a	.0153	.3310*	-.0669	.0797	.1183	.0684
Q23b	-.1642	.2811	-.2319	-.3219*	.0358	-.1306
Q23c	-.1250	.1360	-.1802	.0092	.1388	-.1630
Q23d	.1029	.0957	-.1182	.0133	-.0771	-.2633
Q23e	.3041*	.2644	-.2091	.0436	-.1678	-.2084
Q24	-.2108	-.1807	.0689	-.1542	.1614	.2421
Q25	.1641	.1470	-.1036	.0239	-.1662	-.1746
Q26	-.0695	-.0468	.2821	-.1441	.0607	.1018
Q27a	-.0512	-.1396	-.0468	.1153	.0488	.2589
Q28	.0649	.0724	.2471	.0592	-.0965	-.2170
Q29	-.3180*	-.0843	.0705	.0760	.2383	.3918**
Q30	-.0185	.1826	-.0505	.0735	.0503	-.0719
Q31	.2441	.2818	.0347	.2567	.0385	.0126
Q32	.2175	.3258*	-.0035	.2812	.0736	-.0284
Q33	.1741	.2215	.1468	.2337	.0670	.1426
Q34	.2374	.4425**	.0080	.2078	-.0567	-.1139
Q35	.2134	.1604	.0612	.2436	.0189	.0442

* - Signif. LE .05   ** - Signif. LE .01   (2-tailed)

TESTS OF THE RESEARCH HYPOTHESES - FORMAL STATEMENT OF STATISTICS
The following format will be used throughout this section.

RH1,2 etc.	=	formal statement of the research hypothesis
RH0	=	null hypothesis
Decision rule	=	formal statement of the conditions under which RH0 may be rejected
Decision	=	the decision whether to reject RH0

APPENDIX 11A: RESEARCH ISSUE 1 - To demonstrate that there is no fatigue effect.

RH1 - there is no significant increase in REFLEX over the duration of the test.

RH0 - the slope of the regression line REFLEX on ORDER of key hit will be zero or greater than zero.

Pattern of the data
Individual REFLEX is recorded by a key hit. The number of hits varies individually. Across the entire procedure (training phase and test phase) in experiment 1 the mean number of hits was 63 (range 58-67).

ORDER of HIT (A1) was correlated with REFLEX at that point. Only 2 significant ($p < .05$) positive correlations were found. The ORDER of HIT was regressed to REFLEX score at that point (A2..A99) (statistics in APPENDIX 12A).

Decision
Only two subject show any evidence of fatigue as measured by increasing REFLEX over the period of the experiment

APPENDIX 11B: RESEARCH ISSUE 2 - To demonstrate that subjects are sufficient motivated to complete the cognitive task.

RH2 - the DILIGENCE of the subjects on the task is significantly higher that expected by random or systematic behaviour.

RH0 - DILIGENCE for some subjects is equal to or less than zero

Decision rule
If, in any case, DILIGENCE < 0 then reject RH0

The stability of REFLEX demonstrated that attention was captured by the vigilance task. DILIGENCE was a computed factor designed to assess the quality of that attention.

DILIGENCE was computed as +3 for each correct YES answer ("is it in the RIGHT place") and +1 for each correct NO answer ("is it in the WRONG place"). A penalty is exacted of -1 for a wrong YES and -3 for an incorrect NO answer. These weighting neutralize the computed differential probability of correct answers achieved by random responses thus:

QUESTION	Right/wrong	points	prob	score
POSITIVE	R	+3	0.25	0.75
	W	-1	0.75	-0.75
NEGATIVE	R	+1	0.75	0.75
	W	-3	0.25	-0.75

Expected random response score = 0.00

Although the goodness of fit to the normal distribution is reasonable the data more closely resembles a bi-modal distribution -- possible constructed of two superimposed n-distributions -- with a transition around zero.

```
    Count   Midpoint    One symbol equals approximately   .40 occurrences

      1      -5.35  |***
      1      -4.85  |:**
      0      -4.35  |.
      0      -3.85  |.
      1      -3.35  |*:*
      3      -2.85  |**:*****
      2      -2.35  |****:
      5      -1.85  |*****:*******
      4      -1.35  |*******:**
      5       -.85  |**********:**
      4       -.35  |**********   .
      2        .15  |*****         <---------- mode transition
      2        .65  |*****            .
      3       1.15  |********          .
      4       1.65  |**********         .
      6       2.15  |***************    .
      7       2.65  |******************.
      8       3.15  |****************:***
     12       3.65  |**************:***************
     16       4.15  |************:***************************
     10       4.65  |**********:*************
      0.      5.15  |        .
      3       5.65  |******:*
                    +----+----+----+----+----+----+----+----+----+----+
                    0         4         8        12        16        20
                              Histogram frequency
```

```
Mean          1.940      Std err        .257      Median         2.800
K-S Test distribution   -  Normal
              Most extreme differences
      Absolute         Positive        Negative          K-S Z   2-Tailed P
        .15155          .10038         -.15155           1.531        .018

Valid observations -      99
```

The data show the strategy of some subjects was markedly worse than that possible by random or systematic answering.

Investigation of systematic strategies

Systematic strategies were investigated using the Monte Carlo procedure to produce pseudo-data for analysis. Statistical subject datafiles were produced by three strategies.

Stat-subject strategies

1. Datafiles were generated by answering YES to every question and consistently identifying 1 as the quadrant in the pre-test.

2. Datafiles were generated by answering NO to every question and identifying 1 as the quadrant in the pre-test.

3. Datafiles were generated by answering on a random schedule. Using a set of random numbers. NO was the answer used when that number was odd and YES when that number was even. THINK time thus reflects the time taken to think through the question 'is it odd or is it even?' and to respond.

The three sets of stat-subjects produced very low DILIGENCE scores.

	DILIGENCE SCORE
strategy 1	-3.95
strategy 2	-3.95
strategy 3	0.0

The random strategy (3) as predicted gave a score of 0. The other systematic strategies give responses marked worse than random response.

Decision
DILIGENCE is not always greater than zero. Reject RH0.

Summary
The performance of some subjects on the cognitive task was significantly worse than could be achieved by either random or systematic strategies.

APPENDIX 11C: RESEARCH ISSUE 3- To demonstrate overall improvement on the task over time (learning).

RH3 - the performance (THINK time) of subjects will reduce between the first (phase 1) and the last phase (phase 5) of the experiment.

RH0 - the THINK time in phase 5 will be equal to or greater than that in phase 1.

The matched-pairs t test is appropriate thus

Decision Rule
If t obs > 1.980 (2-tail Prob .05) reject RH0

Decision
t obs = 5.51, 10.95 & 8.63. In all case reject RH0 ($p < .0005$).
Learning appears to occur.

(T-TESTS IN APPENDIX 12B)

APPENDIX 11D: RESEARCH ISSUE 4 - To demonstrate individual disengagement behaviour.

RH4 - The VARIABILITY difference (phase 1 - phase 5) will be greater than zero.

RH0 - the mean of variance differences (phase 1 - phase 5) will be equal to or less than zero.

The matched-pairs t test is appropriate

Decision Rule
If critical value of t < = -2.000 (2-tail Prob .05) reject RH0

Decision
For all subjects t obs > -2.000. Do NOT reject RH0.

For the clerical subjects only t obs < -2.000. Reject RH0 (p < .002)

Disengagement was only significant in the longer experiment 1 and not in 2 & 3

(T-TESTS IN APPENDIX 12C)

APPENDIX 11E: RESEARCH ISSUE 5 - to demonstrate subject consistency across similar experiments.

RH5 - A subject will tend to maintain their rank order in all variables measured across three different experiments well separated in time.

RH0 - the relationship between a subject's performance on the three experiments (expressed as * Kendall's W) is zero.

Decision Rule
If chi-square obs > 50.89, p = .01 reject RH0

Kendall's Coefficient of concordance for all experimental variable across three experiments.

Variable	Experiments	W	Chi-Square	D.F.	Significance
CAPACITY *	2	.7914	71.2301	45	.0076
DILIGENCE	3	.5337	70.4506	44	.0069
REFLEX	3	.8387	113.2234	45	.0000
THINKtime	3	.6613	89.2773	45	.0001
VARIABILITY	3	.5618	75.8447	45	.0027
ERRORS	3	.5659	76.3924	45	.0024

Decision
The null hypotheses may be rejected at p > .01 for all experimental variables.

RELIABILITY
Kendall's W is a nonparametric statistic convenient for summarizing analysis. The conclusions of this test were further investigated using Hotelling T^2 a more powerful parametric statistic.

Decision rule
Reject RH0 if F > 4.00 (1:48) for CAPACITY or F > 3.15 (2:44) other variables. (HOTELLINGS TEST OF RELIABILITY IN APPENDIX 12D)

Decision
The critical value is exceeded for CAPACITY, REFLEX and VARIABILITY. In these cases RH0 may be rejected. The mean pattern of results over the three experiments is the same. F narrowly fails to achieve significance for THINK. The ERRORS pattern however is clearly markedly different.

The ERRORS difference is readily explained. The distribution of errors appeared to be Poisson (K-S Z = 1.811, p = .003 (2-Tailed). Errors occurred in the same manner as other rare events. The THINK time difference is less readily explained but the distribution of THINK difference is markedly less normal (K-S Z = 1.201, P=.112) than that of VARIABILITY difference (K-S Z = 1.692, P = .007).

APPENDIX 11F: RESEARCH ISSUE 6 - To demonstrate individual differences are more significant than between group differences.

RH6 - the group means on all variables will be substantial different.

RH0 - there will be no substantial difference between group means

Decision Rule
t obs > varies in each case (degrees of freedom different)

Decision
t is significant for REFLEX only (clerks v mariners).
There are no significant sex differences

(T-TESTS for independent samples CLERKS V MARINERS IN APPENDIX 12E)

APPENDIX 11G: RESEARCH ISSUE 7 & 8

RESEARCH ISSUE 7 - To demonstrate that the individual pattern of disengagement relates to performance on work thought to be repetitive and boring.

RH7 - The Pearson correlation coefficients, job performance to VARIABILITY and THINK, will be negative and significant.

RESEARCH ISSUE 8 - To demonstrate that the individual pattern disengagement relates to absence from work thought to be repetitive and boring.

RH8 - The Pearson correlation coefficients, ABSENCE to VARIABILITY and THINK, will be positive and significant.

RH0 - The null hypothesis, $r = 0$, is the same in both cases.

APPENDIX 11H: CORRELATIONS OF EXPERIMENTAL RESULTS TO WORK DATA

CORRELATION COEFFICIENTS EXPERIMENTAL VARIABLES TO RAW JOB DATA

	OUTPUT	ACCURACY	VERIFY	DAY USE	KNOW	SERVICE	ABSENCE	ATTEND
CAP	.1780	.2815*	.1951	.0371	.2201	.0587	-.2316	-.2988*
DILI	-.0309	-.0817	.0162	-.1685	-.1035	.0448	-.1482	-.2167
REFLEX	-.0422	-.0278	-.0836	.1241	.0236	.2103	.2197	.2672*
THINK	-.2730*	-.3649**	-.3269**	-.1269	-.3413**	-.1422	.1656	.1477
VAR	-.1939	-.3483**	-.3034*	-.1076	-.1636	-.1659	.2576*	.2094
ERRORS	-.0388	.1388	-.0703	.0973	.0684	.2183	.0256	.0282

* - Signif. LE .05   ** - Signif. LE .01   (2-tailed)

CORRELATION COEFFICIENTS EXPERIMENTAL VARIABLES TO JOB DATA DILIGENCE GROUP

MOTIVATED GROUP (DILIGENCE > 0, AND ERRORS =< 2) [N=67]

	OUTPUT	ACCURACY	VERIFY	ABSENCE	ATTEND
CAP	.4010**	.5564**	.3913*	-.2016	-.2452
DILI	-.2181	-.1948	-.2434	.3091*	.3592*
THINK	-.4025**	-.4074**	-.4067**	.2804	.3461*
VAR	-.3095*	-.4787**	-.4035**	.3490*	.3395*

UNMOTIVATED GROUP (DILIGENCE <= 0, AND ERRORS > 2) [N=35]

	OUTPUT	ACCURACY	VERIFY	ABSENCE	ATTEND
CAP	-.1902	-.0146	-.1249	-.0468	-.2250
DILI	.2283	.1191	.1784	-.0691	.1046
THINK	-.1877	-.3659	-.3238	.1267	-.0522
VAR	-.0395	-.2038	-.1966	.0845	-.0511

* - Signif. LE .05   ** - Signif. LE .01   (2-tailed)

APPPENDIX 11I: CORRELATION EXPERIMENTAL VARIABLES TO WORK FACTORS

Equations for PERFORM & DISTANCE (using weightings from factor analysis)

FACTOR 1 PERFORM = (D1 x .915) + (D2 x .908) + (D3 x .914) + (D4 x .603) + (D5 x .866) + (D6 x .514)

FACTOR 2 DISTANCE = (D6 x .309) + (D7 x .949) + (D8 x .949)

	PERFORM	DISTANCE
CAPACITY	.4603**	-.3086
DILIGENCE	.3116	-.2666
REFLEX	-.2491	.3014
THINK	-.5050**	.3054
VARIABILITY	-.4433**	.3478*
ERRORS	-.3281*	.0557

* - Signif. LE .05 ** - Signif. LE .01 (2-tailed)

(REGRESSION OF JOB FACTORS IN APPENDIX 12F)

APPENDIX 11J: PREDICTORS OF WORK FACTORS

The regression experimental variables on PERFORM and DISTANCE was repeated excluding those with DILIGENCE < 0 and ERRORS > 1.

Variable	B	SE B	Beta
A4	-1.506761	.443403	-.443109
A1	.708236	.236792	.390010
(Constant)	23.314822	2.056365	

Variable	B	SE B	Beta
A5	.692907	.284129	.359259
A3	6.008577	2.814717	.314474
(Constant)	3.988476	2.218142	

Compute MENTAL AGILITY FACTOR inserting BETA from multiple regression

MENTAL AGILITY = (A1 x .39) - (A3 x .32) - (A4 x.44) - (A5 x.36)

CORRELATION MATRIX

	DISTANCE	PERFORM
MENTAL AGILITY	-.4395**	.6223***

** - $p < .005$ *** - $p < .0005$ (2-tailed)

RELIABILITY OF PREDICTOR MENTAL AGILITY

The factor MENTAL AGILITY was calculate for all 3 independent experiments and a reliability calculated.

(R E L I A B I L I T Y A N A L Y S I S IN APPENDIX 12G)

MENTAL AGILITY frequency and histogram

```
    Count    Midpoint    One symbol equals approximately   .40 occurrences

        1       -6.63  |***
        1       -6.13  |***
        0       -5.63  |
        0       -5.13  |.
        0       -4.63  | .
        2       -4.13  |***:*
        2       -3.63  |*****  .
        2       -3.13  |*****     .
        8       -2.63  |***************:****
        3       -2.13  |********             .
        9       -1.63  |***********************   .
       20       -1.13  |*****************************:********************
        9        -.63  |***********************       .
       12        -.13  |****************************:*
        9         .37  |***********************.
       10         .87  |******************:******
        7        1.37  |************:*****
        3        1.87  |*******:
                       +----+----+----+----+----+----+----+----+----+----+
                       0         4         8         12        16        20
                                 Histogram frequency
```

Mean	-.762	Std err	.163	Median	-.775
Mode	-6.884	Std dev	1.635	Variance	2.674
Kurtosis	1.696	S E Kurt	.476	Skewness	-.910
S E Skew	.240	Range	8.856	Minimum	-6.884
Maximum	1.972	Sum	-76.930		

K-S Test distribution - Normal

Absolute	Positive	Negative	K-S Z	2-Tailed P
.20037	.16481	-.20037	2.024	.001

Valid cases 98

APPENDIX 11K: RESEARCH ISSUE 9 - To investigate whether ability on the SWAT test relates to the extent of disengagement.

RH10 - The Pearson correlation coefficients, CAPACITY scores to VARIABILITY and THINK, will be negative and significant.

RH0 - The null hypothesis, r = 0, is the same in all cases.

Pearson correlation coefficients

	THINK	VARIABILITY
CAPACITY	-.1395	-.2137*

* - Signif. LE .05 (2-tailed)

Decision
The null hypothesis may be rejected for VARIABILITY. There is a weak link in the predicted direction. The null hypothesis cannot be rejected for THINK.

APPENDIX 12A: REGRESSION ORDER of HIT to REFLEX score

The 2 significant positive slopes are marked (*).

Variable	B	SE B	Beta	T	Sig T
Means	-0.00236	.062150	-0.01425	-0.104	.5030
A2	.067650	.108378	.086812	.624	.5356
A3	.120620	.100485	.179471	1.200	.2363
A4	.066944	.097471	.092924	.687	.4957
A5	.006211	.116759	.007450	.053	.9578
A6	-.306908	.153770	-.297367	-1.996	.0520
A7	.320689	.163315	.303103	1.964	.0558
A8	-.125611	.144895	-.137955	-.867	.3906
A9	.137204	.130367	.150880	1.052	.2982
A10	-.119009	.106323	-.173065	-1.119	.2689
A11	-.015217	.091220	-.024895	-.167	.8683
A12	.007707	.102884	.010437	.075	.9406
A13	-.010282	.118889	-.012108	-.086	.9315
A14	.269727	.155391	.247503	1.736	.0894
A15	-.082959	.120245	-.107831	-.690	.4938
A16	-.041524	.120861	-.051050	-.344	.7328
A17	-.212511	.140382	-.242864	-1.514	.1371
A18	-.008287	.005103	-.225803	-1.624	.1114
A19	-.079582	.118376	-.113783	-.672	.5048
A20	-.117115	.114317	-.144154	-1.024	.3111
A21	.077791	.139348	.099185	.558	.5794
A22	.055705	.089408	.102361	.623	.5364
A23	.042495	.113971	.058954	.373	.7110
A24	.099038	.125051	.128773	.792	.4325
A25	-.050062	.106476	-.075022	-.470	.6405
A26	-.194209	.113631	-.262164	-1.709	.0943
A27	-.005837	.005554	-.166993	-1.051	.2989
A28	-.113387	.128391	-.135848	-.883	.3819
A29	.028469	.136146	.032976	.209	.8353
A30	.082349	.113100	.110262	.728	.4703
A31	-.037779	.113462	-.049577	-.333	.7407
A32	.077773	.127268	.105369	.611	.5442
A33	-.017073	.128169	-.021232	-.133	.8946
A34	.006647	.103162	.009467	.064	.9489
A35	-.119442	.124681	-.149011	-.958	.3432
A36	.057399	.104913	.085142	.547	.5870
A37	-.046021	.140298	-.060215	-.328	.7444
A38	-.015658	.140612	-.016480	-.111	.9118
A39	.001414	.114211	.002028	.012	.9902
A40	.122853	.127237	.168912	.966	.3394
A41	-.068367	.103279	-.104204	-.662	.5114
A42	-.167706	.075100	-.326682	-2.233	.0306
A43	.114315	.141036	.138044	.811	.4219
A44	.108935	.120892	.150856	.901	.3722
A45	.117056	.141966	.122531	.825	.4139
A46	.065818	.149968	.065109	.439	.6628
A47	-.001743	.005376	-.046015	-.324	.7473
A48	-.209726	.103361	-.268197	-2.029	.0475
A49	.001081	.005553	.027566	.195	.8465
A50	-.001943	.005710	-.048629	-.340	.7352
A51	-.001468	.005789	-.036037	-.254	.8010
A52	-.038952	.055484	-.091263	-.702	.4857

A53	.002979	.006042	.070387	.493	.6243	
A54	.004459	.006106	.103498	.730	.4690	
A55	-.121156	.072409	-.222511	-1.673	.1002	
A56	-.005740	.004615	-.202337	-1.244	.2199	
A57	-.001006	.006357	-.022034	-.158	.8749	
A58	-.004873	.006503	-.104357	-.749	.4574	
A59	-.003541	.006646	-.074174	-.533	.5967	
A60	-.003248	.006784	-.066627	-.479	.6343	
A61	.001293	.006922	.026001	.187	.8526	
A62	-.003413	.007090	-.066992	-.481	.6324	
A63	.008599	.007258	.164914	1.185	.2421	
A64	-.001043	.004449	-.030786	-.234	.8156	
A65	.003036	.004092	.103304	.742	.4618	
A66	.004462	.007821	.079500	.571	.5710	
A67	-.008411	.048275	-.022793	-.174	.8623	
A68	-.008397	.008207	-.142319	-1.023	.3115	
A69	.001239	.008131	.020369	.152	.8795	
A70	-.001308	.008339	-.020978	-.157	.8760	
A71	-7.40684E-04	.008565	-.011944	-.086	.9314	
A72	-.008444	.008843	-.127668	-.955	.3442	
A73	.011315	.009116	.166103	1.241	.2203	
A74	2.54583E-04	.009420	.003620	.027	.9785	
A75	-.001733	.010019	-.023896	-.173	.8633	
A76	-.008156	.010057	-.108704	-.811	.4212	
A77	.017404	.010395	.224171	1.674	.1003	
A78	-.022908	.010438	-.285184	-2.195	.0331	
A79	-.005882	.010845	-.070381	-.542	.5901	
A80	-.004563	.011247	-.052543	-.406	.6867	
A81	.018372	.011714	.202995	1.568	.1233	
A82	-.008932	.012212	-.095135	-.731	.4681	
A83	-.005581	.012717	-.056917	-.439	.6627	
A84	.015737	.013436	.171751	1.171	.2473	
A85	-.001911	.004595	-.053826	-.416	.6793	
A86	.002525	.014710	.022211	.172	.8644	
A87	.016137	.015484	.135831	1.042	.3025	
A88	-.002543	.018407	-.020189	-.138	.8907	
A89	.011006	.014732	.083195	.747	.4586	
A90	-.047977	.015954	-.339490	-3.007	.0042	
A91	-.054456	.016910	-.495128	-3.220	.0023	
A92	.047650	.018047	.291969	2.640	.0111	*
A93	.031343	.019051	.181744	1.645	.1063	
A94	-.004945	.003853	-.141030	-1.283	.2054	
A95	.098004	.032297	.469211	3.034	.0038	*
A96	-.022353	.024739	-.101942	-.904	.3706	
A97	-.020742	.026640	-.087135	-.779	.4399	
A98	.020475	.032193	.070878	.636	.5277	
A99	-.011795	.040020	-.039449	-.295	.7693	

APPENDIX 12B: T-TESTS FOR PAIRED SAMPLES PHASE THINK TIME DIFFERENCE

Variable	Number of Cases	Mean	Standard Deviation	Standard Error	(Difference) Mean	Standard Deviation	Standard Error	Corr.	2-tail Prob.	t Value
EXPERIMENT 1										
P1THK1		3.9809	1.486	.149						
Experiment 1	99				.7652	1.381	.139	.450	.000	5.51
P5THK1		3.2158	1.050	.106						
EXPERIMENT 2										
P1THK2		5.8307	1.814	.232						
	61				2.1523	1.536	.197	.538	.000	10.95
P5THK2		3.6784	1.111	.142						
EXPERIMENT 3										
P1THK3		5.7584	1.639	.208						
					1.6511	1.507	.191	.461	.000	8.63
P5THK3		4.1073	1.148	.146						

APPENDIX 12C: T-TESTS FOR PAIRED SAMPLES PHASE VARIANCE DIFFERENCE

Variable	Number of Cases	Mean	Standard Deviation	Standard Error	(Difference) Mean	Standard Deviation	Standard Error	Corr.	2-tail Prob.	t Value
EXPERIMENT ONE										
A17 P1VAR1		3.0839	2.862	.288						
ALL SUBJECTS	99				-.3812	2.598	.261	.507	.000	-1.46
A21 P5VAR1		3.4652	2.265	.228						
A17 P1VAR1		2.4014	2.401	.285						
CLERICAL ONLY	71				-.9004	2.371	.281	.432	.000	-3.20
A21 P5VAR1		3.3018	2.004	.238						
EXPERIMENT TWO										
B17 P1VAR2		3.3149	6.575	.842						
	61				.2325	5.760	.737	.482	.000	.32
B21 P5VAR2		3.0825	3.216	.412						
EXPERIMENT THREE										
C17 P1VAR3		2.0129	2.009	.255						
	62				-.1090	1.626	.207	.587	.000	-.53
C21 P5VAR3		2.1219	1.217	.155						

APPENDIX 12D: HOTELLINGS T-SQUARED TEST OF RELIABILITY ACROSS EXPERIMENTS

1.	A1	CAPAC1
2.	B1	CAPAC2

OF CASES = 49.0

HOTELLINGS T-SQUARED =	13.8225	F =	13.8225	PROB. =	.0005
DEGREES OF FREEDOM:		NUMERATOR =	1	DENOMINATOR =	48

1.	A3	REFLEX1
2.	B3	REFLEX2
3.	C3	REFLEX3

OF CASES = 46.0

HOTELLINGS T-SQUARED =	10.5061	F =	5.1363	PROB. =	.0099
DEGREES OF FREEDOM:		NUMERATOR =	2	DENOMINATOR =	44

1.	A4	THINK1
2.	B4	THINK2
3.	C4	THINK3

OF CASES = 46.0

HOTELLINGS T-SQUARED =	5.4556	F =	2.6672	PROB. =	.0807
DEGREES OF FREEDOM:		NUMERATOR =	2	DENOMINATOR =	44

```
  1.     A5            VAR1
  2.     B5            VAR2
  3.     C5            VAR3

      # OF CASES =        46.0


HOTELLINGS T-SQUARED =      7.8107           F =       3.8186        PROB. =   .0296
  DEGREES OF FREEDOM:                NUMERATOR =       2      DENOMINATOR =      44

RELIABILITY COEFFICIENTS     3 ITEMS

----------------------------------------------------------------------------

  1.     A6            ERRORS1
  2.     B6            ERRORS2
  3.     C6            ERRORS3

      # OF CASES =        46.0


HOTELLINGS T-SQUARED =      1.1465           F =       .5605        PROB. =   .5749
  DEGREES OF FREEDOM:                NUMERATOR =       2      DENOMINATOR =      44
```

APPENDIX 12E: T-TESTS for independent samples CLERKS V MARINERS

Variable		Number of Cases	Mean	Standard Deviation	Standard Error	F Value	2-tail Prob.	t Value	Degrees of Freedom	2-tail Prob.	t Value
A1	CAPAC1										
	CLERKS	71	4.7028	1.943	.231	1.01	.946	.42	96	.676	.42
	GROUP 2	27	4.5185	1.949	.375						
A2	DILIG1										
	CLERKS	71	6.6915	2.532	.300	1.17	.589	-.78	96	.437	-.75
	MARINERS	27	7.1481	2.740	.527						
A3	REFLEX1										
	CLERKS	71	.7424	.213	.025	3.72	.000	3.40	96	.001	4.45
	MARINERS	27	.5956	.110	.021						
A4	THINK1										
	CLERKS	71	3.0614	1.044	.124	1.19	.629	.01	96	.993	.01
	MARINERS	27	3.0593	.956	.184						
A5	VAR1										
	CLERKS	71	2.3966	1.922	.228	1.35	.399	.91	96	.366	.97
	MARINERS	27	2.0163	1.655	.319						
A6	ERRORS1										
	CLERKS	71	1.2676	2.084	.247	2.05	.044	1.20	96	.231	1.41
	MARINERS	27	.7407	1.457	.280						

T-TESTS for independent samples MALE v FEMALE

Variable		Number of Cases	Mean	Standard Deviation	Standard Error	F Value	2-tail Prob.	t Value	Degrees of Freedom	2-tail Prob.	t Value
A1	CAPAC1										
	MALE	13	5.0846	1.881	.522	1.01	.917	.88	62	.383	.88
	FEMALE	51	4.5725	1.876	.263						
A2	DILIG1										
	MALE	13	2.5154	2.160	.599	1.34	.600	1.22	62	.226	1.33
	FEMALE	51	1.5902	2.500	.350						
A3	REFLEX1										
	MALE	13	.6792	.143	.040	2.50	.086	-1.02	62	.312	-1.33
	FEMALE	51	.7467	.226	.032						
A4	THINK1										
	MALE	13	2.8600	1.391	.386	1.79	.150	-1.00	62	.323	-.84
	FEMALE	51	3.2049	1.039	.145						
A5	VAR1										
	MALE	13	1.7223	1.888	.524	1.67	.336	-1.44	62	.155	-1.68
	FEMALE	51	2.7702	2.438	.341						
A6	ERRORS1										
	MALE	13	.8462	1.463	.406	1.03	.874	-.26	62	.799	-.25
	FEMALE	51	.9608	1.442	.202						

APPENDIX 12F: REGRESSION OF JOB FACTORS

Variable(s) Entered on Step Number 1.. A1 CAPAC1

		Analysis of Variance	DF	Sum of Squares	Mean Square
Multiple R	.47357				
R Square	.22427				
Adjusted R Square	.20487	Regression	1	6.77636	6.77636
Standard Error	.76550	Residual	40	23.43933	.58598

F = 11.56409 Signif F = .0015

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
A1	.225849	.066414	.473568	3.401	.0015
(Constant)	3.699387	.364846		10.140	.0000

------------- Variables not in the Equat

Variable	Beta In	Partial	Min Toler
A3	-.200745	-.227432	.995693
A4	-.384761	-.434706	.990198
A5	-.350606	-.392733	.973351
A6	-.291449	-.330907	.999999

Variable(s) Entered on Step Number 2.. A4 THINK1

		Analysis of Variance	DF	Sum of Squares	Mean Square
Multiple R	.60898				
R Square	.37086				
Adjusted R Square	.33859	Regression	2	11.20567	5.60284
Standard Error	.69817	Residual	39	19.01002	.48744

F = 11.49450 Signif F = .0001

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
A1	.207682	.060872	.435474	3.412	.0015
A4	-.373179	.123797	-.384761	-3.014	.0045
(Constant)	4.978924	.539351		9.231	.0000

------------- Variables not in the Equat

Variable	Beta In	Partial	Min Toler
A3	-.136129	-.168460	.958157
A5	-.176779	-.171292	.59069[illegible]
A6	-.228255	-.282770	.95609[illegible]

Variable(s) Entered on Step Number 1.. A5 VAR1

Multiple R	.35684
R Square	.12734
Adjusted R Square	.10552
Standard Error	1.91139

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	21.32362	21.32362
Residual	40	146.13622	3.65341

F = 5.83664 Signif F = .0204

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
A5	-.432023	.178824	-.356841	-2.416	.0204
(Constant)	-3.506404	.514171		-6.820	.0000

------------- Variables not in the Equat

Variable	Beta In	Partial	Min Toler
A1	.179821	.189911	.973351
A3	-.336017	-.359467	.998723
A4	-.169373	-.140551	.600937
A6	.026488	.027947	.971440

Variable(s) Entered on Step Number 2.. A3 REFLEX1

Multiple R	.49000
R Square	.24010
Adjusted R Square	.20113
Standard Error	1.80635

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	40.20688	20.10344
Residual	39	127.25296	3.26290

F = 6.16122 Signif F = .0047

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
A5	-.417485	.169104	-.344833	-2.469	.0180
A3	-3.447191	1.432941	-.336017	-2.406	.0210
(Constant)	-1.063591	1.125712		-.945	.3506

------------- Variables not in the Equat

Variable	Beta In	Partial	Min Toler
A1	.159767	.180486	.96977
A4	-.082104	-.071388	.57448
A6	.144693	.155701	.87992

PIN (probability limit for includion = .050

APPENDIX 12G: R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L L)

1. MENTAL AGILITY EXP1
2. MENTAL AGILITY EXP2
3. MENTAL AGILITY EXP3

OF CASES = 30.0

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUM OF SQ.	DF	MEAN SQUARE	F	PROB.
BETWEEN PEOPLE	129.0788	29	4.4510		
WITHIN PEOPLE	69.0792	60	1.1513		
BETWEEN MEASURES	14.4768	2	7.2384	7.6888	.0011
RESIDUAL	54.6024	58	.9414		
NONADDITIVITY	.2919	1	.2919	.3063	.5821
BALANCE	54.3105	57	.9528		
TOTAL	198.1580	89	2.2265		

GRAND MEAN = -0.0097

TUKEY ESTIMATE OF POWER TO WHICH OBSERVATIONS
MUST BE RAISED TO ACHIEVE ADDITIVITY = 0.9988

HOTELLINGS T-SQUARED = 18.6212   F = 8.9896   PROB. = .0010
DEGREES OF FREEDOM: NUMERATOR = 2   DENOMINATOR = 28

RELIABILITY COEFFICIENTS 3 ITEMS

ALPHA = .7885   STANDARDIZED ITEM ALPHA = .8045

APPENDIX 13

OVERVIEW OF METHODS EMPLOYED IN THE STUDY

TOPIC	METHOD	VARIABLE	MEASURE	KEY STAT.
BACKGROUND THEORY				
Existing theory and evaluation	Literature review			
	Accidents records			
FOCAL THEORY				
Construction of new theory	Observation in a simulator	Disengagement behaviour	Activities Interview	
	Workplace observation	Disengagement behaviour	Interview. Day v night comparisons	ANOVA T-TEST
DATA THEORY				
Testing hypotheses	Experiment	Speed and variability	Response time, Puzzle solving speed & variance	REGRESSION T-TEST
		Attention	Reaction time, Error rate, Diligence	T-TEST
Stability of variables	Further experiments			KENDALL'S W HOTELLING T^2
Criterion validity	Work record	performance Absence	Output Accuracy Days lost	PEARSON'S R FACTOR ANALYSIS MULITPLE REGRESSION