THE EFFECTIVENESS OF COGNITIVE STRATEGIES FOR REDUCING BOREDOM DURING REPETITIVE TASK PERFORMANCE

by

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The Effectiveness of Cognitive Strategies For Reducing

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ABSTRACT

Recent applications of information processing theory suggest that the type of cognitive strategy a person uses to reduce boredom may be effective differentially across tasks of varying difficulty.

To investigate this hypothesis, sixty undergraduate students were assigned randomly to either a cognitive task restructuring, a cognitive goal restructuring, or a no assigned cognitive restructuring condition under either easy or difficult task conditions. Self-report measures of boredom, attentiveness, frustration, fatigue, strain restlessness , and non-task related thought; physiological measures of frontal EMG, peripheral skin temperature, skin conductance, and body movement; and performance measures of number of items attempted, accuracy, response latency, and response consistency served as dependent measures.

The results showed that cognitive task and cognitive goal restructuring were both effective in reducing boredom when performing an easy task, but that only cognitive goal restructuring effectively reduced boredom in the difficult task condition.

Performance varied as a function of cognitive strategy rather than boredom. Groups who cognitively restructured the task were less bored but performed less well than either cognitive goal restructuring or no cognitive restructuring groups.

Physiological indices of peripheral responding varied as a function of boredom, task duration, and task difficulty. Post hoc univariate analyses showed that frontal EMG was greater for groups reporting less boredom, that peripheral skin temperature decreased during easy task performance, and that body movement was greatest for subjects who performed the easy task under the no cognitive restructuring condition.

The results suggest that the choice of cognitive strategy to reduce boredom during repetitive task performance should depend on task difficulty and on the importance of maintaining performance standards; that processes leading to boredom are different in easy and difficult tasks; and that a physiological stress response is associated with the nature of the repetitive task rather than with boredom.

Implications for the treatment of boredom are discussed in terms of the need for a functional assessment of the conditions leading to boredom.

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CHAPTER I

Introduction

The influence of affective processes on behavior, and the use of cognitive strategies in the self-control of affective experience have gained widespread acceptance in the past five years (Kanfer & Goldstein, 1986; Klinger, 1982). Boredom is one affect that has been widely implicated in behavior problems, but little investigated in terms of the role that cognitive strategies play in producing or alleviating it. Most strategies to alleviate boredom involve either engaging in alternate, more meaningful activities, or enhancing the intenstity, meaningfulness, or complexity of the environment. Recently, Hamilton (1981) has proposed both that cognitive strategies can be effective in reducing boredom, and that the effectiveness of cognitive strategies in reducing boredom may vary according to level of task difficulty. Commonly suggested cognitive strategies such as making a game of the task, telling yourself that completion of the task is necessary to achieve some desired goal, or daydreaming about something else, therefore, may be effective differentially in reducing boredom depending on whether one is engaged in easy or difficult tasks.

To date, no empirical research exists to substantiate these claims. The primary goal of this dissertation is to test empirically the hypothesis that cognitive strategies are effective differentially in reducing boredom across tasks of varying difficulty. Three additional goals of this study are: a) to determine the extent to which use of different cognitive strategies is reflected in different physiological indices of peripheral responding, b) to determine the extent to which the use of different cognitive strategies to reduce boredom is reflected in task performance, and c) to determine the extent to which the subjective self-report correlates of boredom vary according to task difficulty.

This Study

To address these questions, a study was conducted that manipulated systematically two types of cognitive strategy and a no cognitive strategy control with two levels of task difficulty. Self-report measures of boredom, frustration, fatigue, attentiveness, restlessness, and strain; physiological measures of frontal electromyography (EMG), peripheral skin temperature (PST), galvanic skin resistance (GSR), heart rate (HR), heart rate variability (HRV), and body movement (BM); and performance measures of accuracy, number of responses attempted, response latency, and response consistency on a repetitive task were monitored. Sixty undergraduate students were assigned randomly to one of the four experimental, or to one of the two control conditions.

In the remainder of this chapter, the implications and reasons for the study will be given. Subsequent chapters will clarify the concept of boredom, and review the existing research base that bears on the experiment (Chapter two); outline the methodology employed (Chapter three); present the results of the experiment (Chapter four); and provide a discussion of the results (Chapter five).

Implications of and Reasons for the Study

The present study has a number of practical and theoretical implications. From a practical point of view, persons frequently find themselves engaged in repetitive tasks where altering their behavior, or altering the environment is not possible. Under these conditions, cognitive strategies may be the only feasible way of reducing boredom. If cognitive strategies are differentially effective in reducing boredom, or if they lead to different performance, or to different patterns of peripheral responding, the optimal choice of a cognitive strategy is dependent on the nature of task.

Second, boredom frequently is considered to be an aversive condition, and is sometimes viewed as being associated with a physiological stress response that may lead, with prolonged exposure, to psychosomatic complaints (Cox, 1978; de la Pena, 1983; Frankenhaueser, 1979; Pines, 1982; Pines, Aronson & Kafry, 1981; Stagner, 1975). This is in contrast to reviews of the research relating physiological indices of peripheral responding to boredom (e.g., O'Hanlon, 1981; Smith, 1981; Thackray, 1981) which conclude unanimously that boredom is accompanied by decreasing levels of peripheral responding, and that this pattern of physiological responding is inconsistent with a physiological stress response. The research reviewed, however, typically does not account for task difficulty. Since patterns of peripheral responses are affected by task difficulty as well as repetitive task performance (e.g., Cox, 1980; MacKay, Cox, Watts, Thirlaway & Lazzarini, 1979), a more reasonable conclusion may be that a physiological stress response depends more on the task than self-reported boredom per se. Such a finding would indicate that in treatment, self-report of boredom should be followed by an assessment of conditions that give rise to boredom to determine the extent to which boredom leads to patterns of peripheral physiology that can be interpreted as a physiological stress response.

The study also has theoretical implications. Past explanations of boredom have emphasized boredom as a biological response to nonvaried environmental stimulation, or a result of psychodynamic processes. The current investigation employs an information processing rationale for the effectiveness of cognitive strategies that posits boredom is due to the perceived mismatch between the amount of information available in the environment and the amount of information desired. While the information processing rationale in no way addresses the important question of whether boredom is primarily a biological or cognitive phenomenon, the rationale does offer an alternate conceptualization that makes boredom amenable to treatments that emphasize personal control.

Summary

To date, no studies have investigated systematically the role of cognitive strategies in reducing boredom, or assessed the role that cognitive boredom-coping strategies may have on task performance or peripheral physiology. This thesis was conceived to address three general questions: a) are cognitive strategies used while performing repetitive tasks effective differentially in reducing boredom across tasks of varying difficulty; b) do cognitive strategies employed during repetitive task performance effect task performance and c) do these strategies effect physiological patterns of peripheral responding. The results of the investigation are viewed as having important implications for the choice of cognitive strategy used to reduce boredom, and theoretical implications for a more cognitive interpretation of boredom.

CHAPTER II

Introduction

The previous chapter raised the general questions of whether cognitive strategies are differentially effective in reducing boredom that accompanies repetitive task performance and whether these differences are reflected in physiological patterns of peripheral responding and in task performance. This chapter pursues several goals in order to address these questions. First, a review of theories and models of boredom will be undertaken. The primary intent of this review is not to adjudicate between theoretical explanations of boredom. Rather, the intent is to generate a synthesis of these explanations which serves to identify the parameters of boredom that accompany repetitive task performance, as distinct from other more perseverant types of boredom that have been linked to behavior disorders and pathology.

A second goal of this chapter is to review the experimental evidence that links self-report of boredom to patterns of peripheral physiological responding. Current reviews of boredom include in their purview studies that fail to provide either a direct measure of boredom or direct measures of peripheral responses. The purpose of the present review is to narrow the focus of studies reviewed in order to draw conclusions concerning patterns of peripheral responding associated with boredom that are based on direct measurement rather than inference.

A third goal of this chapter is to review studies that relate cognitive variables to boredom. Despite the currency of cognitive interventions intended to regulate affective states, research specifically relating cognitive strategies to boredom is sparse. This portion of the chapter brings together research suggesting that cognitive variables play a role in the etiology of boredom, and that the intentional use of cognitive interventions can serve to reduce boredom. Finally, Hamilton's (1981) theory of boredom-coping, and specifically cognitive boredom-coping strategies is presented. In conjunction with the aforementioned reviews, this theory will form the basis for developing testable hypotheses to determine the efficacy of cognitive strategies for reducing boredom, and the effect of these cognitive strategies on task performance and peripheral physiology. The chapter will proceed with a definition of boredom, and the review of theories of boredom.

Boredom

Boredom can be defined as " the negative experience that arises from exposure to stimulus conditions that are perceived to be either uniform or repetitive, and which are also accompanied by a desire for change or variety " (Thackray, 1981, p. 166). Included in this definition are a wide variety of experiences from the occasional boredom experienced by persons engaged in repetitive tasks, to the boredom that occurs despite varied environmental stimulation and that has been related to such diverse problems as disruptive classroom behavior (Wasson, 1981;

Vandewielle, 1980), higher school drop out rates (Robinson, 1975), memory impairment (Jacoby, 1978), decreased judgemental reliability (Dong, 1983), errors in verbal transformations (Calef, Calef, Piper, Shipley & Thomas, 1979), obesity (Abramson & Stinson, 1979; Dullahan, 1981), alcoholism (Orcutt, 1984), and criminal behavior (Cleckly, 1964). Is the boredom that occurs during repetitive task performance conceptually the same as the boredom that has been related to more severe behavior problems? Are the strategies to reduce boredom the same in both cases? This section will review theories of boredom with the intent of identifying how theorists deal with these questions. Additional purposes of the review will be to determine, where applicable, the role that theorists attribute to physiological responses in boredom, and to identify the cognitive strategies suggested by theorists to reduce boredom that accompanies repetitive task performance.

Theories of Boredom

Three theoretical orientations are largely responsible for early explanations of boredom. Existential theorists view boredom primarily as the willful denial by persons of the full range of human experience. Psychoanalytic theorists view boredom as one possible result of the lack of expression of libidinal (vital impulse) energies; and arousal theorists hypothesize that low physiological arousal states that occur in response to nonvariant stimulation are a necessary prerequisite to the affective experience of boredom. In addition, there are a number of more recent theories and models of boredom that draw upon a variety of theoretical orientations, but take a more perceptual view of the processes leading to boredom.

These theoretical orientations will be used here as a classificatory convention for reviewing theories and models of boredom. It should be pointed out, however, that the classification is not mutually exclusive. Rather, it is employed to reflect the primary emphases of the theories and to provide an organizational framework for the presentation.

An Existential Theory of Boredom

The review will begin with the existential view of boredom. Since existential theories of boredom emphasize personal choice rather than repetitive task performance, and are primarily descriptive rather than explanatory, they will not be dealt with extensively here. Instead, the most comprehensive existential theory of boredom (O'Connor, 1967) will be presented as an exemplar of existential theories.

O'Connor (1967) distinguishes between two types of boredom that occur simultaneously: one that is directed outward towards a particular phenomenon (it bores me), and the other that is directed towards the self (I am bored). It is self-referential boredom that has important psychological implications for existential theorists.

O'Connor describes self-referential boredom as a reflexive emotion. Reflexive emotions set the tone for the evaluation of both the environment and the self. In self-referential boredom, the tone is one of irritation over personal frustration and a sense of loss that is reflected in the symptoms of losing time, wandering attention, fixation on trivial details, casual rehearsal of memories, physical discomfort, and bodily agitation. This tenor of emotional life, however, is not something that merely happens. It is, to a large extent, something people choose. O'Connor illustrates these choices by three examples that lead to different types of bored personality: the asthete who refuses commitment and seeks self-gratification in its stead; the intellectual who chooses to refuse all interests but his narrow academic interests, and seeks compensation in obsessive work and self-expression; and the spiritual person who adopts moral good to counteract the refusal of joy. The key to each of these personality types is not the incapacity to experience, but the refusal to experience the appetite that results in the reduction of all phenomena to the same level of indifference.

Summary. Existential theorists view boredom as a symptom of the willful denial of the full range in the experience of life. This denial is reflected in the temporary disinterest for activities other than the current one, or , when prolonged, is reflected in a bored personality trait. When compelled to perform a task other than the one in which the person is interested, the person willfully chooses to deny any possibility of variability in the task itself. Boredom, therfore, is a self-imposed emotion that is alleviated only by choosing to embrace the experiences that have been willfully denied.

As exemplified by O'Connor's theory, existential views of boredom hypothesize no mechanisms that might account for boredom, nor explain why boredom, rather than some other experience, might result. The most important contributions of existential theories of boredom rest in their emphases on personal control over boredom, their focus on intraindividual differences in boredom susceptibilty, and in their rich descriptive value.

Psychoanalytic Theories of Boredom

Psychoanalytic theories posit as a basic premiss that the expression of libidinal energies (the vital impulse or energy of persons) is the life force of man. Although all psychoanalytic theories view the experience of boredom as one possible manifestation of the repression, or blocking, of libidinal drive, they differ in their emphasis on the cognitive manifestations of boredom, and in their emphasis on cognitive variables in the definition of libidinal drives. In the following review, psychoanalytic theories will be classified as classical or ego-analytic theories to reflect these differential emphases.

Classic Psychoanalytic Theories of Boredom. The original and most influential psychoanalytic theory of boredom is the one presented by Fenichel (1945, 1951). Fenichel (1951) proposes that boredom is the "feeling of displeasure due to a conflict between a need for intense psychological activity and the lack of stimulation or inability to be stimulated" (p. 349). Two types of boredom are identified: pathological and normal. Pathological boredom functions as a defense mechanism for anxiety. In situations where the expression of libidinal energies results in anxiety for the self, the active repression of libidinal energies serves to exclude perceptions, or actions, that may provoke anxiety. Normal boredom, on the other hand, occurs where the structure of the real situation (lack of stimulation) does not allow the discharge of intense psychological (libidinal) energy. In this context, monotony refers to the lack of novel stimulation in the environment, and boredom refers to the affective state associated with the conflict between the need to express libidinal energies, and the monotonous situation that leads to disinterest. Fenichel's (1951) classic statement is that normal boredom is "the state of conflict that arises when we must not do what we want to do or must do what we do not want to do" (p.359).

Normal boredom in Fenichel's theorizing can be viewed as the boredom that occurs during repetitive task performance. The strategies that Fenichel suggests to alleviate normal boredom are a discharge of libidinal energies brought about either by a change in the environment, a change in one's behavior, or a change in object cathexis (the redirection of goals from the task to a more valued goal for which performance of the task is necessary to achieve). The latter solution amounts to a cognitive strategy for redirecting attention from the monotonous task to the long term consequences of the task. According to Fenichel, however, cognitive-like strategies are effective only to the extent that they are not prolonged beyond the monotonous situation, and that the libidinal energies are expressed fully after the duration of the monotonous situation has expired. By contrast, pathological boredom is alleviated only by the discharge of libidinal energies through abreaction of the specific causes underlying repression.

In both types of boredom, the unpleasantness experienced is the result of a high arousal state engendered by the psychodynamic conflict between the need to express libidinal energies, and either the self-imposed constraint due to the repression of libidinal energies, or the environmental constraint that limits the expression of these energies. This conflict may express itself symptomatically as muscular rigidity, hypotonic laxity, or a vascillation between the two states. Insofar as it is possible to interpret high arousal due to psychodynamic conflict as high cortical arousal, Fenichel's position with respect to physiological responding is that boredom is accompanied by high cortical arousal, but that its manifestation in behavioral and peripheral responses may reflect either high or low arousal.

Elaborating on Fenichel's work, Greenson (1953) describes boredom as a feeling state of dissatisfaction and disinclination to action, while simultaneously longing for some unidentifiable goal. Pathologically bored persons exhibit a lack of emotion and and a lack of fantasy imagination due to the repression of libidinal energies. Verbal expression is marked by concreteness, the recall of minute detail, and a lack of metaphor. The characteristic features of boredom are this lack of fantasy imagination, plus a feeling of emptiness combined with a sense of longing, and a passive expectation that what is missing will be provided by the external world. Pathologically bored persons seek to overcome the void of emptiness by engaging in oral-incorporative behaviors such as eating, fasting, excessive alcohol consumption, and homosexual acts. In essence they substitute sensation for satisfaction. Since classical psychodynamic theories view normal and pathological boredom as observationally and experientially indistinguishable, and discriminable only by their locus of constraint, persons experiencing normal boredom exhibit these same symptoms, although to a lesser degree.

Ego-analytic Theories of Boredom. Later psychoanalytic theorists adopt a more cognitive approach to boredom in that they either specify mainly cognitive symptoms associated with boredom, and/or define the libidinal energies that are repressed as the striving for cognitive goals. Weinberger and Muller (1974, 1975) express the former view. In their formulation, pathological boredom is the affective disorder arising when libidinal energies, defined as ego-alien (primarily incestuous) goals, are repressed. The repression of libidinal goals leaves the person feeling aimless and without interests, despite apparent material and intellectual successes.

Eisnitz (1974) describes boredom as the experience that arises when the possibility for gratification of the self cannot be experienced, either as a result of a nonstimulating environment (what Eisnitz refers to as exogenous boredom and analogous to Fenichel's normal boredom), or as a result of a disturbance in the experience of the self due to repression (endogenous boredom analogous to pathological boredom). Eisnitz attempts to distinguish between the subjective feeling of emptiness that occurs because one is unable to experience oneself as potentially achieving one's goals, and the attribution of boredom to one's surroundings. From this point of view, boredom refers to the projected (cognitive) attribution of boredom to the environment rather than the affective experience itself. In Eisnitz's theory, persons who claim that they are bored when they perform a repetitive task are really saying that performing the task is preventing them from engaging in some other activity that they would find personally rewarding. The activity currently engaged in, therefore, is labelled as boring. This distinction between the experienced affect, and the attribution of boredom to the environment, is very similar to O'Connor's (1967) distinction of outward and inward directed boredom.

Bernstein (1975) defines boredom as the repression of affect that makes a person unable to experience one's feelings directly. Responsive (normal) boredom is distinguished from chronic (pathological) boredom. Responsive boredom is the appropriate suppression of affective responses to monotonous situation, whereas chronic boredom is the psychopathological expression of repressed affect that makes a person unable to experience one's feelings directly. Although both normally and pathologically bored persons misattribute the cause of their loss of feeling to the environment, normally bored persons are aware of this misattribution while chronically bored persons are not. In a manner similar to Eisnitz, therefore, Bernstein defines boredom as a cognitive misattribution that results from the repression of affect, rather than as the affect itself. To compensate for their unexperienced feelings, bored people seek out sensations of increasing intensity and impact.

Bernstein extends his analysis to a sociological account of presumed widespread boredom in adolescents. He speculates that an overemphasis on cognition and skills training that require rigidity of behavior and the exclusion of feelings, is characteristic of current parenting and educational procedures. This leads to the overdevelopment of self-control (the super-ego) that serves as a repressive barrier to the expression of affect, and predisposes a generation of adolescents to chronic boredom. Adolescents who are chronically bored due to this developmental process, presumably "bring" their boredom to the repetitive task performance, rather than being bored by the task.

Waugh (1975) suggests that the primary cause of libidinal repression that leads to boredom is the unconscious fear that fantasy might lead to acts of aggression that would be punished. In contrast to other psychoanalytic theorists reviewed so far, however, he does not distinguish between normal and pathological boredom. Rather, he argues that the source of boredom is always internal, intrapsychic conflict. Since monotonous stimulation can be soothing or exciting as well as boring, and since the same stimulus can be either depending on the circumstance, monotonous stimulation is a possible but not sufficient condition of boredom. The major stimulus for boredom, therefore, must come from within either as a response to monotonous stimulation, or as a response to threatening affective impulses. The experience and expression of boredom that accompanies repetitive task performance, therefore, is similar to pathological boredom in that it originates within the person, and is the result of attributions (misattributions) of monotony to the environment.

Waugh's theory continues the progression of psychoanalytic theories to a more cognitive, and a more attributional orientation. The theory also provides a useful addition to psychoanalytic theory in its attempt to account for intraindividual differences in the perception of monotony, and its emphasis on personal responsibility for boredom. In light of Waugh's retention of both monotonous stimulation and threatening affective experiences as stimuli for boredom, however, his rejection of any distinction between normal and pathological boredom seems more a rhetorical move intended to emphasize personal responsibility for boredom, than a conceptual distinction. The main thrust of Waugh's argument is that monotonous stimulation is a sufficient precondition, but neither a necessary, nor a sufficient condition of boredom.

Esman (1979) pursues the argument that all boredom is the result of peoples' misattribution of monotony to the environment.

In Esman's theory, boredom is not simply a response to external stimulation. It is the product of an interaction between the monotonous circumstances, and the psychological set, or ego characteristics of the individual. Boredom has multiple genetic and dynamic roots which can be summarized as the developmental failure to acquire interests, and/or the cognitive and adaptive resources to cope with endless leisure and libidinal impulses. A person's misattribution of monotony to the environment, therefore, is the result of a developmental failure rather than a nonvariant response to monotonous stimulation, or repetitive task performance. Although Esaman's theory stresses interindividual differences in the experience of boredom, the theory seems more devoted to a sociological analysis of boredom than a psychological explanation which identifies specific conditions that give rise to boredom, and the consequences of boredom for the individual and for behavior.

Summary. Psychoanalytic theorists interpret boredom as one possible result of the constrained expression of libidinal impulses. They differ, however, on whether they view boredom that accompanies repetitive task performance as distinct from pathological boredom that occurs in the presence of varied environmental stimulation; and whether they interpret boredom as an affect, or an attribution made to ones' surroundings in response to perceived monotony and affectively experienced emptiness.

Differences in the distinction between normal and pathological boredom can be viewed as reflecting alternate sources of perceived monotony giving rise to boredom. Classical theorists, who differentiate between boredom as a normal and a pathological response, adopt essentially moderate constructivist-realist view of monotony: perceived monotony in normal boredom is the result of the veridical acquisition of information from the environment, and perceived monotony in pathological boredom is due to imagined monotony in the environment despite objective varied stimulation. The ego-analytic view is totally constructivist in that it posits all monotony is the result of internal, self-imposed constraint on the expression of libidinal energies.

All psychoanalytic theorists adopt a constructivist approach to locus of constraint in that they view the reasons that compel a person to remain in a situation that is perceived to be monotonous as self-generated. They differ, however, on whether locus of constraint is attributed to identifiable reasons for persisting at the task (classical normal boredom), or attributed exclusively to the repression of libidinal impulses (classical pathological and ego-analytic boredom). The attribution of monotony to the environment, therefore, is the result either of a conscious processes, or of an unconscious attribution to the environment due to the repression of libidinal energies. Repression is the mechanism that accounts for the nonveridical perception of monotony in the environment and for the unconscious attribution of boredom to the environment.

Psychoanalytic theories focus most of their attention on boredom as a defense mechanism for anxiety, and deal only in a limited way with normal boredom that accompanies repetitive tasks. The primary suggestion for coping with boredom during task performance is to alter one's reasons for engaging in the task.

Arousal Theories of Boredom

In contrast to the psychoanalytic focus on pathological boredom, arousal theories deal largely with boredom that accompanies repetitive task performance. Historically, arousal theories can be classified as theories that emphasize decreases from personal optimal levels of tonic physiological arousal, and theories that stress optimal levels of arousal potential in the environment. The theories reviewed in this section, will be organized according to this distinction.

Optimal Level of Arousal Theories. Optimal level of physiological arousal theories define boredom as the end result of a process entailing decreases from personal optimal levels of physiological arousal required for task performance. The first comprehensive arousal theory of boredom was provide by Barmack (1938, 1939a, 1939b, 1939c, 1940).

Barmack (1939c) defined boredom as " a state of conflict between the tendency to continue and the tendency to get away from a situation which has become unpleasant principally because of inadequate motivation resulting in inadequate physiological adjustments to it (the situation)" (p. 468). Boredom, however, is not simply the state of low physiological arousal due to stimulus satiation. Boredom occurs only where the person wants to leave the situation, but is compelled to remain after stimulus satiation (habituation) has occurred.

Mention should be made concerning Barmack's idiosyncratic terminology. Barmack notes that boredom is not the same as fatigue. A feeling of fatigue is usually associated with boredom, but boredom is relieved by the cessation or avoidance of the repetitive task whereas fatigue is not. Perhaps confusingly, Barmack, refers to the fatigue that occurs in boredom as psychological fatigue and labels it monotony. This is in contrast to Fenichel's (1951) definition, that refers to monotony as the objective structure of a situation that is marked by a lack of stimulus variability, and not to the affective experience of fatigue.

Given the era of Barmack's formulation, he makes no distinction between cortical and autonomic arousal. Physiological adjustments refer to the sleep-like state, including low arousal, that the person seeks to counteract. Barmack (1937) suggests that any method that serves to counteract the dimunition of arousal can be employed as an effective means of coping with boredom. Experimentally, he validated the short term effects of benzedrine, caffeine, and incentives as preventatives to boredom (Barmack, 1938, 1939a, 1939b, 1940). However, based on observation of subjects during experimental conditions of repetitive task performance, he also identified cognitive strategies such as varying the rate of work, day dreaming, and cognitively restructuring task procedures as means by which boredom could be warded off (Barmack, 1937).

Hebb (1966) defines boredom as a state of low tonic arousal in which a person seeks a higher level of excitement, usually in the form of play. The low drive or arousal (Hebb equates the two), produces the unpleasantness in boredom that initiates the striving for curiosity seeking which, for Hebb, is a fundamental factor in explaining human behavior. When constrained from avoiding boredom or curiosity seeking, mental functioning deteriorates, and personality disintegrates (Hebb, 1966; Heron, 1957).

In order to explain these deleterious effects, Hebb (1955) postulates that the restriction on motor activity and sensory input from exteroceptors that occurs in monotonous environments, leads to the disorganization of neural firing and the disruption of cognitive and visual-motor performance. Boredom, therefore, is viewed as occuring as a result on CNS inactivity.

Hebb (1949), like Barmack (1937, 1939b), initially did not distinguish between cortical and autonomic arousal in his theory of boredom. His theory, therefore, has been interpreted frequently as indicating that boredom is associated with both low cortical, and low autonomic arousal. In other writings, however (e.g., Hebb, 1955; 1966), Hebb recognized the role of the reticular activating system (RAS) in regulating cortical arousal, and the need for sensory stimulation to "charge" the cortex through the RAS. This view is congruent with the interpretation that peripheral responses are activated to compensate for low cortical arousal, and that peripheral responding varies according to these compensatory actions (Zuckerman, 1979).

Hebb suggests that although spontaneous mental imagery may alleviate boredom temporarily, curiosity seeking behavior is the only way of effectively removing the restrictions on motoric activity and sensory input. His theory, therefore, advocates primarily behavioral means for reducing boredom that have their effect by augmenting low tonic levels of cortical arousal that cause boredom.

O'Hanlon (1981) defines boredom as the unique psychophysiological state that occurs as a result of the conflict between cortical habituation that occurs in response to monotonous stimulation, and the effort required to maintain optimal task performance. While cortical habituation is a necessary precondition of boredom, it is not a sufficient condition. By itself, cortical habituation leads only to sleep or a change in the environment. Boredom occurs only when effort, defined as a voluntary internally generated cognitve process that increases cortical arousal, must be employed to counteract low cortical arousal. O'Hanlon proposes that it is the intentional allocation of cognitive effort that accounts for the unpleasantness or negative affect associated with boredom.

Analogous to the theories of Barmack and Hebb, O'Hanlon implies in his theory that any actions a person undertakes that prevent cortical habituation are effective in alleviating boreom. In addition, however, any strategy that serves to reduce cognitive effort might also be expected to reduce boredom.

Optimal Arousal Potential Theories. Arousal potential theories of boredom accept the principle of personal optimal levels of physiological arousal for repetitive task performance, but emphasize the potential of environmental stimulation to maintain optimal levels of arousal, rather than personal optimal levels of arousal per se. Perhaps the most influential arousal potential theory of boredom is the one offered by Berlyne (1960, 1967).

Berlyne (1960) proposes a drive state theory of boredom similar to Hebb's with the aforementioned exception that he focusses on the arousal potential of stimuli, rather than the individual's tonic level of arousal. Berlyne views man as having a continual need for varying stimulation. Boredom is defined as the drive state that arises out of a continued exposure to repetitive and nonvarying (monotonous) stimulation, and that interferes with some other, strongly motivated behavior. This drive may be for either diversive seeking behavior or epistemic variety seeking behavior that serve to alleviate the aversiveness of the monotonous stimulation.

In contrast to Hebb, Berlyne views the aversiveness in boredom as being due to high autonomic arousal that is indicated by the experiential and observational data relating boredom to restlessness, agitation, and emotonal upset. Berlyne (1960) explains high autonomic arousal by hypothesizing that monotonous stimulation serves to liberate the reticular activating arousal system from the mediating influences of the cortex. This process prevents habituation to repetitive stimulation from occurring, thus leading to high autonomic arousal. Alternatively, he proposes that boredom may also occur where monotonous stimulation is too strong to be soporiphic, again leading to the prevention of habituation and high autonomic arousal. In a later formulation, Berlyne (1967) viewed monotonous stimulation as leading to low cortical arousal that releases brain stem mechanisms from restraint which in turn leads to high autonomic arousal. Berlyne's theory logically implies that changes in the arousal potential of environmental stimuli and, that in particular, changes in the complexitiy, novelty, and intensity of environmental stimuli are successful in alleviating boredom.

Fiske and Maddi (1961) also posit that boredom occurs under conditions of nonvarying stimulation. They extend their analysis, however, to include exterioceptive, interoceptive, and cortical sources of stimulation (thoughts or images). Stimulation that is low in intensity, meaningfulness, or variablity has little arousal potential (impact), and reduces cortical activation below the optimal level for the given situation. The organism may seek to increase CNS stimulation by moving to increase proprioceptive inflow, by engaging in cognitive fantasy to increase cortical stimulation, or by seeking external sources of stimulation. Fiske and Maddi's formulation, therefore, includes cognitive activities as well as changes in behavior, environment, or peripheral responding as possible boredom-coping strategies. Peripheral responses in boredom may vary depending upon the nature and combination of these compensatory activities.

Maddi (1961) further proposes that individual differences in preference for levels of stimulus intensity, meaningfulness, and/or variation may account for differences in susceptibility to boredom. He speculates that children reared in environments where a premium is placed on the development of human potentialities other than cognitive functioning and thought processes, will not be stimulated to develop subtleties of thought requiring fair amounts of discrimination. The child therefore developes vague and superficial expectations of the world, and comes to experience it as more or less expected and monotonous. As a result, the child avoids such situations in favour of a continual search for 'kicks', radically novel experiences, and potentially delinquent behavior.

Summary and Integration. Arousal theories view boredom as the end consequence of a process entailing either a lack of adequate cortical stimulation, or a lack of arousal potential in the environment. Repetitiveness of environmental stimulation leads to low cortical arousal which is hypothesized to be a necessary prerequisite for boredom. Although arousal theorists eschew the psychoanalytic concepts of libidinal energy and intrapsychic conflict, they nevertheless posit that boredom occurs only when the performance of a repetitive task interferes with some other, more desired, activity and/or requires some compensatory action to remain at the task. This stipulation can be interpreted as a requirement for constraint in addition to monotonous stimulation. While no a priori reason exists why constraint to remain in the repetitive situation should be externally based rather than self-imposed, arousal and arousal potential theories emphasize external constraint in the same manner that psychoanalytic theorists deal with constraint in normal boredom: the individual has identifiable reasons for remaining in the monotonous situation. Insofar as arousal theories deal with pathological boredom, it is hypothesized to result from extreme variations in personal optimal needs for arousal which are due to biological and/or developmental factors.

Arousal theories can be viewed in an historical perspective as embracing increasingly more differentiated views of peripheral responding, and more cognitive interpretations in explaining inter and intraindividual differences in boredom. Barmack's early formulations (Barmack, 1939) viewed physiological arousal as a unidimensional and undifferentiated phenomenon, and boredom as a state that lies somewhere near sleep on a hypothetical physiological arousal continuum. Later theorists, however, posit no necessary relationship between cortical and peripheral physiological arousals. Peripheral responses are seen as a manifestation of central nervous system processes, and are related to the compensatory actions that are taken in response to boredom. Peripheral responses, therefore, intervene between the monotonous stimulation and individual responses to modify and potentiate behavior.

Cognitive processes in early arousal theories are manifest in the conflict between what one is doing and what one would prefer to be doing. Later theorists incorporate additional cognitive processes that may serve both to mediate the relationship between repetitive environmental stimulation, and to act as one of the compensatory processes taken in response to perceived monotonous stimulation.

A variety of cognitive strategies to reduce boredom are suggested by arousal theorists. The basic rationale for these strategies is that they are intended to enhance the personal optimal level of cortical arousal, or the the arousal potential of the environment. This may be accomplished by altering one's behavior, increasing the meaningfulness, intensity, or complexity of the environment, or by cognitive strategies such as mentally varying the rate of work, mentally altering the task requirements, mental imagery, and daydreaming.

Later Theories and Models of Boredom

More recent theories and models increasingly define boredom in perceptual terms. Geiwitz (1966) proposes a model in which there are four common components associated with boredom: perceived monotony, externally imposed constraint, reduced cognitive arousal (cortical arousal measured by subjective report), and unpleasantness. Geiwitz suggests that no one of these component is a necessary precondition for boredom. Any one component may serve as a stimulus cue that triggers the "redintegration" of the other components. Strategies to alleviate boredom, therefore, depend on identifying and attempting to alter the most salient component of boredom for that individual.

Zuckerman (1978, 1979) defines boredom as the negative feeling produced by a lack of change in environmental (both internal and external) stimulation. Whereas the previously cited optimal level theories define boredom with respect to optimal levels of physiological arousal or arousal potential, Zuckerman defines boredom in terms of the amount of stimulation perceived as necessary by an individual to achieve this optimal level of arousal.

Zuckerman (1979) posits that every individual has characteristc levels of optimal stimulation for cognitive activity, motoric activity, and positive affective tone which may be sought in either the external or internal environments. Depending on the pursuit of these varying optimal levels of stimulation, and the combination of activities engaged in to achieve them, there is no necessary fixed relationship between low cortical arousal in boredom and peripheral responses.

Hamilton (1981, 1983; Hamilton et al.,1984) presents a theory of boredom that substitutes the notion of optimal information flow for optimal stimulation. From this point of view, boredom occurs where there is a perceived mismatch between the amount of information actually available, and the individual and situation specific amount of information desired. When information flow is lower than the personal/situational optimal level, and where compensatory increases in information, by either behavioral, environmental, or cognitive means are constrained or limited, spare attentional capacity is devoted to irrelevant distraction or self-monitoring that is reflected in boredom and a sense of time passing slowly. Alternatively, where information flow is both higher than the personal/situational optimal level and meaningless (e.g., memorizing the phone book), the information overload may be experienced as being worthless and boring, as well as frustrating, anxiety provoking, and arousing. Peripheral responses play no necessary role in boredom. Rather, they vary as a function of information flow and cognitive effort. As with O'Hanlon's (1981) theory, the increased effortful attention that occurs when one is constrained to engage in a monotonous task is responsible for the strain and fatigue in boredom.

de la Pena (1983) adopts and extends Hamilton's model by positing that the brain has an organized perceptual-cognitive-behavioral function which requires an optimal range of information flow to maintain positive mood. Boredom is defined as the information underload that occurs when the environment provides low information relative to the organizing capacity of the brain. Attentional processes which entail the selection of cognitive structures for organizing information are one way by which individuals can counteract information underload. In addition cortical, autonomic, and behavioral activation occur as homeostatic processes to rectify low information flow. As a result of these processes, de la Pena hypothesizes that one can counteract perceived monotony by learning "to see the universe in a grain of sand", either by exposure to didactically presented material, or by learning certain psychophysiological procedures such as meditation, autohypnosis, and biofeedback-assisted cognitive-behavioral training.

Finally, Hill and Perkins (1985) present a model of boredom in which they distinguish between cognitive and affective components in boredom. Based on their previous empirical work (Perkins & Hill, 1985), they view these components as the cognitive "construal" of stimulation as monotonous, and the affectively experienced frustration of personal needs and motives. They hypothesize that where instrumental construing, defined as the personal cognitive constructs relevant to an individual's needs satisfaction, are constrained, the environment is perceived as homogeneous and undifferentiated. Boredom and the affective experience of frustration, therefore, are linked by the cognitive interpretation of the environment as frustrating one's basic needs. Boredom is the result of this perceived monotony and frustration of personal needs.

Hill and Perkins view boredom as a purely psychological phenomenon. Boredom bears no necessary relationship to the objective repetitiveness of stimulation, or to central or peripheral physiological processes. Boredom is related solely to subjectively experienced monotony, and is reduced only when persons are able to satisfy or alter their basic needs.

The elementary features of Hill and Perkins' model are remarkably similar to attributional psychoanalytic views of boredom. As such, the model provides an alternate conceptual framework from which to address the emergent themes of constraint, subjective monotony, and boredom.

Summary. In contrast to early psychoanalytic and arousal theories which attempt objectively to define repetition in the environment, the models of boredom reviewed in this section emphasize the perceived monotony of the environment and the perceived mismatch between personal optimal amounts of stimulation desired and the perceived amount stimulation available. No necessary relationships are posited between boredom and either central or peripheral physiological processes. Peripheral responding is free to vary as a function of perceived stimulation, information flow, or degree of frustration of personal needs. An implication of this perceptual view of monotony is that persons can learn to perceive monotony differently in the environment.

In their focus on perceived mismatches in the environment, these models parallel the constructivist view of perceived monotony advocated by ego-analytic theorists. They adopt, however, a nonpsychic conflict interpretation to account for these perceived mismatches. In this sense, the models reviewed in this section resemble emerging attempts to reinterpret the psychodynamic mechanism of repression in terms of selective cognitive structures that organize and guide perceptual processes and behavior (e.g., Erdelyi & Goldberg, 1979; Meichenbaum & Gilmore, 1984), rather than as the result of intrapsychic forces.

Perceptual models also are analogous to modern theories of stress that view stress as the product of a perceived mismatch between demands made on a person and the person's perceived ability to cope with these demands (e.g., Cox, 1978; Everly & Rosenfeld, 1981; Hiebert, 1985; 1986). The crucial variable is the personal rather than veridical perception of the environment as monotonous. Although models of boredom are not formulated in these terms, early environmentally based theories of boredom can be viewed as having the same shortcomings as environmentally based theories of stress: namely that inter and intraindividual differences in boredom occur in response to similar repetitive stimulation. The stress analogy, if it were to be completed, would also include a physiological boredom response analogous to the physiological stress response. Although some theories (e.g., Barmack, 1937; Hebb, 1966; O'Hanlon, 1981), and some reviews of the research on physiological responses during boredom (e.g., O'Hanlon, 1981; Thackray, 1981) hypothesize a physiological boredom response characterized by low levels of physiological responding, the evidence for this view is not without controversy. The research related to physiological responses in boredom will be reviewed in a subsequent section of this chapter.

A Summary View of Theories of Boredom

How do theories of boredom distinguish between boredom that accompanies repetitive task performance and other, more general, types of boredom? Before addressing this question, a note should be made about terminology. In subsequent portions of this investigation, monotony will refer to perceived uniformity in the environment rather than subjective fatigue (Barmack, 1939), or the objective repetitiveness of the environment (Fenichel, 1951).

Distinguishing Types of Boredom

Table 1 summarizes the theoretical formulations of boredom according to locus of constraint, hypothesized mechanisms accounting for boredom, and suggested treatments. Despite differences in the explanations offered, the theories reviewed agree that whereas subjectively experienced monotony is a necessary condition, it is not a sufficient condition for boredom. In addition, the situation must be marked by the desire to leave or change the situation, but being constrained from doing so. Theoretical differences both within and between theories are due largely to alternate hypotheses regarding sources of perceived monotony and loci constraint. Monotony is alternatively hypothesized to be a function of the veridical pickup of repetitiveness from the environment, or of intense involvement in some other more desired activity, a defense

Table 1.

Summary of Theories of Boredom.

Theory Type	Locus of Constraint	Type of Boredom	Hypothesized Mechanism	Suggested Treatment
Existential	internal	pathological	none	Expansion of interests
Psychoanalytic	1)external	normal	Suppression of libidinal energies in response to monotonous stimulation	Redirection of object cathexis (change reasons for engaging in the task) Reattribution of reasons for boredom to self
	2)internal (a)	pathological	Repression as defense mechanism for anxiety	Abreaction of anxiety provoking thoughts
	(b)	pathological	Developmental repressive barrier	Abreaction of anxiety provoking thoughts
Optimal Level of Arousal	1)external	normal	Reduction from optimal levels of arousal	Alter arousal level via envoironment or behavior change, stimulants, cognitive enhancements
	2)internal	normal, or pathological	Individual differences in optimal arousal levels	
Optimal Arousal Potential	1)external	normal	Arousal poten. of environ. insufficient for optimal levels of arousal	Enhance meaniningfulness, intensity, or complexity of external or internal environment
	2)internal (a)	normal, or pathological	Biological diffs. in need for arousal poten.	Place in more arousing environment Pharmacological?
	(b)	normal, or pathological	Developmental diffs in need for arousal poten.	Discrimination training?
Optimal level of Stimulation	1)external	normal	Insufficient stimulation for optimal arousal level	Enhance stimulation via environment or behavior change, cognitive,proprioceptive means
	2)internal (a) (b)	normal, or pathological	Biological, developmental diffs in need for stim.	Place in more stimulating environment Stimulation enhancement strategies?
Optimal Level of Info. Flow	1)external	normal	Insufficient info. flow for optimal arousal level	Enhance info. flow via environment or behavior change, cognitive strategies
	2)internal (a) (b)	normal, or pathological	Biological, developmental diffs in need for info.	Place in environment with more info. Cognitive strategies?
Optimal Effort	1)external	normal	Effort allocation requ'd to offset low arousal	Reduce effort via enhanced external or internal environment
Perceived inability to meet needs	1)internal	normal, or pathological	Frustration of personal needs	Meet basic needs

mechanism for anxiety, frustration of personal needs, or biological and/or developmental differences in the need for arousal/stimulation. In addition, table 1 shows that constraint to remain in a perceived monotonous environment is hypothesized to be based either in the environment or exlusively within the individual.

Synthesis

In terms of achieving a synthesis between these views, it seems possible to identify perceived monotony either as a normal or as a maladaptive response, and to retain the distinction between external and internal loci of constraint. Perceived monotony can be viewed as normal response to performing repetitive tasks where there is congruence between perceived monotony and objectively defined repetitiveness in the environment; where monotony is a transient response to intense involvement in some other activity, or to the frustration of personal needs; where monotony is a situationally specific defense mechanism for anxiety; or where biological or developmental factors predispose one to perceive less variability in the environment. Although the demarcation is not precise, perceived monotony can be viewed as a maladaptive response where monotony becomes a characteristic style of responding despite objectively defined variability in the environment. For examples, subjective monotony may be a normal response to intense involvement in some other activity, but be maladadaptive if it becomes the characteristic mode of responding to the environment.

Similarily, subjectively experienced monotony may serve as an effective coping strategy if it is employed in situationally specific circumstances, but become maladaptive if used consistently and indiscriminantly (Bandura, 1977). Finally, biological and/or developmental factors may serve to increase boredom susceptibility or be maladaptive depending on the severity of these factors.

Given that perceived monotony occurs, locus of constraint can be classified according to whether there are compelling reasons for remaining in the environment despite experienced monotony, or whether one persists at a task without having identifiable reasons for doing so. While acknowledging that constraint cannot be viewed exclusively as external to the individual, the presence or absence of compelling reasons to remain in the environment can be interpreted, respectively, as external to the task itself, or internal to the individual. Maintaining these distinctinctions, boredom that accompanies repetitive task performance can be viewed as a normal response to situations where there is both congruence between objective repetitiveness and perceived monotony, and where there are definite reasons for remaining in the situation despite perceived monotony (external constraint). Differences in other factors influencing perceived monotony can then be used to account for individual differences in boredom susceptibility.

Alternatively, other types of boredom can be described according to their predominant sources of monotony and loci of constraint. An advantage of characterizing boredom in these terms is that the description facilitates the assessment of boredom for treatment interventions. As an illustration, where perceived monotony is congruent with objectively defined monotony and constraint is external, specific boredom-coping strategies which a person can intentionally employ, such as Fenichel's proposal of altering ones reasons for engaging in the task, may be indicated. Where perceived monotony serves as a coping strategy for anxiety, however, it may be preferable to teach coping skills that deal with the cause of anxiety rather than boredom per se. Correspondingly, treatment interventions will vary as a function of locus of constraint. Where locus of constraint is external and a person compelled to persist at a task, self-control strategies to reduce boredom that the person can initiate may be indicated. However, where locus of constraint is internal, identification of the reasons for task persistence is necessary prior to the development of an intervention strategy. Table 1 summarizes the treatment interventions suggested by the different theoretical orientations to deal with alternate loci of constraint.

Finally, source of monotony and locus of constraint also can be used to classify theoretical accounts of boredom. Existentential theories deal primarily with internally based monotony and locate the locus of constraint internally in the personal choices persons make when they devote themselves to narrow foci of interests. Psychoanalytic theories alternately deal with external and internal sources of monotony, and suggest both internal and external loci of constraint. Arousal theories identify primarily external sources of monotony and loci of constraint. Internal loci of constraint in arousal theories are due to biological or developmental factors and are used to account for individual differences in boredom susceptibility, and only tangentially to account for pathological boredom.

The theories reviewed offer a variety of cognitive strategies that may be used to alleviate boredom during repetitive task performance. A list of these strategies includes the redirection of attention from task specific to task extrinsic goals (Fenichel, 1951), mentally varying the rate of work, cognitively restructuring task procedures, daydreaming (Barmack, 1937), spontaneous imagery (Hebb, 1949), or intentional imagery (Berlyne,1960; Fiske & Maddi, 1961; O'Hanlon, 1981; Zuckerman, 1979). Suggested cognitive strategies for boredom as a result of other sources of monotony and loci of constraint can be implied. Existential theorists recommend the redirection of volitional choice in experiencing life. Psychoanalytic theorists propose that the abreation of underlying causes of anxiety that cause the nonveridical perception of monotony in the the environment, and by implication, at least, reattribution training. Developmentally or genetically based boredom is dealt with only in a limited way by the theories just reviewed. Perceptual discrimination and skills training, however, can be inferred for developmentally based constraint, and appropriate person-environment matches recommended for genetically based constraint.

Lastly, the consensus of latter theories of boredom just outlined propose that patterns of peripheral responding which accompany boredom vary as a function of perceptual processes, and the compensatory actions taken in response to low cortical arousal. In the next section studies that relate specifically physiological indices of peripheral responding to boredom will be reviewed.

Psychophysiological Studies of Boredom

Despite the near unanimity of latter day theories that patterns of peripheral responding which accompany repetitive task performance vary as a function of compensatory physiological processes engaged in to counteract boredom, reviews of the literature relating boredom to physiological indices of peripheral responses (e.g. O'Hanlon, 1981; Smith, 1981; Thackray, 1981) conclude that boredom is accompanied by decreased levels of peripheral responding. In this section, the literature that specifically relates self-reported boredom to physiological indices of peripheral responding will be reviewed.

A note should be made about the type of studies excluded from this review. Major surveys of peripheral responses accompanying boredom generally include sensory deprivation and vigilance studies, and field studies of boredom. Sensory deprivation and vigilance studies, however, do not measure boredom directly. Instead, they infer boredom as a post hoc explanation to account for observed deterioration in mental functioning, and/or observed decrements in performance. Field studies of boredom, on the other hand, typically do not monitor physiological responses, and typically are confounded by spurious factors such as the self-selection of workers in repetitive jobs. In order to assess objectively the relationship between boredom and peripheral responses, a measure of each was considered necessary and the exclusion of these other studies deemed warranted.

Three sources were used to locate research relating measured indices of peripheral physiology in boredom: recent major reviews of boredom (O'Hanlon, 1981; Smith, 1981; Thackray, 1981); reference lists of obtained articles from these reviews; and a computer data base search (PSYCHINFO) using the major key words (boredom or monotony) by psychophysiological arousal. The sole criterion for inclusion was that at least one physiological measure of a peripheral response, and one measure of boredom or monotony be made in the study. Using this criterion, Smith's (1981) report of the paucity of literature on boredom was readily affirmed: only seven articles were located. Since the number of investigations is small, each study can be considered in some detail.

The Research

Barmack(1937) conducted a pair of early exploratory studies to investigate the relationship between peripheral responding and boredom. In each study subjects were engaged successively in two tasks: a boring task adding six digit numbers, and an interesting task filling out five forms of the Otis Self-Administering Examination. Subjects were habituated to the experimental apparatus over eight prior sessions following which they were assigned, in counterbalanced order, to the two experimental tasks for 90 minutes. Oxygen consumption was measured in one experiment, while blood pressure and pulse rate were monitored in the other. Ten-point subjective rating scales for bored-interested, relaxed-strained, irritated-pleased, peppy-fatigue, sleepy-awake, attentive-inattentive, and percent of time spent daydreaming were presented at fifteen minute intervals. As well, spontaneous introspective reports were recorded at these intervals. The general conclusions drawn were that decreased physiological indices of oxygen consumption, blood pressure and, to a lesser extent, heart rate were associated with subjective reports of boredom. These changes, however, were not necessarily associated with different work output as measured by number of errors.

Barmack's study is cited universally as supporting the view that boredom is accompanied by low physiological arousal. Barmack's conclusion, however, is qualified by many individual differences in responses, so many in fact, that statistical procedures were deemed unwarranted. Barmack (1937) attempts to explain the inconsistencies between subjective report of boredom and indices of physiological responses as measurement difficulties associated with interindividual individual differences in interpreting boredom. He suggests that subjects may have interpreted boredom as dislike for the task based either on the discomfort of the experimental apparatus, or on the previous dislike associated with repetitive tasks. A close look at his report, however, is illuminating. Published before restrictions on article length, it provides complete data for each subject. These data suggest an alternate explanation, namely that subjects approached the task with differential cognitive activities. Reports of subjects who volunteered introspective information show that some subjects appear to have approached the task as an anticipatory game, restructured the task information to form patterns, or attempted to discover the underlying rationale for the experiment. Moreover, subjects who adopted these cognitive strategies also appear to be those who responded to the task with less boredom and with increased, rather than decreased, indices of physiological responses.

London, Schubert and Washburn (1972) conducted two experiments to investigate the issue of autonomic arousal in boredom. In the first experiment, paid volunteers were assigned randomly to either a boredom condition in which subjects pushed a button on a monitor in response to an irregularly flashing light, or an interest condition in which subjects wrote stories in response to Thematic Apperception Test (TAT) cards. Galvanic skin potential (GSP), and postexperimental questionnaires to assess boredom were employed as dependent measures. Results indicated that the boredom-interest condition manipulations were effective; that GSP decreased over time; and that GSP interacted with condition so that subjects performing the boring task had consistently higher GSP levels than subjects performing the interesting task. The results are interpreted as supporting the hypothesis that boredom is associated with increased autonomic arousal.

In the second experiment (London et al., 1972), army enlisted men were assigned randomly in counterbalanced order to a boredom condition in which they wrote the letters CD continuously for thirty minutes, and to an interesting condition in which they wrote stories in response to magazine stories that contained no emotional themes. Skin conductance (SC) and heart rate (HR) were measured, and a posttask boredom questionnaire administered. Mean HR decreased over time in both conditions, but HR (significant) and log SC (nonsignificant) were higher in the boredom versus the interest condition. Since HR and log SC decreased less in the boredom condition than they did in the interest condition, London et al. again interpret their results as indicating high autonomic arousal in boredom. On the basis of these findings, London et al. argue for the necessity of employing an experimental control group design. Had comparisons been made solely over periods of task performance rather than with an interest control group, the conclusion drawn would have been simply that boredom leads to decreased indices of autonomic arousal. London et al. also speculate that the increased arousal (attenuation of decrease) in the boredom condition was due to the focussing or narrowing of attention required to oppose the seeking of stimulation from the nontask environment. That is, that the increased arousal was due to effortful attention.

Bailey, Thackray, Pearl and Parish (1977) extended London et al.'s study to include more indices of autonomic responses. Paid subjects were assigned randomly to one of two two-hour tasks varying in visual complexity. Subjects rated both tasks as boring although the high visual complexity condition was rated less so. Decreases in SC, HR, systolic blood pressure, and subjective reports of attentiveness were noted in addition to increases in HRV, body movements, and subjective reports of fatigue and irritation. Bailey et al. conclude that the results support a complex physiological response pattern with HR, SC, and systolic BP decreasing, and HRV and body movement increasing. No group differences were found between the two conditions on either physiological, or self-report measures. However, since no comparisons were made between bored and nonbored groups, it is not possible conclude whether the observed differences are due to boredom or simply repetitive task performance.

Thackray, Bailey and Touchstone (1977) conducted an extension of Barmack's (1937) exploration of the relationship between patterns of physiological responses and subjective report of boredom. Paid subjects responded to infrequent changes in alphanumeric symbols on a simulated radar diaplay for one hour. Results showed that body movement (measured by a finger-pulse transducer affixed to the seat cushion) showed a significant increase over time while physiological indices of blood pressure, oral temperature, SC, and HR decreased over time. There were no differences observed in HRV. Self-report measures of boredom, monotony, irritation, fatigue and strain increased, while self-report of attentiveness decreased. Not all subjects rated the task as boring, however. The sample was divided, therefore, into the eight highest boredom subjects, and the eight lowest boredom (moderate to high interest) subjects. The high boredom group displayed significantly more HRV, longer response times, greater strain, and decreased attentiveness. Thackray et al. relate these differences to attentional processes rather than "arousal". Specifically, they propose that boredom is associated with declining arousal and, in contrast to O'Hanlon, declining attention. The initial manifestation of declining attention is reflected in the increased HRV, and in the subjective reports of decreased attention and increased strain. Their results also indicate, however, interindividual differences in reported boredom to the task, and the decline of physiological response indices regardless of whether the task is reported as being boring or not.

Thackray, Bailey and Touchstone (1979) replicated the Thackray et al. (1977) experimental procedure using three task conditions varying in visual complexity. In this experiment, HRV and body movements increased over time while HR, SC, and systolic BP decreased. Subjective reports of boredom, monotony, fatigue, irritation and tension increased, while report of attention decreased. No differences were found across task conditions on either physiological or self-report measures, even though there were increased detection latencies in the high visual complexity condition. The proposed relationship between declining arousal and manifestations of attention was presumed to have occurred, but to have been insensitive to measurement.

Weber, Fussler, O'Hanlon, Grier and Grandjean (1980) attempted to relate four repetitive tasks, differing in their information processing requirements to changes in physiological indices and subjective reports of boredom. The tasks were presumed, respectively, to require (a) relatively little sustained attention, (b) sustained attention and a perceptual load, (c) a short-term memory load (i.e. sustained attention), or (d) both perceptual and short-term memory loads. Each task duration of 70 minutes was divided into a short work period of 14 minutes, and a long work period of 56 minutes. When analyzed over time, repetitive performance was associated with slight but nonsignificant decreases in HR, increased HRV, and no change in trapezius EMG. When compared to rest periods, however, all repetitive tasks were associated with depressed alpha activity, elevated HR, and elevated adrenaline secretion, indicative of increased arousal. When tasks involving perceptual load were contrasted with those not requiring perceptual load, increased trapezius EMG, decreased HRV, increased feelings of tension, and decreased feelings of boredom and drowsiness were observed. No performance differences were observed between conditions. Weber et al. conclude that repetitive tasks requiring sustained attention are accompanied by elevated arousal; that tasks requiring perceptual discrimination in addition to sustained attention are associated with enhanced arousal and decreased HRV relative to other repetitive tasks; and that dissimilar physiological and subjective reactions can occur in repetitive tasks that appear similar, but differ with respect to their information processing requirements. The results are consistent with the interpretation that increased attention attenuates subjective report of boredom, but at the cost of increased tension.

Frankenhaeuser, Nordheden, Myrsten and Post (1971) compared indices of physiological responses and subjective reports of boredom across conditions of understimulation and overstimulation. A vigilance task detecting signal intensity to visual stimuli constituted the understimulation condition; the vigilance task combined with a complex sensori-motor task involving an incidental visual vigilance task comprised the overstimulation condition; and a magazine reading task was the control condition. Results showed that catecholamine secretion was less in the understimulation than the overstimulaion condition, but that both were greater than the control condition; that HR was less during understimulation than overstimulation, with overstimulation being associated with increased HR from baseline, and understimulation being associated with decreased HR from baseline; and that boredom was greater in understimulation than overstimulation. With respect to the latter finding, however, the graphic data presented show that boredom also increased in the overstimulation condition, and that subjects rated the overstimulation condition as boring by the end of the three-hour period. Variation in peripheral responses due to different tasks are again indicatd. Post hoc analyses also demonstrated that high catecholamine increasers and high HR increasers performed better during understimulation, while low catecholaine and low HR increasers performed better during over stimulation. The results again argue for individual differences in physiological responses to repetitive task performance .

Perkins (reported in Hill & Perkins, 1985) found a significant decrease in both HR and HRV during the performance of a boring task that involved a high mental load, but no significant changes in these variables for a boring task with low mental load. Although particulars of this study have not been published and therefore cannot be evaluated, the results suggest that HR and HRV are also a function of task parameters rather than boredom.

Summary

The findings of studies specifically relating self-report of boredom to physiological indices and performance measures are summarized in Table 2. Table 3 summarizes self-report measures for these studies. Consistent with current reviews of the literature relating boredom to lowered indices of peripheral responding, Table 2 shows that duration of repetitive task performance is associated with increased boredom; decreased HR,

Table 2.

Summary of Studies Relating Boredom to Peripheral Physiology and Performance.

Study	Comaparison	N	Physiological Indices: HR	HRV	BP	SC	BM	OTHER	Performance Measures: # of errors	response latency	response consist.
Barmack (1937)	Over time	(a)12						Oxygen (-)	(+)	(+)	
		(b)12	(-)		(-)			Consum.	(+)	(+)	
Thackray et al. (1977)	Over time.	16	(-)	ND	(-)	(-)	(+)	Oral (-)	ND	ND	ND
	Hi vs Low boredom on the same task.		ND	(+)	ND	ND	ND	Temp.	ND	(+)	(-)
Thackray et al. 1979)	Over time	48	(-)	ND	(-)	(-)	(+)		ND	ND	ND
	Hi vs Medium vs Low visual complexity. All boring.		ND	(+)	ND	ND	ND		ND	(+)	ND
London et al. (1972)	Over time	(a)20	(-)			(-)					
	Bored vs Interset control grp.	(b)40	(+) Decrease less			GSP(+) LogSC (+)					
Bailey et al. (1977)	Over time.	32	(-)	(+)	(-)	(-)	(+)				
	Hi vs Low visual complexity All boring.		ND	ND	ND	ND	ND				
Weber et al. (1980)	Over time	20	ND	(+)			EMG ND	CFF (-) ALPHA ND ADREN (+)	ND		
	Attention vs Disorimination vs both.		ND	(+)	Hi discrim.		(+)	ND ND ND	ND		
Frankenhaeuser et al. (1971)	Over time.	28	(-)					Adren.(+)	(+)		
	Overstim. vs understim. vs control.		(-)Understim.					(+)overstim.	(+)		

ND denotes no difference.
(+) denotes an increase.
(-) debotes a decrease.

Table 3.

Summary of Self-report Findings for Studies Relating Boredom to Peripheral Physiology.

			Self-report Indices				
Study	Comaparison	N	Boredom	Irritability	Fatigue/ Drowsiness	Attentiveness	Other
Barmack (1937)	None	(a)12 (b)12	(+) (+)	(+) (+)	(+) (+)	(-) (-)	% of time(+) daydreaming
Thackray et al. (1977)	Over time.	16	(+)	(+)	(+)	(-)	Strain(+)
	Hi vs Low boredom on the same task.		ND	ND	ND	(-)	Strain(+)
Thackray et al. (1979)	Over time.	48	(+)	(+)	(+)	(-)	Tension(+)
	Hi vs Medium vs Low visual complexity. All boring.		ND	ND	ND	ND	Tension( )
London et al. (1972)	Over time.		(+)		(+)	(-)	
	Bored vs Interset control grp.	(a)20 (b)40	(+) (+)		(+) (+)	(-) (-)	
Bailey et al. (1977)	Over time.	32	(+)	(+)	(+)	(-)	
	Hi vs Low Visual complexity. All boring.		(+)	ND	(+)	(-)	
Weber et al. (1980)	Attention vs Discrimination vs both.	20	(+) (more in non-discrim.)		(+) (for non-discrim.)		Tension (+) (for discrim.)
Frankenhaeuser et al. (1971)	Over time.	28	(+)	(+)		(-)	Unpleasant (+)
	Overstim. vs understim. vs control.		(+)understim.	(+)overstim.		ND	Unpleasant (+)

BP, SC, and respiration rate; and increased HRV (Thackray et al.,1977 excepted) and body movement. These patterns of physiological responses, however, were not unique to self-reported boredom, but were observed for both bored and nonbored subjects during repetitive task performance. When comparisons are made between high versus low boredom groups, the most common findings are that persons reporting greater boredom were distinguishable only by increased HRV (Thackray et al., 1977; Thackray et al., 1979), although even this conclusion is called into question by Perkin's findings that HRV is a function of mental load, and not boredom. The most reasonable conclusion, therefore, is that self-report of boredom is not associated with a unique pattern of peripheral physiological responding, at least as indicated by the physiological indices employed in these studies. Patterns of peripheral responses previously associated with boredom, namely increased HRV and body movement, and decreases in other peripheral indices, appear to be more a function of task paramaters than of boredom.

Research on boredom that also manipulates task parameters reinforces the conclusion that tasks are the salient variables in determining peripheral responses. In the only study to make comparisons between resting baselines and repetitive work conditions (Weber et al, 1980), repetitive task performance is associated with increased autonomic responding in difficult tasks, and decreased autonomic responding in easy tasks. When discrimination in addition to sustained attention is required, HRV decreases, and neck EMG were greater. These results suggest that task variables are salient factors in generating differential peripheral responses while perons experience boredom.

In terms of performance measures, the findings of these studies are conflicting. Studies showing performance decrements over time did not make comparisons between bored and nonbored subjects. Thackray et al.'s (1977) study which did make comparisons between bored and nonbored groups showed no performance decrements over time, but found that bored subjects demonstrated longer response latencies and greater inconsistency in response latencies, despite no differences in absolute level of performance. Only one study, therefore, provides evidence for differences in temporal patterns of responses between bored and nonbored subjects, and this study did not find differences in absolute levels of performance.

Self-report measures also varied as a function of whether comparisons were made over time or between bored and nonbored groups. Increased duration of repetitive task performance was associated with increased self-report of boredom, strain, fatigue, irritability and daydreaming, but decreased attentiveness. When comparisons were made between bored and nonbored groups, some studies failed to find between group differences on other self-report measures suggesting that subjective self-reports accompanying boredom also vary with individual responses to task parameters. The most reliable findings were that boredom was associated with lack of attentiveness, and increased fatigue, strain, and tension. Irritability was associated with the nature of the task rather than boredom.

Finally, most of the studies reviewed have not given systematic attention to the nontask specific cognitive activities a person engages in during repetitive task performance. The studies either do not address the role of cognitive activity as a source of variance in generating boredom or physiological responses, or implicitly assume that tasks requiring sustained attention leave no spare attentional capacity to indulge in cognitive activities such as problem solving, imagery, and/or fantasy. The only comprehensive treatment of cognitive activity in boredom is Barmack's (1937) early study which simply monitors voluntary reports of cognitive activities. Although cognitive activity was not treated as an experimental variable, perusal of these data suggested that the cognitive activity a person engaged in while performing repetitive tasks influenced self-report of boredom and physiological responses. In the next section, research that links cognitive activities to self-reports of boredom will be reviewed.

Empirical Support for Cognitive Factors in Boredom

To date, few direct empirical investigations are available to show that perceived rather than objectively defined monotony is a crucial variable in boredom, or that the adoption of different cognitive strategies can affect differentially the experience of boredom. In this section, the studies that are available will be reviewed. The section will be organized according to four subheadings: studies that demonstrate perceived monotony, studies that use cognitive manipulations to influence boredom, observational/correlational studies of boredom, and studies that attempt to relate extroversion and sensation seeking to boredom.

Perceived Monotony and Boredom

Perkins and Hill (1985) conducted three particularly interesting and germane studies that tested the hypotheses that a) boredom arises when stimulation lacks meaning for the individual; b) boredom is associated with subjective monotony; and c) boredom is associated with a high degree of frustration. In the first experiment, 12 subjects each were assigned to either a high or a low interest groups based on their professed interest for a stimulus topic. Subjects used Osgood semantic differential scales to rate seven sets of three stimuli according to six experimenter defined constructs, and to as many self-produced dimensions as they could generate. Meaningfulness and meaninglessness were defined in terms of deviation from neutral ratings on the semantic differential ratings. Self-report of boredom was measured at the end of the experimental period. No differences between groups were observed for meaningfulness, but bored groups generated significantly fewer constructs and made significantly fewer distinctions among stimuli than interested subjects.

The second experiment replicated the first with the exceptions that different subjects and stimulus sets were used, and that boredom was monitored before and after the experiment. Data analysis was conducted by comparing subjects for whom the task became boring (N=16), to those for whom the task remained interesting (N=10). Results were identical to the first experiment: no differences were observed according to meaningfulness, but bored groups produced significantly fewer constructs and made significantly fewer distinctions among stimuli than interested subjects.

In the final experiment, meaningfulness was defined in terms of relevance to the satisfaction or frustration of subject motives. Motives were assessed by a Motivational Needs Satisfaction Schedule (MNSS) consisting of 30 bipolar statements, two relevant to each of the 15 "needs" of the Edwards Personal Preference Schedule. Two groups of 18 and 24 subjects were used. In the first group, subjects identified school subjects they liked, disliked, or found boring. Subjects in the second group identified activities they had engaged in during the past month that they liked, disliked, or found boring. The school subjects or activities then were rated individually according to the MNSS. Boring school subjects and activities were associated with frustration of needs for order, dominance, change, and endurance, while interesting subjects and activities were associated with the satisfaction of subject needs as defined by the MNSS.

The results of this experiment are interesting for a number of reasons. First, the findings provide empirical evidence that perceived rather than objective monotony is the important criterion for boredom. Second, the experiment substantiates that bored subjects perceive stimuli as less differentiated and more homogeneous than nonbored subjects. Finally, the results emphasize that meaningfulness is a significant variable in boredom only when it is defined in terms relevant to the individual, but not when it is defined in purely objective terms.

Cognitive manipulations of boredom

A number of studies that employ cognitive manipulations to influence or induce boredom suggest that intentionally engaging in cognitive strategies can differentially reduce the experience of boredom. Locke and Bryan (1967) conducted four experiments in which they evaluated systematically the effects of performance goal specificity on boredom and performance. Paid college student volunteers performed continuosly for periods of one, one and half, or two hours separated at fifteen minute intervals by subjective rating scales. Tasks performed were either a simple addition task, a perceptual speed task, or a psychomotor task. Performance goals were selected from tables of expected mean performance, or stated as "do your best". Goal acceptance was ensured either by monetary rewards for achieving goals, or by post experimental interview. Although boredom increased for all groups, mean increase in boredom over task duration was less for specific goal groups than "do your best groups". Despite better task performance for specific goal groups, no relationship was found between boredom and performance. In the final experiment of the series, knowledge of results and specificity of goal setting were assessed independently. Knowledge of results affected neither boredom nor performance. Specific goals, however, improved performance and decreased boredom although the effects on boredom were observed only over the last fifteen minute duration.

London and Monello (1974) led subjects to believe, by means of a rigged clock, that a thematic apperception test lasting twenty physical minutes lasted either ten or thirty minutes. Subjects in the "ten minute" condition who experienced time as moving more slowly, rated the session as more boring and less interesting than subjects in the "30 minute" condition. The results suggest that a simple cognitive monitoring strategy is able to effect differentially the experience of boredom.

Troutwine and O'Neal (1981) assigned randomly 40 students to either an interesting task, or a boring task under conditions of subjective volition in choosing to listen to a subsequent (boring or nonboring) task, or no choice in choosing a subsequent task. Students in the volition condition rated both tasks as less boring and shorter in duration than students in the no volition group. The results suggest that individual control over the choice of task reduces both boredom and time estimation.

Geiwitz (1966) conducted several experiments in which perceived monotony, externally imposed constraint, reduced cortical arousal, and unpleasantness were manipulated individually using post-hypnotic suggestion. Based on this experimental procedure, Geiwitz concludes that the manipulation of any one of the four components, but especially of low cognitive arousal and constraint, is sufficient to produce boredom. Geiwitz's results must be taken with considerable circumspection. In addition to the dubious procedure of manipulating individually monotony, constraint, arousal, and unpleasantness via posthypnotic suggestion, trials sometimes lasted only a minute and a half, only four subjects were included, and cortical arousal was measured by self-report, rather than with physiological indices. The results are nonetheless provocative in suggesting that boredom can be manipulated hypnotically under identical environmental conditions.

Observational/Correlational Studies

Observational and correlational studies suggest further that persons who spontaneously engage in cognitive activities experience less boredom. McBain (1970) classified highly rated safe truck drivers into high and low boredom susceptibility groups. Correlational analyses showed, contrary to prediction and to the previously cited results of Thackray et al. (1977), that drivers who were least susceptible to boredom were those who performed least consistently on an experimental vigilance task and were poorer drivers as measured by inconsistent engine speeds (an industrial indicator of a "good" driver). Moreover, increased errors made on the vigilance task predicted nonpreventable, but not preventable accidents. If, as Thackray et al. hypothesize, bored persons make more errors while performing repetitive tasks due to decreased attention, one might expect that increased errors on a vigilance task would be related to accidents that were the result of lapses in attention. Post hoc observational and self-report data showed, however, that safe drivers, even those susceptible to boredom, used prophylactic cognitive strategies such as ritualistic signalling to other drivers, constant commentary on the idiosyncracies of other drivers, and continual notation of ongoing road changes and construction projects to combat monotonous work conditions. The results suggest that persons, even those who are most susceptible to boredom, experience less boredom and commit fewer boredom related errors when they build variability into repetitive tasks.

Dickson (1973) conducted semi-structured interviews in four work shops. His findings revealed that feelings of monotony varied more as a function of the individual than as a function of the type of work. Further, persons who formed subjective batches of work (usually according to time, but also according to units of work when work quotas were present), and persons who relied on the rhythm of task movements to free them for thinking about matters external to the work situation, were least bored. Dickson concludes that subjective batching, and jobs whose structure permit nontask related thought, increase job variety and decrease boredom.

Csikszentmihalyi (1978) used electronic pagers to collect experiential mood and cognitive reports from clerks in repetitve jobs. Workers reported more positive moods and less boredom when thinking about what they are doing as opposed to thinking about something else. Moreover, job related fantasy decreased boredom even when the workers were doing something they would not do if they had the choice. The results imply that task related thought is more effective than task unrelated thought in alleviating boredom.

Davies, Shackleton, and Lang (1972) assigned randomly ten subjects to each of three series problem solving tasks of increasingy, decreasing, or randomly ordered task complexity. Although there were no group differences in problem solution or self-reported boredom, Spearman rank order correlations of subjective measures for the entire population showed that boredom was related positively and significantly to daydreaming and perceived task difficulty, and negatively to interest, trying, and concentrating. Hence, subjects who were most bored found the task more difficult and daydreamed more, but did not concentrate as hard or expend as much effort.

Extroversion, Sensation Seeking, and Boredom

Several claims have been made that extroverts are more susceptible to boredom than introverts (Davies, 1970; Kantowitz & Sorkin, 1983; Smith, 1981; Berch & Kanter, 1984). This claim stems from vigilance research which shows that extroverts' performance on monotonous tasks becomes inconsistent more quickly than introverts' performance on monotonous tasks. Since persons who become bored more quickly are presumed to display similar inconsistent performance on vigilance tasks (Thackray et al., 1977), it is assumed that extroverts and those who are more easily bored are one and the same population. Studies that specifically relate extroversion to boredom, however, do not substantiate the relationship between extroversion and boredom susceptibility (e.g., Hill, 1975a; P.C. Smith, 1955). Moreover, studies on extroversion have shown that extroverts are more likely to build variety into their task responses (Hill, 1975b), and are more likely to generate mental imagery under conditions of monotonous stimulation (Morris & Gale, 1974). This has led to the speculation that extroverts may possess more efficient cognitive strategies for coping with monotonous situations (Davies et al., 1983). For example, Neary and Zuckerman (1976) found, contrary to their prediction, that the orienting response to complex colour stimuli as measured by electrodermal response, reappeared after habituation in some high sensation-seeking subjects. Post-experimental interviews revealed that these subjects were interpreting differences in the silhouettes cast by the stimuli as one would interpret inkblots. Zuckerman (1979) speculates that this unanticipated restructuring of the task as a game may have accounted for the disinhibition of the orienting response after initial habituation. The speculation suggests that cognitive strategies may rekindle interest in stimuli and that this interest is reflected in physiological responses.

Persons high on sensation seeking also have been hypothesized to be more susceptible to boredom (Schalling, Edman & Aspery, 1983; Zuckerman, 1979). Hamilton et al. (1984), however, provide evidence that possessing effective boredom-coping skills, and not the trait of boredom susceptibility is the crucial factor in boredom. Hamilton et al. developed a boredom coping scale similar to the boredom susceptibility subscale of Zuckerman's (1979) Sensation Seeking Scale, with the exception that items asked how a person typically responded to the situation rather than their preference for the situation. Correlational analyses showed that boredom-coping predicted boredom, but that boredom-coping was related neither to boredom susceptibility nor to sensation seeking. The results provide compelling support for the hypothesis that boredom-coping skills rather than sensation seeking or boredom susceptibility are the crucial factors in boredom.

<u>Summary</u>

Wide individual differences in susceptibility to boredom have been observed under monotonous conditions. The research just reviewed suggests a) that boredom is a function of how one cognitively structures the environment rather than repetitive stimulation per se.; b) that cognitive manipulations can alter the experience of boredom; and c) that the type of cognitive activity a person spontaneously engages in while performing a monotonous task may contribute to inter and intraindividual differences in the experience of boredom. The research suggests specifically that bored persons cognitively experience the environment as less differentiated; and that persons who set specific performance goals, spontaneously embellish repetitive tasks with game like qualities, engage in task related thought, cognitively restructure tasks, or subjectively batch tasks, experience less boredom. In the next section, a model of boredom-coping that takes into account such cognitive activities will be presented. This model will lead to the development of specific hypotheses that relate cognitive strategies to boredom, and to physiological responses and task performance.

Coping Strategies in Boredom

Hamilton (Hamilton, 1981; Hamilton et al., 1984) has presented a model of behavioral, physiological, and cognitive boredom-coping strategies that may serve to integrate the findings relating cognitive activities to boredom. In this and subsequent sections the focus will be on cognitive boredom-coping strategies.

Hamilton et al. (1984) define boredom-coping as "the disposition to restructure one's perceptions and/or participation in potentially boring activities so as to decrease boredom" (p. 183). Hamilton (1981) hypothesizes that attention regulation is the primary mechanism by which the cognitive regulation of boredom occurs. Through attention, persons regulate the perceived meaningfulness, intensity, and variability of information. Effective boredom-coping, therefore, reflects the capacity for good attentional control across a variety of informational environments. Persons who are most susceptible to boredom are those who lack good attentional control within a specific information environment.

In order to explain the role of these attentional processes in boredom, Hamilton et al. employ a limited capacity model of attention. The model asserts that capacity, synonymously referred to as attention or cognitive effort, is a function of task difficulty and knowledge of results, and not of an individual's intention or external compulsion to perform a task (Kahneman, 1973). At low and medium task difficulties, available capacity is sufficient to meet task demands with spare capacity left over. Under conditions of high task difficulty, however, overtaxing of available capacity results in the deterioration of cognitive task performance.

Given this model of attention, Hamilton (1981) posits that in performing an easy task, spare attentional capacity is occupied with irrelevant distractions and self-monitoring that is reflected in the experience of boredom and a sense of time passing slowly. When absorbed in a task, spare capacity is decreased and the cognitive concomitants of boredom (i.e., distractions and self-monitoring) are avoided. When constrained to attend to a simple monotonous task, increased effort is required. However, since effort is a function of intrinsic task demands and not volition, the attempt to exert compensatory effort is experienced as increased strain with no commensurate increase in capacity to facilitate task performance. This strain experienced in the constraint condition, is referred to as felt effort, and may, if prolonged, lead to fatigue and task antipathy.

Boredom may also be experienced while performing difficult tasks although the processes leading to boredom are different. Difficult tasks are associated with low spare capacity. Where interest is low, or where task difficulty exceeds the individual's ability to perform, attempts to deploy compensatory effort may be given up altogether. Under this condition, initial frustration and/or anger may be followed by apathetic resignation towards the task and boredom. Thus, boredom on a difficult task in which interest is low is associated with more spare capacity relative to a difficult task of high interest, and with low felt effort towards the task.

According to Hamilton's theory, there are two general cognitive boredom-coping strategies that are differentially effective in dealing with boredom accompanying easy or difficult tasks. Although Hamilton (1981) refers to the two strategies as cognitive restructuring, and cognitive restructuring of rule/guidelines for performing the task, for clarity they will be referred to here as cognitive task restructuring, and cognitive goal restructuring.

Cognitive task restructuring occurs when spare attentional capacity is used to increase interest and reduce felt effort. A number of strategies may be adopted to accomplish this. Hamilton (1981) specifically identifies daydreaming or fantasy as one means of restructuring the task. Daydreaming appears to be most effective when it is controlled with low felt effort, is positive, and is task related (Csikszentmihalyi, 1978). Other strategies might entail making the task mentally more complex, handicapping the cognitive operations deployed in performing the task, embellishing the task reqirements, emphasizing the rhythmic qualities of the task, or selectively attending to the game like features of the task (Csikszentmihalyi, 1978).

Cognitive goal restructuring may also be used to increase interest and reduce felt effort. The reasons for engaging in the task are diverted from the task itself to the attainment of long term goals for which completion of the task is necessary. The, strategy is analogous to Fenichel's (1951) change in object cathexis.

The primary difference between cognitive task and cognitive goal restructuring is that spare capacity is deployed differentially either towards the task, or towards external goals. It might be inferred that goal restructuring would be more effective in alleviating boredom in difficult tasks since there is less spare capacity available to cognitively restructure the task. Conversely, goal restructuring may be hypothesized to be less effective than task restructuring in easy tasks, since greater spare capacity would remain when goal restructuring is employed in an easy task thus providing more opportunity for self-monitoring that would lead to increased boredom.

Criticisms and Qualifications

Hamilton's model of cognitive boredom-coping must be criticized on at least one major point. Whereas an information processing rationale may explain adequately the processes that make available spare capacity for cognitive restructuring, the information proccessing approach to cognition fails to account for how people come to perceive or selectively attend to different aspects of the environment (Neisser, 1976, 1980). More recent theorizing (e.g., Meichenbaum & Gilmore, 1984; Norman & Shallice, 1986) speculates that attention is not simply a mechanism that accounts for the amount of spare capacity available, but that attention plays a role in modulating and directing schemata used by persons in approaching a task. For example, when performing difficult tasks, ceiling effects on processing capacity may result in frustration, giving up the task, and boredom. However, persons also may switch to other attention processing channels or develop other strategies for processing information. If the capacity required to process difficult verbal information exceeds an individual's available capacity, persons may respond by processing the information visually, or pay attention only to a limited portion of the information (Kahneman & Treisman, 1984; Lane, 1982). The effect is to increase spare attentional capacity, but the relationship is reciprocal in that attention is directed to alternate features of the task which in turn leads to an increase in capacity. Hamilton's suggestion that creative insight may provide a means of generating spare capacity to engage in cognitive boredom coping strategies, therefore, may be more profitably viewed as a redirection of attention to an alternate schema. While the cognitive restructuring approach remains a valid hypothesis for coping with boredom, it needs to be pointed out that the mechanisms hypothesized by Hamilton may not explain fully the effectiveness of cognitive restructuring.

In addition to this criticism, a number of limitations to Hamilton's model must be made clear. First, individual differences in the effective use of cognitive boredom-coping strategies are to be expected. In addition to the inter and intraindividual differences in perceived monotony reviewed earlier in this chapter, Hamilton (1981) acknowledges that personal and situational variables may affect a person's ability to deploy cognitive coping strategies. Persons typically vary with respect to their preferred mode of obtaining information, that is, whether information flow is internally, or environmentally generated. An individual who is adept at augmenting or reducing information flow behaviorally, for example, may not be equally adept at augmenting or reducing internally generated information. Also, individuals may not be equally adept at regulating information across information environments that vary along dimensions such as task difficulty, meaningfulness, or sensory modality.

Second, the cognitive formulation of boredom coping assumes that cognitive processes are independent of behavioral, and biological attention regulation processes. This assumption is clearly untenable. Persons normally have behavioral and biological as well as cognitive coping strategies in their repertoire, and these strategies are interrelated. For example, focusing on the rhythmic qualities of a task may involve cognition, but it also is related to cortical augmentation. Similarly, behavioral and cognitive means of attention are clearly interrelated. It is important to remember, therefore, that this independence is a conceptual and investigative categorization, and does not reflect the mutual dependency of these processes.

In summary, Hamilton's model of cognitive boredom-coping strategies relies on a reciprocal perceptual schema and information processing rationale. Further, just as there are differences in the experience of boredom, idiographic differences in individuals' abilities to effectively use cognitive boredom-coping strategies will be present.

Hypotheses

From Hamilton's theory, and the findings of the previous reviews relating task performance and peripheral physiological responses to boredom, the following hypotheses are suggested:

1. Cognitive task restructuring is more effective than goal restructuring in reducing boredom when persons are engaged in easy repetitive tasks.
2. Cognitive goal restructuring is more effective than cognitive task restructuring in reducing boredom when persons are

engaged in difficult repetitive tasks.

3. Boredom experienced during the performance of easy repetitive tasks is accompanied by increased perception of effort as evidenced by its relationships to strain and fatigue.
4. Boredom experienced during the performance of difficult repetitive tasks is accompanied by low perceived effort as evidenced by its relationships to strain and fatigue.
5. Bored and nonbored groups will perform at the same absolute levels of performance.
6. Bored groups will demonstate greater response variability than nonbored groups on task performance measures.
7. Physiological indices of peripheral responding will vary as a function of task duration.
8. Physiological indices of peripheral responding will vary as a function of the cognitive strategy used to approach the repetitive task.
9. Physiological indices of peripheral responding will vary as a function of task difficulty.

Summary

In this chapter it was proposed that boredom accompanying repetitive task performance could be distinguished from boredom that occurs despite varied environmental stimulation on the bases of sources of perceived monotony and the locus of constraint. Boredom that occurs during the performance of repetitive tasks normally occurs where there is congruence between objective and perceived monotony, and where there is some reason for remaining in the environment despite its perceived monotony. Other factors that influence perceived monotony, such as intense involvement in some other activity, and biological and/or development factors may contribute to individual differences in boredom susceptibility during task performance.

Reviews of the empirical research suggest that boredom is not associated with any unique physiological pattern of peripheral responding, and that the precise specification of patterns of peripheral responses which accompany boredom must take into account, amongst other things, the nature of the task persons are engaged in, and the compensatory actions that persons take to counteract the experience of boredom. Based on reviews of theories and research related to boredom, and on Hamilton's (1981) model of boredom coping, hypotheses predicting that cognitive strategies would be effective differentially in reducing boredom accross tasks of varying difficulty were derived.

CHAPTER III

Design and Procedure

Chapter Two concluded with a number of specific hypotheses relating boredom to cognitive strategies, peripheral physiology and task performance. In this chapter, an overview of the basic research design used to test these hypotheses will be presented. This will be followed by descriptions of the subject population, the physical facilities in which the experiment took place, the experimental manipulations, and the dependent measures employed.

Research Design

The basic research design employed in this study was a 2 (task difficulty) x 3 (cognitive strategy) x 4 (time) factorial design with repeated measures on the time factor. Subjects performed either an easy or a difficult task under one of three cognitive strategy conditions: a cognitive task restructuring condition; a cognitive goal restructuring condition; or a no assigned cognitive restructuring control condition. The three cognitive strategy conditions were crossed with two levels of task difficulty to comprise six experimental conditions. Self-report subjective measures, performance measures, and peripheral physiological responses were employed as dependent measures according to different time sampling procedures. These sampling procedures led to different levels of the repeated measures time factor for the the three types of dependent measures. Self-report measures were recorded prior to task onset and at the end of each ten-minute task period, resulting in the basic 2 (difficulty) x 3 (cognitive strategy) x 4 (time period) factorial design with repeated measures on the time factor.

Performance measures were recorded during the ten-minute task performance periods and summed to form performance measures for the entire task duration. Performance measures, therefore, were analysed using a 2 (difficulty) x 3 (strategy) design.

Physiological measures, with the exception of heart rate and body movement, were recorded at alternate one-minute intervals to coincide with performance reaction time sampling, and to provide maximum proximity to subjective report measures. Heart rate was monitored continuously over one-minute intervals, and body movement was monitored continuously over two minute intervals. For analysis purposes, pre and postbaseline measures were calculated as the average of each physiological response for the first six minute period and last four minute period respectively. Measures used during task performance were the last minute of each ten minute interval. This sampling procedure resulted in a 2 (difficulty) x 3 (strategy) x 5 (time) design with repeated measures on the time factor for physiological dependent measures.

Subjects

Sixty volunteer undergraduate subjects were solicited from undergraduate education and psychology courses. Subjects were told that the experiment was an investigation preliminary to a subsequent study intended to help persons improve their performance on repetitive tasks. The primary goal of the current study was to assess a person's normal physiological response to performing a repetitive task. To ensure that boredom was spontaneously induced rather than the result of instruction, no mention of the incentive condition was made during subject solicitation, in the task instructions, or in debriefing. In return for their participation, subjects were offered the opportunity to participate in an experiment that was intended to have some practical application in improving repetitive task performance. In addition, all subjects who completed the experiment were to have their names placed in a raffle to be drawn at the end of data collection for a free dinner for two.

Subjects were assigned randomly to one of the six experimental conditions. Two constraints were placed on random assignment: that there be equal cell sizes; and that the same proportion of subjects per condition participated in morning, midday, and late afternoon sessions. The latter constraint was imposed to control for differences in physiological responding and in performance that have been shown to occur as a result of time of day (Berch & Kanter, 1984; Fisher & Winkel, 1979; Folkard & Monk, 1979; Hockey & Colquhoun, 1972; Parasuraman, 1984; Waters, Koresko, Rossie & Hackley, 1979).

Facilities and Equipment

Sessions were conducted in a quiet, temperature monitored laboratory. Subjects were seated on a sturdy cafeteria style chair in front of a microcomputer used to present instructions, stimuli, and rating scales. Physiological recording equipment was located to the subject's left and was separated from view by a metal cabinet door intended both to deter subject interest in the physiological recording equipment and to keep the experimenter out of the subjects' view.

Self-report and performance measures were collected by the computer, written to disk, and later transferred to a mainframe computer for data analysis. Frontal EMG, heart rate, peripheral skin temperature, skin resistance, and body movement were monitored simultaneously using Colborne Instruments physiological recording equipment. (the recording equipment and calibration procedures are described in Appendix A).

Experimental Procedure

Subjects were escorted into the room, signed a consent form, and were asked to remove their watches. After a brief introduction to the equipment and to the experimental procedure, subjects were seated in front of the computer and physiological transducers attached. Subjects were told that in order to make valid comparisons of physiolgical measures, a six-minute baseline period during wich they simply sat still was required. Following the baseline period, instructions were presented on the computer terminal (instruction protocols and time sequences for the six experimental conditions are presented in Appendix B), and reviewed by the experimenter to ensure task comprehension. The experimenter then retired to the other side of the partition. No further contact with the subject was made until the conclusion of the post-task baseline period when post session debriefing occurred.

Experimental Manipulations

The repetitive task employed in this study was an alphanumeric task in which the subject had to increment or decrement a letter by a fixed number of letters in the alphabet. The letters were presented individually by microcomputer and subjects responded by keying in the correct response on the keyboard. Subsequent letters were not presented until a response had been made to the previous letter. The task ran continuously for thirty minutes interspersed by the presentation of rating scales at 10 minute intervals.

Cognitive Strategies

In order to have subjects cognitively structure the task differently, three variations of the task were devised. The rationale for preferring different task parameters to instructions as experimental manipulations was to ensure that there was some basis for assessing objectively that subjects complied with the different information processing requirements of the task.

In the cognitive task restructuring condition, the stimuli were ordered so that the correct letter response for each item combined with subsequent correct responses to form a proverb (see Appendix C for a list of proverbs used). In addition to responding to the stimuli, subjects were instructed to anticipate simultaneously the proverbs. To assist subjects in identifying the patterened responses, the letters as they responded to the stimuli appeared at the top of the screen. As a proverb was completed, the display disappeared and a new display began. By incorporating patterns in the repetitive stimulus set, and providing instructions to seek out these patterns, the manipulation was intended to operationalize cognitive task restructuring.

The goal restructuring group was presented with the identical stimulus set with the exception that the order of presentation was generated randomly and did not combine to form meaningful patterns. Subjects in the goal restructuring group were offered one dollar for every 50 letters answered correctly in the easy condition, and one dollar for every 25 letters answered correctly in the difficult condition. A cumulating tally of the number of correct responses, and of the amount of money currently earned was displayed in the upper right corner of the screen. The basic alphanumeric task, therefore, was identical to the one employed in the task restructuring condition, with the exception that no patterns of information were evident. The rationale for including the incentive was to alter the person's reasons for performing the task.

The no cognitive restructuring control groups were presented with the same stimulus sets as the goal restructuring groups, but were neither provided with task restructuring instructions nor offered a reward. To achieve consistency in terms of the feedback provided, a cumulating tally of the number of items responded to appeared in the upper right corner of the screen.

This condition was intended to operationalize boredom and to serve as boredom control group. Although subjects were hypothetically free to adopt their own cognitive strategies, post experimental interviews indicated that, at least according to self-report, this was never the case in the easy condition, and seldom the case in the difficult condition.

Task Difficulty

Each of the cognitive strategies described above was crossed with two levels of task difficulty. In the easy task conditions, subjects responded to each letter with the letter that either immediately succeeded or immediately preceded that letter in the alphabet (e.g., B + 1= C, B - 1= A). The difficult task condition was identical with the exception that letters were incremented or decremented by five letters in the alphabet (e.g., F + 5= K, F - 5= A).

Dependent Measures

Three general classes of dependent measures were used in this study: self-report measures, performance measures, and physiological measures. In the next sections, descriptions of these dependent measures will be presented.

Self-report Measures

The variable of primary interest in this study was self-report of boredom. In addition, self-report measures of attentiveness, frustration, fatigue, restlessness, strain, and non-task related thought were included. Self-report data were collected by the computer from subject responses to the rating scales that appeared immediately prior to task onset and at the end of each ten-minute task performance interval. Ten-point rating scales (see Appendix D) cued by two extreme and one medial categories were used to insure ordinality and symmetry (Mackay, 1980). The cursor appeared randomly at a numerical value and subjects responded by moving the cursor to the chosen rating and pressing the return key.

In addition to these measures, a self-report item intended to assess subject compliance with the experimental regimen was included at the end of each 10 minute performance period. Subjects in the two experimental conditions were asked, respectively, to report the percent of the time they attempted to answer the proverbs or the percent of time engaged in achieving the incentives. To provide symmetry in the number of questions asked, subjects in the no strategy control conditions were requested to rate the percent of time that they felt bored.

<u>Performance Measures</u>

Performance data collected included the number of items attempted, and the number of correct and incorrect answers within time periods and over the entire session. From these data, an accuracy score calculated as the ratio of correct to number attempted was derived. In addition, reaction time (RT) data, measured as the time between stimulus onset and subject response was recorded by the computer using an internal, real time clock calibrated in tenths of a second. RT was recorded as the subject's last response at the end of each 2nd, 4th, 6th, 8th, and 10th minute. Mean response time and consistency of response time (standard deviation of RT) were derived from these RT data points.

Physiological Measures

Since physiological responding must be viewed as a complex of patterned responses rather than a unidimensional and undifferentiated response (Stern, Ray & Davis, 1980), multiple physiological responses were monitored. The physiological dependent measures employed were HRV, body movement, frontal EMG, PST, and SC. The measures, with the exception of frontal EMG, were selected on the basis of their hypothesized relationships to boredom as outlined in Chapter Two, and recorded according to the procedures outlined in Appendix A.

Frontal EMG was used as a dependent measure since it has been related previously to task difficulty, as well as the important psychological variables of task involvement and motivation during task performance (Andreassi, 1980; Eason, 1963; Eason & White, 1960; Pishkin, 1973; Pishkin & Shurley, 1968). Since boredom has been related to lack of task involvement and lack of motivation to perform the task, it was speculated that frontal EMG would serve as a sensitive physiological measure of boredom. It should be pointed out, however, that frontal EMG recordings reflect differences in potential between frontales muscles, and not simultaneously occurring frontales activitiy (Davis, Brickett, Stern & Kimball, 1978). Also, frontal EMG is influenced by a number of factors including EEG, eye blinks, jaw movements, and swallowing. Frontal EMG, therefore, served as a global measure of muscular activity, rather than as a measure of frontales muscle potentials per se (Basmajian, 1976; 1979).

Summary

This experiment employed a 2 (task difficulty) x 3 (cognitive strategy) x 4 (time) factorial design with repeated measures on the time factor. Sixty undergraduate volunteer subjects were assigned randomly to one of six experimental conditions in which they performed either an easy or difficult repetitive task using either a cognitive task restructuring, a cognitive goal restructuring, or a no assigned cognitive restructuring strategy. Self-report measures of boredom, frustration, fatigue, attentiveness, restlessness, strain, degree to which the intended experimental manipulations were succesful, and the percent of time thinking about things other than the experimental task; performance measures of correct responses, and reaction time; and physiological measures of HR, HRV, GSR, frontal EMG, PST, and body movement were recorded in the experiment. In the next chapter, the results of the experiment will be presented.

CHAPTER IV

Results

In this chapter, the results of the experiment just outlined will be presented. Prior to the presentation of results, an overview of the data analysis procedures will be given. This will be followed by a description of the sample and an assessment of subject compliance with the experimental manipulations. Results of hypotheses testing then will be reported. The results will be organized under the headings of self-report of boredom, relationships between self-report measures, performance measures, and physiological measures. The chapter ends with a summary of the findings and their relationship to the hypotheses derived in Chapter Two.

Overview of Data Analyses

As the primary variable of interest in this investigation, self-report of boredom was analysed directly using a 2 (task difficulty) x 3 (cognitive strategy) x 4 (time) univariate analysis of variance with repeated measures on the time factor. The relationships between self-report measures were analysed using bivariate correlation analyses on the data for the easy task groups, the difficult task groups, and the groups combined. Performance and physiological measures were analyzed using multivariate analyses of variance. Multivariate analyses were employed for these measures to account for the interrelationships between dependent measures and to protect against type I error

(Muller, Otto & Benignus, 1983; Tabachnick & Fidell, 1983). These analyses were followed by post hoc univariate tests to determine which variables contributed maximally to the observed differences.

Results

The Sample

Sixty-one subjects were actually solicited for the experiment. One subject in the difficult task restructuring group, however, considered the task ridiculous and simply typed random responses for the duration of the experiment. The lack of conformity to the experimental manipulation was detected immediately following the experiment when the experimenter reviewed task responses with the subject. In order to maintain purity of treatment conditions, the subject was dropped from the subject pool, and an alternate subject recruited to retain equal cell sizes.

The final sample was comprised of sixty subjects of whom 49 were female with a mean age of 24.1 (sd= 5.23), and 11 were male with a mean age of 25.5 (sd= 6.09). Group profiles of the experimental groups by age and sex are presented in table 4.

Effectiveness of Experimental Manipulations

In studying experimentally induced affective responses, an important consideration is to corroborate the success of the experimental manipulations in inducing the intended affective response (Simon, 1982). In this study, compliance with experimental manipulations was assessed by the rating scale at

Table 4.

Cell Composition by Age and Sex

Task Condition	Sex	Task Restructuring	Goal Restructuring	No Cognitive Restructuring
Easy	Male	N=1 $\overline{X}$=26 (.00)*	N=2 $\overline{X}$=30 (4.24)	N=2 $\overline{X}$=21.5 (3.54)
	Female	N=9 $\overline{X}$=23.3 (3.64)	N=8 $\overline{X}$=22.4 (3.42)	N=8 $\overline{X}$=25.0 (6.91)
Difficult	Male	N=2 $\overline{X}$=28.5 (12.02)	N=3 $\overline{X}$=21.3 (4.04)	N=1 $\overline{X}$=20.0 (.00)
	Female	N=8 $\overline{X}$=25.5 (7.89)	N=7 $\overline{X}$=25.6 (6.21)	N=9 $\overline{X}$=23.2 (2.44)

* Standard deviations are presented in brackets in this, and all subsequent tables.

the end of each performance period that requested subjects to rate the percent of time they attempted to anticipate the proverbs, or achieve the incentive. Table 5 presents the means and standard deviations for ratings of the percent of time subjects reported adherence to the experimental manipulation. The table shows that for both the task restructuring and goal restructuring conditions, subjects reported conforming to the task instructions at least 72 percent of the time. There were no statistically reliable differences between these results.

Self-report of Boredom

To assess the differential effects of cognitive strategy on the experience of boredom across the two task conditions, a 2 (task difficulty) x 3 (cognitive strategy) x 4 (time) univariate analysis of variance with repeated measurements on the time factor was conducted on self-report of boredom. Post hoc Scheffe tests were employed to determine the location of these effects.

Preliminary Analyses. To check that the experimental groups did not differ in self-report of boredom prior to the experimental manipulations, a one-way analysis of variance on initial self-report of boredom was conducted. The results revealed no statistically significant differences between the groups on self-report of boredom.

A necessary assumption for interpreting repeated measures analyses of variance is that the data meet the conditions of compound symmetry (Norusis, 1985; Tabachnick & Fidell, 1981). Tests of these assumptions were provided by Box's M statistic

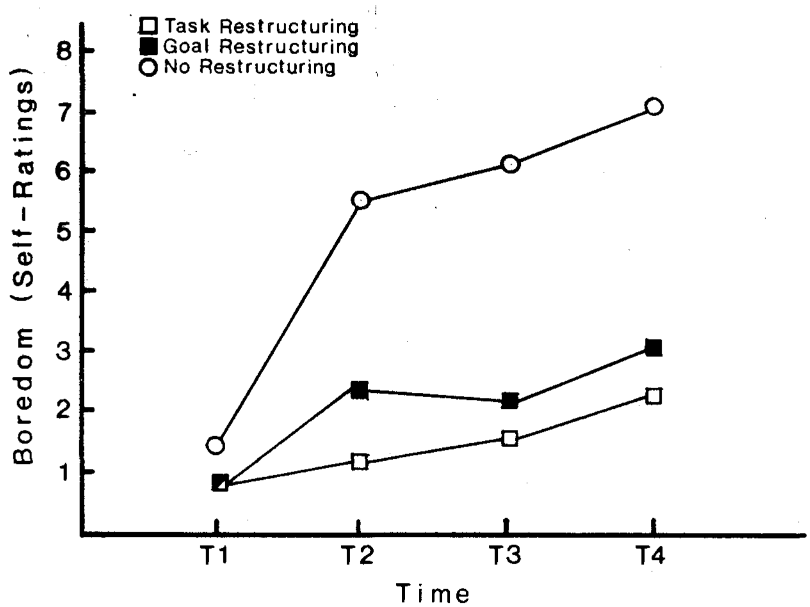
Table 5.

Reported Percent of Time Engaged in Experimental Manipulation.

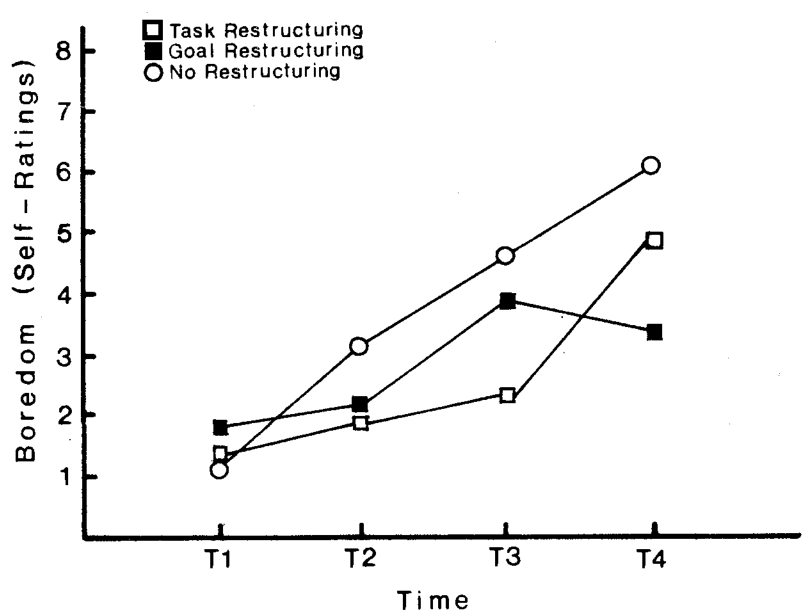
Task Condition	Cognitive Strategy	Time1	Time2	Time3
Easy	Task Restructuring	78 (23.9)	77 (22.1)	75 (16.5)
	Goal Restructuring	80 (18.3)	77 (20.6)	73 (22.6)
Difficult	Task Restructuring	75 (26.8)	79 (17.3)	78 (21.0)
	Goal Restructuring	72 (24.4)	76 (23.7)	83 (23.6)

(BoxM=63.096, F(50, 5351)=1.016, p=.443) which failed to reject the hypothesis of differences in the variance-covariance matrix, and Bartlett's Test of Sphericity (B=37.204, p<.001) which rejected the hypothesis of no correlation between the time measures thus supporting the hypothesis that these conditions were met.

Results. Plots of self-reported boredom for each strategy over time are presented for easy and difficult task conditions in Figure 1. Results from the analysis of variance (group means and standard deviations for the self-report boredom measures appear in Table 6, and summary statistics for the analysis of variance appear in appendix D) show a significant main effect for time ($F(3,162)=68.183$, $p<.001$) confirming the graphic impression that boredom increased for all subjects over task duration. The interpretation is made more difficult, however, by a significant difficulty by strategy by time interaction ($F(6,162)=2.173$, $p=.048$) that showed cognitive strategies were differentially effective over time in reducing boredom for the easy and difficult tasks. Post hoc Scheffe tests revealed that both cognitive task and cognitive goal restructuring reduced boredom significantly for the easy task condition (Sch Crit(2,54)>2.728, $p<.05$). For the difficult task condition, however, cognitive task restructuring was not effective in reducing boredom. Boredom also increased over the first 20 minutes for the cognitive goal restructuring condition, but then decreased over the final ten minutes of the task's duration.



EASY TASK



DIFFICULT TASK

Figure 1

Profiles of Difficulty x Strategy x Time Interactions
For Self-Report of Boredom

Table 6.

Means and Standard Deviations for Self-report of Boredom by Task × Strategy × Time.

Task Condition		Time 1	Time 2	Time 3	Time 4
Easy	Task Restructuring	.90* (.876)	1.20 (1.229)	1.60 (1.506)	2.40 (1.897)
	Goal Restructuring	.90 (1.101)	2.40 (0.966)	2.20 (1.033)	3.20 (2.098)
	No Restructuring	1.50 (1.080)	5.60 (2.757)	6.20 (2.440)	7.20 (1.636)
Difficult	Task Restructuring	1.40 (1.174)	1.90 (1.450)	2.30 (1.829)	4.90 (2.079)
	Goal Restructuring	1.800 (0.919)	2.10 (1.729)	3.90 (1.970)	3.40 (2.989)
	No Restructuring	1.10 (1.596)	3.20 (1.619)	4.70 (1.494)	6.20 (1.549)

* Values represent subject ratings on a 10 point scale from 0 to 9 with increasing values indicating increased boredom.

Additional effects observed in the analysis were statistically significant time by difficulty ($F(3,162)=4.478$, $p=.049$), time by strategy ($F(3,162)= 9.565$, $p<.001$), and difficulty by strategy ($F(2,54)=4.759$, $p=.012$) interactions. These effects, however, were not interpreted due to the above three-way interaction.

Summary. Hypotheses 1 and 2 proposed that cognitive task restructuring would be more effective in reducing boredom than cognitive goal restructuring in the easy task, and that cognitive goal restructuring would be more effective than cognitive task restructuring in reducing boredom in the difficult task. Based on the present analysis, hypothesis 1 must be rejected: cognitive task and cognitive goal restructuring were equally effective in reducing boredom for the easy task condition.

There is, however, some support for hypothesis 2. Cognitive goal restructuring but not cognitive task restructuring was effective in reducing boredom in the difficult task condition, although this effect did not occur until the final ten minutes of task duration.

Additional findings were that self-report of boredom increased over duration of task performance and that self-report of boredom increased more rapidly in the easy than in the difficult task condition.

<u>Relationship Between Self-report Measures</u>

To determine if the relationships between boredom and other self-report measures varied as a function of task difficulty, bivariate correlation analyses were performed by subjects overall, and by task difficulty (correlation matrices are presented in tables 7(a) and 7(b)). For the overall analysis, self-report of boredom was negatively and significantly related to attention, and positively and significantly related to self-report reports of frustration, fatigue, restlessness, strain, and thinking about something other than the task ($p<.01$, two tailed). The same relationships obtained when analyses were performed on responses for the easy task condition ($p<.02$, two-tailed), but not for the difficult condition. Analyses for the difficult task condition failed to detect a relationship between self-report of boredom, and either strain or frustration.

A second notable difference emerged between the task conditions. Boredom was most strongly associated with fatigue for both the easy and combined groups analyses, but was most strongly associated with lack of attentiveness in the difficult task condition.

<u>Summary</u>. Results in this section lead to the acceptance of hypotheses 3 and 4. The results show that boredom was associated with self-report of fatigue, restlessness, daydreaming, and lack of attention. In addition, strain and frustration were associated with boredom in easy repetitive tasks, but not with boredom in difficult tasks. Boredom was most strongly related to

Table 7

(a)
Self-report correlations for all groups (N=60)

	BOREDOM	FRUST	FATIG	ATTEN	RESTLESS	STRAIN	NONTASK
BOREDOM		.349* P=.006	.610 P<.001	.484 P<.001	.462 P<.001	.408 P=.001	.542 P<.001
FRUST			.404 P=.001	.344 P=.007	.435 P=.001	.648 P<.001	.437 P<.001
FATIG				.311 P=.016	.472 P<.001	.679 P<.001	.451 P<.001
ATTEN					.441 P<.001	.366 P=.004	.521 P<.001
RESTLESS						.349 P=.006	.552 P<.001
STRAIN							.419 P=.001

(b)
Self-report correlations for easy (top half of matrix) and difficult (bottom half of matrix) task groups (N=30)

	BOREDOM	FRUST	FATIG	ATTEN	RESTLESS	STRAIN	NONTASK
BOREDOM		.453 P=.012	.754 P<.001	.477 P=.008	.423 P=.020	.674 P<.001	.636 P<.001
FRUST	.224 P=.235		.605 P<.001	.355 P=.054	.458 P=.011	.634 P<.001	.568 P=.001
FATIG	.428 P=.018	.147 P=.439		.493 P=.006	.563 P=.001	.829 P<.001	.612 P<.001
ATTEN	.593 P=.001	.328 P=.077	.040 P=.833		.463 P=.010	.587 P=.001	.576 P=.001
RESTLESS	.542 P=.002	.398 P=.029	.347 P=.060	.404 P=.027		.553 P=.002	.732 P<.001
STRAIN	.128 P=.500	.669 P<.001	.524 P=.003	.034 P=.859	.088 P=.645		.498 P=.005
NONTASK	.532 P=.002	.233 P=.216	.267 P=.154	.330 P=.075	.240 P=.201	.316 P=.089	

* 2-tailed

fatigue in easy tasks and to lack of attentiveness in difficult tasks.

Performance Measures

To determine the effects of cognitive strategies on performance during repetitive tasks, a 2 (difficulty) x 3 (cognitive strategy) multivariate analysis of analysis of variance was conducted using the number of items attempted, mean response latency, accuracy, and response consistency as dependent measures. Since time was required for subject familiarity with the tasks, especially in the proverb conditions, performance measures were calculated only for the last 20 minutes of the task duration.

Initial data analysis revealed the accuracy scores to be binomially distributed and latency data to be positively skewed. Since these distributions also contributed to heterogeneity of variances, a standard 2*arcsine transformation on the square root of accuracy scores that is recommended for proportion data (Winer, 1962) was applied to accuracy scores. Latency data was transformed by a logarithmic function prior to the calculation of mean latency and consistency scores.

In reporting multivariate results, Wilk's approximation of F is used. Although arguments can be advanced for employing Pillai's criteron (e.g., Barker & Barker,1984; Olson, 1976), significance levels for both performance and physiological measures were identical for all approximations of F. It was decided, therefore, to use the more popular Wilk's criterion.

Results. The results (group means are presented in Table 8, and summary statistics for the analyses of variance are presented in Appendix E) revealed a significant difficulty by strategy interaction ($F(8,102)=4.812$, $p<.001$). Post hoc analyses of variance showed these results to be due to decreased consistency for the task restructuring group in the easy condition relative to the difficult condition ($F(2,54)=3.978$, $p=.024$). Of importance in terms of hypothesized performance differences across strategy conditions, was a statistically significant main effect for strategy ($F(8,102)=5.500$, $p<.001$). Post hoc univariate analyses of variance showed that the result was due primarily to fewer items attempted ($F(2,54)=9.098$, $p<.001$) and to decreased consistency in responses ($F(2,54)=10.011$, $p<.001$) for the task restructuring groups. Accuracy and mean latency were not significantly different between the conditions. Also, as expected, there was a significant main effect for difficulty ($F(4,51)=80.915$, $p<.001$) indicating that performance was inferior for the difficult task. Post hoc univariate analyses showed that all dependent measures except response consistency contributed to the decreased performance. No other results achieved significance.

Summary. Results of the performance data analysis revealed a significant difference between the cognitive restructuring groups thus leading to the rejection of hypothesis 5. The cognitive task restructuring groups completed fewer items, took longer to respond, and were less consistent in their responses

Table 8.

Means and Standard Deviations for Performance measures.

		Strategy Condition		
		Task Restructuring	Goal Restructuring	No Restructuring
Easy	# attempted	266.6 (43.49)	324.0 (35.77)	302.5 (22.67)
	accuracy*	98.19 (1.32)	98.20 (1.72)	98.75 (1.37)
	mean latency	.173 (.288)	.123 (.134)	.132 (.087)
	consistency	.333 (.143)	.158 (.053)	.148 (.048)
Difficult	# attempted	154.3 (34.81)	179.8 (29.80)	177.0 (14.29)
	accuracy*	96.83 (3.13)	93.98 (6.71)	93.57 (4.10)
	mean latency	.720 (.212)	.551 (.176)	.559 (.074)
	consistency	.258 (.117)	.227 (.065)	.209 (.073)

* Accuracy figures are expressed as a percent in this table.

than either the cognitive goal restructuring or no restructuring groups. Post hoc univariate analyses showed that response variability varied as a function of cognitive strategy rather than boredom. Hypothesis 6, therefore, is also rejected. Despite arguments that the response contingencies in the goal restructuring condition may have led to increased performance, no differences were observed between the cognitive goal restructuring and the no restructuring control groups on performance. Although more bored, increased boredom in the no restructuring group was not reflected in performance differences.

Physiological Measures

Preliminary analyses and qualifications. Since HRV has been previously and reliably related to attention (e.g., Antrobus, Coleman & Singer, 1967; Ettema & Zielhuis, 1971) and to boredom (Thackray et al., 1974, 1977), a reliable measure of HRV was desired for this study. In fifteen cases, however, the HR measure decreased to or near zero on one, and sometimes more, occasions during task performance. Although records of HR continued to be collected by resetting the HR gain on the pulse monitor optical densitometer module, maintenance of HR level cannot be assured using this procedure (Cook, 1974). HR, therefore, was dropped from the analysis. Further, since variation of level is essential in calculation HRV over task duration, HRV also was dropped reluctantly from the analysis. A possible explanation for this lack of reliability will be offered in the discussion session. For now, it will be noted simply that in ten of the fifteen cases, the drop in HR occurred in difficult task conditions.

Of the remaining physiological variables, initial data analysis revealed that measures of body movement were highly and positively skewed. A review of the raw data showed this to be an accurate reflection of little or no body movement for some subjects, and considerable body movement for others. Since these differences also appeared to be a function of group membership (subjects in the no restructuring conditions demonstrated increased levels of body movement, but were more consistent, i.e., demonstrated lower variability in responses, than subjects in the restructuring conditions) and contributed to significant differences in the homogenity of dispersion (variance-covariance) matrices, body movement measures were transformed using a square root function. It should be noted that the square root transformation means that results attributable to body movement should be interpreted in terms of median rather than mean levels (Mosteller & Tukey, 1977).

A second transformation entailed the standard transformation of GSR to skin conductance (SC). SC has been demonstrated to be more normally distributed, and to have more desirable statistical properties in terms of averaging (Andreassi, 1981; Stern, Ray & Davis, 1980) which was performed in this study to calculate pre and post baseline measures.

A note also must be made in terms of the procedures used to check MANOVA assumptions. Since repeated measures MANOVA treats each measurement of a dependent variable over time as a new dependent variable, the number of dependent variables per cell (4 x 5 measurement intervals = 20 dependent variables) exceeded the number of cases per cell and prevented the calculation of Box's M statistic on the full model. Although MANOVA in the nonrepeated measures case has been shown to be robust with respect to violations of the homogeneity of dispersion matrices assumption where there are equal n per cell (Hakstian, Roed & Lind, 1977; Olson, 1974), the design employed here was actually doubly multivariate in that it employed multiple dependent measures measured over multiple time intervals. Since it was desired to collapse the design into a singly multivariate one by using the averaged over time sums of squares and cross products matrix, a test of the assumptions for compound symmetry of the averaged results was required (Norusis, 1985). An approximate test of the assumption of homogeneous dispersion matrices was provided by calcualting Box's M statistic on each pairwise 2 x 3 design over the five measurement intervals. Using this strategy an approximation to the overall test of equivilence of individual cell variance-covariance was achieved.

Results. Given the above qualifications, the physiological measures of frontal EMG, PST, SC, and square root of body movement were analyzed using a 2 (task difficulty) x 3 (cognitive strategy) x 5 (time period) multivariate analysis of variance. Since the assumptions for using the univariate results for the repeated measurements portion of the analysis were met using the procedures just outlined, the singly multivariate results will be presented here. The results revealed a statistically significant difficulty x strategy x time interaction ($F(32,787.10)=2.475$, $p<.001$ (Means and standard deviations for physiological dependent measures are presented in tables 9 and 10, and analysis of variance summary tables are presented in Appendix D). Post hoc univariate analyses of variance revealed the measures primarily responsible for the effect were frontal EMG ($F(8,216)=6.642$, $p<.001$) and body movement ($F(8,216=2.029$, $p=.044$). Plots of these dependent measures by strategy and time for each level of task difficulty (see figures 2 and 3) reveal that, in the easy task, frontal EMG increased for the two cognitive restructuring conditions, but decreased for the no restructuring control group. In the difficult task condition, frontal EMG initially increased and then decreased for all strategy conditions, but the rate of increase for frontal EMG was significantly greater for the cognitive goal restructuring conditions than either the task restructuring strategy or the no restructuring condition. The results show that frontal EMG was greater for cognitive strategy groups that were effective in reducing boredom.

The results for body movement showed that body movement increased at task onset and was significantly greater for the no restructuring group in the easy condition than for either of the cognitive restructuring conditions. No significant differences were observed between any of the groups performing the difficult task.

Table 9.

Means and Standard Deviations for Physiological Measures.
(Easy task condition.)

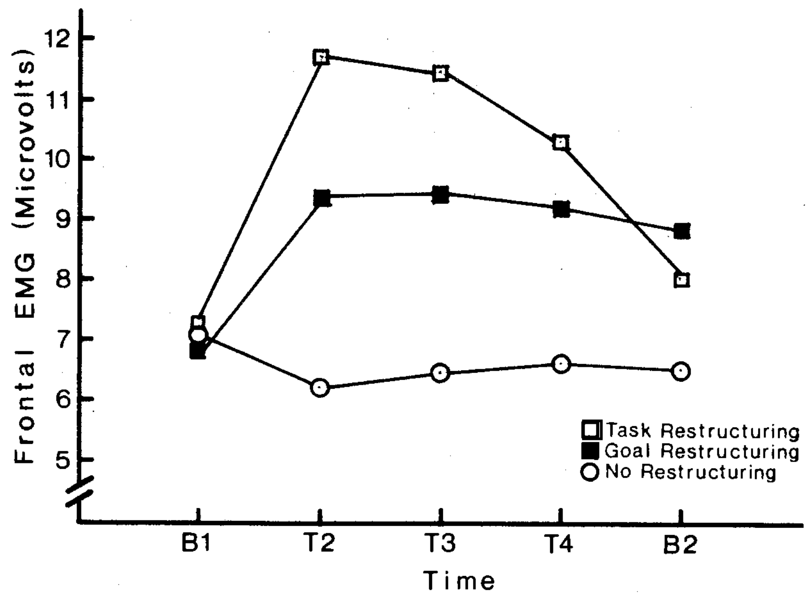
		Time				
Strategy		Time 1	Time 2	Time 3	Time 4	Time 5
Task Restructuring	Frontal EMG	7.32 (1.34)	11.77 (1.73)	11.43 (1.65)	10.34 (1.94)	7.59 (1.36)
	PST	34.56 (1.49)	32.64 (2.96)	32.69 (2.81)	31.85 (3.61)	32.82 (2.84)
	SC	10.40 (2.42)	15.65 (6.54)	15.27 (5.06)	15.59 (5.79)	14.18 (5.13)
	BM*	1.03 (.83)	1.14 (1.06)	1.64 (1.30)	1.79 (1.05)	1.43 (.90)
Goal Restructuring	Frontal EMG	6.80 (1.44)	9.28 (1.59)	9.33 (1.10)	9.21 (1.51)	8.83 (1.06)
	PST	33.99 (2.26)	30.64 (2.57)	30.94 (2.19)	30.79 (2.19)	31.59 (2.10)
	SC	11.73 (2.90)	15.06 (3.56)	15.52 (3.98)	15.26 (4.14)	14.19 (3.49)
	BM	.48 (.67)	1.08 (1.17)	.89 (1.11)	.89 (1.01)	1.36 (1.05)
No Restructuring	Frontal EMG	7.15 (.73)	6.26 (.56)	6.52 (.91)	6.69 (1.17)	6.56 (1.18)
	PST	32.74 (3.31)	31.71 (3.46)	31.66 (3.77)	31.25 (3.56)	31.07 (3.57)
	SC	9.89 (1.63)	11.85 (3.52)	12.64 (3.14)	12.86 (2.70)	12.17 (3.32)
	BM	.86 (.44)	1.89 (1.50)	2.15 (1.82)	2.60 (1.80)	1.57 (1.26)

* Body movement scores in this and subsequent tables are the square root of body movement counts.

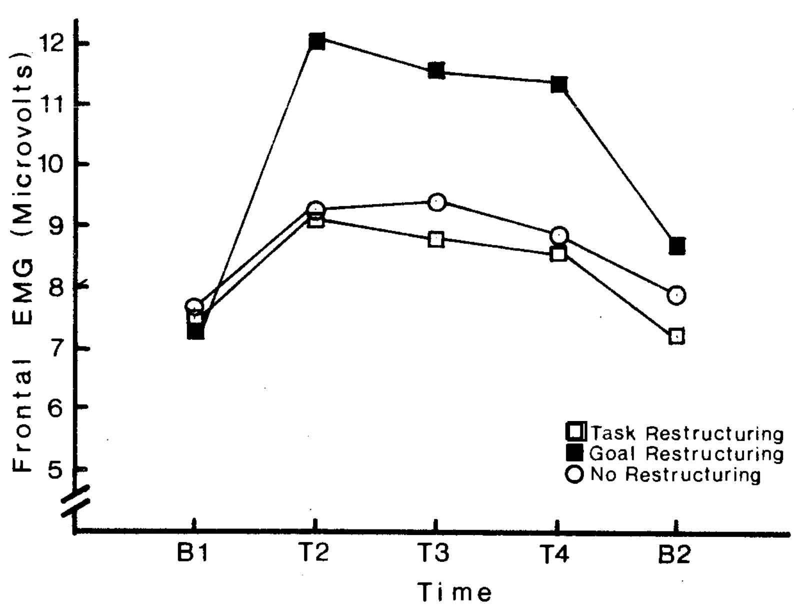
Table 10.

Means and Standard Deviations for Physiological Measures.
(Difficult task condition.)

Strategy		Time 1	Time 2	Time 3	Time 4	Time 5
Task Restructuring	Frontal EMG	7.44 (1.45)	9.11 (2.00)	8.79 (2.02)	8.58 (2.07)	7.18 (1.49)
	PST	32.70 (3.69)	32.72 (1.96)	33.24 (1.76)	32.70 (2.12)	32.64 (2.12)
	SC	11.53 (3.55)	15.57 (4.92)	16.79 (5.95)	14.57 (4.57)	14.36 (4.58)
	BM*	.42 (.59)	1.82 (.57)	1.44 (1.01)	1.68 (.94)	.69 (.90)
Goal Restructuring	Frontal EMG	7.29 (1.28)	12.04 (1.81)	11.64 (2.19)	11.35 (1.35)	8.70 (1.90)
	PST	33.25 (3.12)	32.47 (3.25)	32.57 (3.23)	32.56 (2.46)	32.16 (2.66)
	SC	13.17 (3.08)	18.22 (3.96)	18.20 (4.04)	17.62 (4.37)	15.71 (2.64)
	BM	.47 (.41)	1.48 (1.25)	1.22 (1.21)	1.57 (1.26)	.99 (.53)
No Restructuring	Frontal EMG	7.55 (.85)	9.22 (1.30)	9.41 (1.84)	8.83 (1.51)	7.94 (2.38)
	PST	32.96 (2.61)	32.75 (3.48)	32.30 (3.62)	32.11 (3.66)	32.42 (3.20)
	SC	13.09 (4.33)	17.59 (5.11)	17.64 (4.58)	16.97 (4.99)	14.34 (3.83)
	BM	.47 (.42)	.63 (1.20)	1.83 (1.51)	1.56 (1.75)	1.18 (.95)



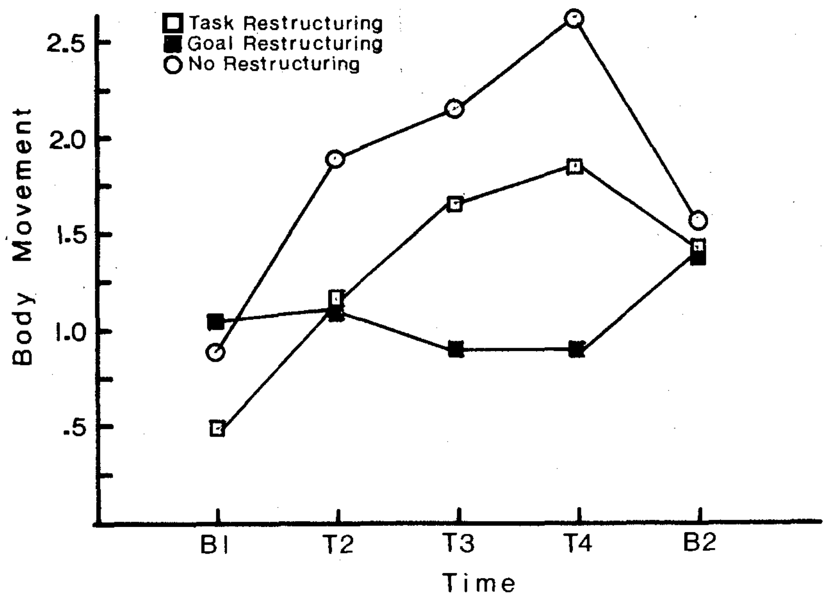
EASY TASK



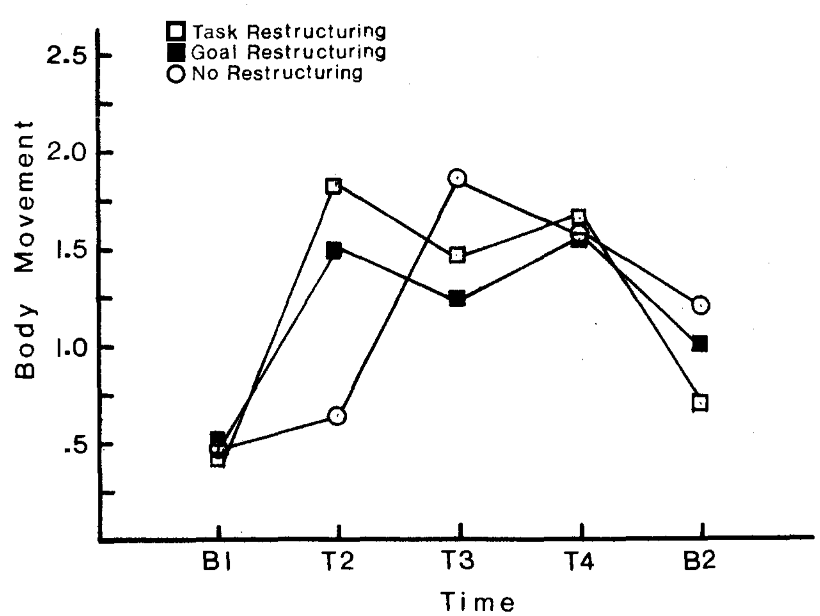
DIFFICULT TASK

Figure 2

Profiles of Difficulty x Strategy x Time Interactions For Frontal EMG



EASY TASK



DIFFICULT TASK

Figure 3

Profiles of Difficulty x Strategy x Time Interactions For Body Movement

Other statistically significant results observed were a difficulty by time interaction ($\underline{F}(16,651.36)=1.895$, $\underline{p}=.018$) that had its effect primarily by decreased PST in the easy tasks ($\underline{F}(4,216)=4.032$, $\underline{p}=.004$); and a main effect for time ($\underline{F}(16,651.36)=22.403$, $\underline{p}<.001$) indicating decreased levels of frontal EMG, PST, and SC, and increased body movement over task duration.

Summary. The findings for physiological dependent measures showed that frontal EMG, PST, and SC decreased as a function of task duration; that frontal EMG was greater for those restructuring conditions that were effective in reducing boredom; and that PST decreased for the easy task conditions. Hypotheses 7 and 9, therefore, are accepted. Hypothesis 8, however, is rejected. Patterns of peripheral responding did vary according to cognitive strategy, but only with those strategies that were effective in reducing boredom. Lastly, it also was found that body movement was greater for the no restructuring groups on the easy task, although no between group differences were observed in the difficult task conditions.

Summary of Results Related to Hypotheses

A wide variety of results were obtained from the analyses just reported. In this section, the results and their bearing on the hypotheses presented at the end of chapter two will be summarized.

Hypothesis 1

Cognitive task restructuring is more effective than cognitive goal restructuring in reducing boredom when persons are engaged in easy repetitive tasks.

This hypothesis is rejected. Cognitive task restructuring and cognitive goal restructuring were equally effective in reducing boredom in the easy task conditions.

Hypothesis 2

Cognitive goal restructuring is more effective than cognitive task restructuring in reducing boredom when persons are engaged in difficult repetitive tasks.

There is some support for this hypothesis. Cognitive task task restructuring was not effective in reducing boredom in the difficult task condition, while cognitive goal restructuring resulted in decreased boredom at the end of the task measurement period.

Hypotheses 3 and 4

Boredom experienced during the performance of an easy repetitive task is accompanied by increased felt effort as evidenced by its relationships to strain and fatigue; and boredom experienced during the performance of a difficult repetitive task is accompanied by decreased felt effort as evidenced by its relationships to strain and fatigue.

The results provided support for these hypotheses. Easy tasks were associated most strongly with fatigue and were related to strain, whereas difficult tasks were most strongly related to lack of attention, and were not associated with strain. A result not predicted, and one that runs counter to expectation based on Hamilton's (1981) model of cognitive boredom-coping, is that boredom in easy tasks, but not in difficult tasks was associated with frustration.

<u>Hypothesis 5 and 6</u>

Bored and nonbored groups will perform at the same levels of absolute performance, but bored groups will demonstrate greater response variability than nonbored groups.

These hypotheses are rejected. Subjects in the easy no restructuring groups were more bored than subjects in the cognitive restructuring groups but performed equally as well as the cognitive goal restructuring subjects on all performance measures. Subjects in the cognitive restructuring groups, however, attempted fewer items and were less consistent in their responses than the either cognitive goal restructuring or no assigned strategy groups. Moreover, subjects in the easy cognitive task restructuring condition were more variable in their responses than subjects in the difficult task restructuring condition. Task performance, therefore, varied as a function of restructuring strategy rather than boredom.

<u>Hypotheses 7, 8 and 9</u>

Physiological indices of peripheral responding will vary as a function of task duration, cognitive strategy, and task difficulty.

Hypotheses 7 and 9 were confirmed, although the patterns of peripheral responses observed were more precise than the general predictions made. Specifically, decreases in frontal EMG, PST, and SC were observed over time, and PST decreased more in easy task conditions than difficult task conditions. In terms of hypothesis 8, frontal EMG varied according to strategy, but only with those strategies that were effective in reducing boredom. Frontal EMG, therefore varied with boredom rather than cognitive strategy. Finally, body movement increases were greater for the no restructuring group relative to other groups in the easy task condition, but not for the nō restructuring group relative to the other groups in the difficult task conditions.

CHAPTER V

Discussion

In this chapter, a discussion of the results is presented. First, the results from tests of hypotheses will be discussed in more detail. A discussion of some of the limitations of the study will then be presented. This will be followed by a summary description of boredom as suggested by the current research, and recommendations for using cognitive strategies to reduce boredom during repetitive task performance. Finally, implications for further resarch will be summarized.

Hypotheses Results

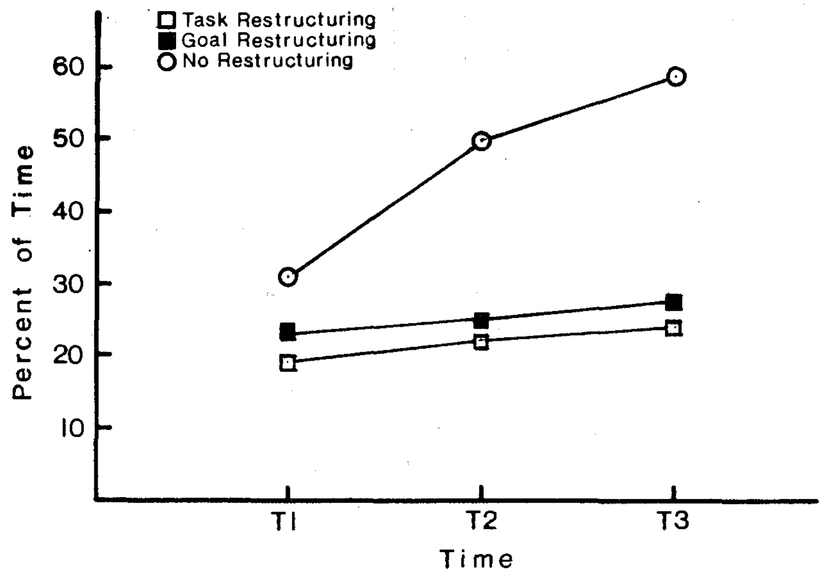
In order to facilitate the discussion, the hypotheses in this section are organized in the same manner as Chapter 4. That is, hypotheses are grouped as those that deal with self-report of boredom, the relationships between self-report measures, performance measures, and physiological measures.

Self-report of Boredom

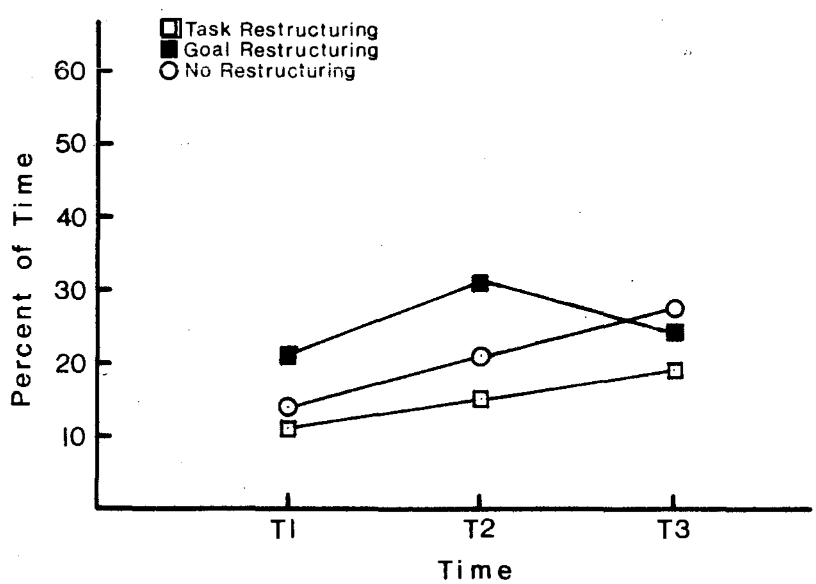
Hypotheses 1 and 2. Contrary to hypothesis 1, the findings of this study were that cognitive task restructuring and cognitive goal restructuring were both effective in reducing boredom in the easy task condition. Congruent with hypothesis 2 was the finding that cognitive goal restructuring, but not cognitive task restructuring was effective in reducing boredom in the difficult task condition although this effect was not observed until the 30 minute interval.

A number of explanations might be advanced to account for these discrepant results. The explanations proposed here are suggested by the theoretical considerations upon which the hypotheses initially were based. Dealing first with the finding that goal restructuring was effective in reducing boredom for the easy task condition, Hamilton's (1981) theory posits that cognitive boredom-coping strategies are effective because they regulate information flow. A possible hypothesis, therefore, is that subjects in the easy cognitive goal restructuring condition experienced less boredom because they generated additional information about the task. Since goal achievement was contingent upon performance, and the correctness of responses was easily verified, it seems reasonable to suppose that monitoring their progress in general, and self-testing in particular played an important role in generating additional information (e.g., Flavell, Fredrichs & Hoyt, 1970; Lane, 1982). The speculation is supported by subject disclosures during post experimental interviews. Subjects in the easy goal restructuring condition invariably reported a) exasperation at keying in answers they knew to be incorrect, and b) that speeded responses led to occasional errors and was less efficient in accumulating correct response than mentally verifying responses prior to keyboard entry. The latter comment was predicated on the observation that wrap-around time for the next stimulus took longer than the verification process, a performance strategy which was, by the way, absolutely correct. These subject disclosures were substantiated by self-report data which showed that nonbored subjects spent less time engaged in nontask related thought, thus adding further credence to the speculation that self-monitoring generated additional information.

Given that goal setting generates additional information, why was goal restructuring effective only for the last ten minute period in the difficult task condition? One possible explanation is suggested by the similarity of the present findings with those previously cited by Locke and Bryan (1967). Locke and Bryan's study, it will be recalled, also found that setting specific goals was effective in reducing boredom only in the final period of task duration. Their study, however, spanned two hours whereas the current study lasted only thirty minutes. Together, the studies suggest that the inclusion of specific goals contained additional information about the impending end of the task. Assuming for the moment that boredom occurs in difficult tasks because persons pay less attention to the task, approaching the the upper limits of the offered monetary incentive may have signalled the end of the task, and resulted in the redirection of attention towards the task. This speculation is supported by subject ratings of time spent on nontask related thought. Figure 4 illustrates graphically that nontask related thought increased progressively over task duration for all groups except the goal restructuring group in the difficult condition. For this latter group, nontask related thought increased over the first 20 minutes, but then decreased for the final ten minute period. The



EASY TASK



DIFFICULT TASK

Figure 4

Percent of Time Thinking Off Task

results are congruent with the interpretation that subjects increasingly paid less attention to the task as time went on, but subsequently redirected their attention back to the task as the opportunity to achieve goals approached an end.

End-of-task effects that previously have been observed in research on task performance (e.g., Barmack, 1937; Parasuraman, 1984) ,therefore, may account for the decreased boredom experienced by subjects in the difficult goal restructuring condition at the end of the task. An implication of this interpretation is that specific goals may have their effect as the achievement of goals approaches, rather than at any specific time interval. If there is merit to this explanation, it would suggest further that goal setting to reduce boredom should incorporate short term achievable goals rather than long term goals that are not so readily achieved. Further research could easily test this hypothesis by comparing conditions where incentives are offered for peformance at regular intervals, to conditions where incentives are offered only at the conclusion of the task.

A second explanation that cannot be ruled out on the basis of this study, however, is that the statistically significant slower rate of increase in self-reported boredom for the difficult task conditions meant that boredom was insufficiently strong for the cognitive strategies to have an appreciable effect. According to this explanation, the effectiveness of cognitive strategies in reducing boredom occurs only when boredom has reached a certain intensity. Further research is necessary to determine which, if either, of these explanations is correct.

Despite the uncertainty over the underlying mechanisms responsible for the effectiveness of cognitive boredom-coping strategies, a number of specific recommendations to reduce boredom while performing repetitive tasks can made based on the findings of self-report measures. First, when performing an easy repetitive task, it makes no difference whether one cognitively restructures the task, or alters one's reasons for engaging in the task: both are equally effective in reducing boredom. Second, if the repetitive task one is performing is difficult, altering one's reasons for engaging in the task may be an effective strategy whereas cognitively restructuring the task is not. It is possible to speculate that cognitively setting many readily achievable goals, as opposed to one long term goal, may be more effective in reducing bordom although this strategy was not tested empirically in this study.

Relationships Between Self-report Measures

Hypotheses 3 and 4. Hypotheses 3 and 4 predicted that boredom during easy task performance would be associated with strain and fatigue, whereas boredom during difficult tasks would not. The hypotheses were confirmed with respect to strain, but not with respect to fatigue. Boredom was related to fatigue during both easy and difficult task performance. Further perusal of the correlational data in table 7, however, shows that fatigue was related to inattentiveness in the easy condition (r=.49, p=.006 2-tailed), but not related to inattentiveness in the difficult condition (r=.04, p=.833, 2-tailed). Since strain also was related to lack of attention in the easy condition (r=.59, p=.001 2-tailed), but not in the difficult condition (r=.03, p=.859 2-tailed), the findings describe fatigue in the easy task condition as due to increased felt effort associated with demands to pay attention to the task, and fatigue in the difficult condition as due to other, unspecified factors. On the basis of this study, it is impossible to determine whether fatigue in the difficult condition was related to a specific variable or variables. In the absence of such evidence, it is attractive to speculate that generalized fatigue is experienced by these subjects. The most justified conclusion, on the basis of the current results, however, is that at the present time the source of this fatigue is not known.

The additional finding that boredom was related to frustration in the easy task, but not the difficult task, is interesting in that it runs counter to Hamilton's hypothesis that boredom would be related to frustration in difficult, but not easy tasks, and to Hill and Perkins' (1985) hypothesis that frustration of personal goals is related to boredom regardless of task difficulty. Further scrutiny of the relationships between frustration and other self-report measures show that frustration was related significantly to all self-report measures except lack of attention in the easy task conditions, but related only to strain and restlessness in the difficult task conditions. This pattern of results suggests that task-related frustration as hypothesized by Hamilton did occur in the difficult task condition, but that this frustration was independent of boredom. Although no steps were taken in this study to ensure that frustration was interpreted by subjects as frustration of personal goals, the present findings suggest that in the easy task condition, more generalized frustration may have been related to frustration of personal goals in addition to frustration of task related goals. Task parameters, therefore, appear to mediate the relationship between boredom and frustration, but not in the manner hypothesized by Hamilton, or Hill and Perkins.

The relationships of self-report measures in this study, therefore, describe bored subjects as restless, tired, inattententive, and thinking about things other than the task at hand and other than the goal (primary or secondary) towards which the task is directed. In addition, bored subjects performing easy repetitive tasks feel frustrated, and experience fatigue and strain related to lack of attention. Bored subjects performing difficult repetitive tasks, on the other hand, do not experience frustration related to boredom, and while they also experienced fatigue related to boredom, the fatigue is more generalized and less related to attentional processes.

Performance Measures

Hypotheses 5 and 6. The predictions made by hypotheses 5 and 6 were that bored and nonbored groups would perform at the same absolute levels of performance, but that bored groups would demonstrate greater response variability. The findings showed that absolute levels of performance and response consistency varied, but as a function of cognitive restructuring, rather than of boredom. In the easy task condition, subjects in both the cognitive task restructuring group and the cognitive goal restructuring groups experienced less boredom, but subjects who reduced boredom by building variability into the task (cognitive task restructuring subjects in the easy condition), completed fewer items and were less consistent in their responses. Moreover, when task restructuring was not effective in reducing boredom, as was the case in the difficult task, subject responses were more consistent. Taken together the results suggest that building variability into the task reduces boredom, but at the additional cost of reduced task performance and consistency.

This interpretation may also explain the contradictory views expressed in the literature that bored subjects are alternatively less attentive and therefore display greater variability of responses, and that nonbored subjects build more variety into their tasks to reduce boredom. According to this study, response consistency varies with the specific cognitive strategy a person uses to approach the task. Bored persons, therefore, may perform consistently or inconsistently depending on whether they cognitively restructure the task, or alter the reasons for engaging in the task.

Why bored subjects perform at comparable levels, and why they are often found to be as consistent as nonbored in their responses, is a matter of some conjecture. Corresponding results have been observed elsewhere (e.g., Davies & Parasurman, 1982; Hoage, 1982; Jerison, Pickett & Stensen 1965; Parasuraman, 1984). Depending on the theoretical view taken, bored subjects have been hypothesized to develop repressive barriers to rejection of repetitive tasks (Hoage, 1982), or slavishly structure their responses to the task parameters. Clearly, this is an area where further research is warranted.

Integrating the performance results with those previously discussed self-reports in using cognitive strategies, it appears that when performing easy repetitive tasks, cognitive task and cognitive goal restructuring are equally effective in reducing boredom, but that cognitive task restructuring results in decreased performance in terms of the number of items completed and response consistency. Persons who wish to reduce boredom during repetitive tasks, but who also need to maintain performance standards, safe drivers for example, therefore ought to employ cognitive strategies that set specific goals for performance rather than use cognitive strategies that restructure the task.

Physiological Responses

Prior to discussing the results for physiological dependent measures, mention must be made of the unreliability of heart rate data. Photoplethysmography typically is used as a measure of HR because it allows for continuous recording of peripheral vascular changes in a convenient and noninvasive manner (Stern, Ray & Davis, 1980; Tursky & Jamner, 1982). Recordings, however, do not measure absolute values, and are subject to variation as a function of a number of factors including limb position, ambient temperature, respiration, exercise, and task difficulty (Cook, 1972; Tursk & Jamner, 1982). In this study, limb position, and respiratory and exercise variables were held constant by task parameters, and ambient temperature controlled for by the constraint on random assignment of equal proportions of subjects over time of day. Task difficulty, therefore, appears to be the most cogent explanation for the unreliabilty of heart rate, especially since the majority of nonveridical recordings occurred in the difficult task condition. This explanation garners support from the PST data which, as measured in this study (sympathetically activated peripheral vasoconstriction or vasodilation leads to changes in PST which alters resistance of the thermistor) also varies as a function of peripheral blood flow. Tables 9 and 10 show that standard deviations for PST were greater in the difficult rather than the easy conditions. A check of the raw data revealed this to be an accurate reflection of variations in subject response rather than a statistical artifact due to outliers. The uncoupling of plethysmograph recordings from HR proportional recordings may have occurred, therefore, as the result of increased variability in peripheral blood flow in response to increased task difficulty. Future studies might avert this difficulty by choosing an alternate site for measuring pulse amplitude. The ear lobe, for example, is less susceptible to variations due to task parameters although it is affected by respiration.

Hypotheses 7, 8 and 9. In this study, physiological measures of peripheral responding were predicted to vary as functions of task duration, cognitive strategy, and task difficulty. The findings were that frontal EMG, PST and SC decreased over task duration; that increased frontal EMG was observed in cognitive strategy groups that were effective in reducing boredom; that increased BM relative to other groups was greater only in the easy no restructuring condition; and that PST decreased for groups performing the easy repetitive task.

The finding of increased frontal EMG exclusively in reduced boredom groups rather than cognitive restructuring groups, and the previously reported relationship of increased frontal EMG to task involvement, suggests that increased frontal EMG in this study also indexed task involvement. The results suggest further that in relation to nonbored subjects, bored subjects are distinguishable by decreased frontal EMG. Recent research (Moran & Cleary, 1986) suggests that increased frontal EMG may index functionally important processes in task performance requiring sustained attention. Specifically, Moran and Cleary suggest that increased frontal EMG may reflect increased cortical activation that is required for tasks involving sustained attention. Frontal EMG, therefore, may provide an alternate measure of attentional processes in bored subjects. A caveat must be stated, however. As previously mentioned, frontal EMG records a wide variety of processes (Basmajian, 1976; Davis et al, 1978). Further research that measures specifically frontales muscle potentials, therefore, is required before conclusions relating boredom, repetitive task performance, or sustained attention to specific muscle groups can be made.

Results for body movement showed increased BM at task onset and increased BM relative to other groups only in the easy no cognitive restructuring condition. Theories of boredom reviewed in Chapter Two conjectured that increased body movement was one means by which persons take behavioral compensatory action to counteract low cortical arousal. The current results are congruent both with this speculation, and with earlier speculation (e.g., Berlyne, 1955) that increased body movement represents constrained attempts to seek novel stimulation. The explanations do not account, however, for the lack of increased BM in the difficult no restructuring condition. While it is possible that increased BM may have been observed for this latter group if task duration had been extended, it also is possible that frustration of personal goals that was, according to self-reports, absent in the difficult no restructuring group accounts for the increased agitation observed in the easy task group.

The findings of decreased PST in the easy task conditions is congruent with other research on PST. As mentioned previously, PST measurement indexes changes in peripheral blood flow. However, patterns of blood flow to different parts of the body vary in response to increased muscle and organ activity (Tursky & Jamner, 1982), and peripheral vasoconstriction has been shown to decrease with duration of task performance and with decreased psychological task requirements (Cook, 1974). Decreased PST in the easy conditions, therefore, may be explained by task duration and psychological task requirements. This hypothesis is consistent with the explanation offered for the unreliability of heart rate measures. When decreased PST in the easy condition is considered in conjunction with the variations in peripheral blood flow in response to task difficulty, the picture that emerges is that of decreased peripheral flow over duration of repetitive task performance that is attenuated ,in the difficult condition, by increased variability of peripheral blood flow. While this explanation is speculative, the results of this study do show that decrements in PST are a reflection of task parameters rather than boredom.

Summarizing the results related to physiological dependent measures, there is no evidence for the view that boredom in repetitive task performance or that repetitive task performance by itself leads to a physiological stress response. The finding is in agreement with a number of industrial studies (e.g. Broadbent & Gath, 1979; Cox, 1980; Mackay et al., 1979) that conclude repetitive tasks may lead either to satisfaction or dissatisfaction, and that pacing rather than the task itself leads to a stress response. Even if self-pacing versus fixed-pacing were to account for the lack of a physiological stress response in this study, the conclusion would remain that task parameters rather than boredom per se are related to a peripheral physiological stress response.

The exception to this conclusion is the finding of increased body movement in the easy no restructuring task condition. Increased body movement can be interpreted as increased behavioral arousal (e.g., Everly & Rosenfeld, 1981; Lacey, 1967). In terms of physiological arousal, however, it appears that task parameters rather than boredom influence peripheral physiological responses.

Integrating these results with those for self-report and performance measures, it appears that the choice of cognitive task versus cognitive goal restructuring strategies to reduce boredom can be made without an additional cost in terms of stressful physiological responses. The optimal choice of cognitive strategy to reduce boredom is related to task difficulty and to the performance standards one is required to maintain. Since task parameters influence peripheral responding, self-report of boredom may be associated physiological stress response, but the source of the physiological stress response lies within the perception of task demands rather than with boredom. Finally, frontal EMG may serve as a measure of attentional processes that is able to discriminate between bored and nonbored subjects.

Limitations of the Current Study

A number of limitations of the current study must be pointed out. First, and perhaps most crucial, is the limited task duration employed. Thirty minutes is the agreed upon minimum duration suggested to investigate spontaneously induced boredom (Hockey & Hamilton, 1983). It is not possible in this investigation to preclude the possibility that an extended period of time would have resulted in, for example, differences in report of boredom for the cognitive restructuring groups in the easy condition, or effectiveness of both cognitive restructuring strategies in the difficult condition. Although this limitation raises a pandora's box of increasing and increasing time durations, it nevertheless would be desirable to have confirmation of the current results over extended time periods.

A second limitation of this study is the lack of an independent measure of task difficulty. Task difficulty in this investigation was assumed to have varied according to the task manipulation, but it was obvious during experimentation that individual differences in experienced task difficulty occurred. Since increases in perceived task difficulty previously have been related to boredom (Davies et al., 1972) and since it is possible to interpret the effectiveness of goal restructuring in the difficult task condition as the result of decreased task difficulty due to increased familiarity with the task, future research ought also to include a measure of perceived task difficulty in addition to "objective" manipulations.

Third, the failure of this study to record reliable measures of HR and HRV made it impossible to address some important aspects of attentional processes in boredom. Although increased frontal EMG may have indexed attentional processes, HRV measures would have provided additional validity for this interpretation. HRV measures also may have shed some light on the counterintuitive findings that boredom is related to a lack of attention, but that bored persons nevertheless perform as well as nonbored persons. These findings suggest alternatively that bored subjects did not pay attention, or that bored subjects did pay attention but only with considerable effort. Although self-report data suggest that both processes occurred depending on whether easy or diffficult tasks were being performed, HRV data would provide important substantiation to this interpretation.

Lastly, it is not possible given the current research design to determine whether the cognitive restructuring conditions had uniform effects with all subjects. Kiesler (1966) has shown previously, for example, that persons in psychotherapy experience different levels of treatment conditions and that this differential experience affects treatment outcomes. Similarily in this study, cognitive restructuring manipulations may have been effective differentially over subjects within treatment conditions. Hamilton's (1981) caveat that personal and situational variables may affect a person's ability to adopt cognitive restructuring strategies, therefore, must be reemphasized.

A Summary Description of Boredom and Recommended Cognitive Strategies to Reduce Boredom

Despite the above mentioned limitations, the results of this study provide alternate empirical descriptions for boredom that occurs while performing easy or difficult repetitive tasks. The results also permit a number of practical recommendations to be made to reduce boredom while performing repetitive tasks.

First, the results describe boredom that occurs during performance of an easy repetitive task as leading to decreased frontal EMG and PST, and increased bodily agitation; and is associated with inattentiveness, thinking about things other than the task, increased fatigue, frustration and strain related to increased effort in sustaining attention, and restlessness. By comparison boredom that occurs while performing a difficult repetitive task leads to decreased frontal EMG and is associated only with increased inattentiveness, thinking about things other than the task, generalized fatigue, and restlessness. Boredom in easy tasks, therefore, is perceived as more aversive and appears to have more aversive behavioral and physiological consequences. In defiance of this aversiveness, bored persons perform equally as well as nonbored persons in performing both easy and difficult repetitive tasks.

These alternate descriptions of boredom provide corroboration for Hamilton's (1981) hypothesis that the processes leading to boredom are different for easy and difficult tasks. The descriptions support the view that boredom experienced while performing easy tasks is associated with increased effort to sustain attention, while boredom in difficult tasks is associated with lack of attention to the task.

A number of specific recommendations for reducing boredom during repetitive task performance also can be made on the basis of the present study. Primarily, the results show that a variety of cognitive strategies are effective in reducing boredom if one is performing an easy repetitive task and if task performance is not an issue. Cognitively altering an easy repetitive task to make it more interesting is an effective way to reduce boredom if no demands exist to achieve certain performance standards. However, where aversive consequences ensue as a result of failure to meet certain standards of performance, cognitively making the task more interesting may be counterproductive insofar as it leads to increased pressures associated with failure to achieve performance criteria. Under these circumstances it is better to set readily achievable performance goals and to generate additional information by directing one's attention to achieving these goals.

When performing difficult repetitive tasks, the choice of cognitive strategies to reduce boredom is more limited. Making a game of the task is ineffective both in reducing boredom and in achieving performance criteria. Cognitively setting performance goals, on the other hand, may maintain performance, but be unsuccessful in reducing boredom until one approaches the end of the task. Although not tested empirically in this study, it may be better to make multiple short-term goals that are constantly achievable. Whether these short-term goals should be combined with an overall end-term goal to reduce maximally boredom is impossible to determine on the basis of this study, although the hypothesis is congruent with some observational studies in the work place (e.g., Baldamus, 1951; Dickson, 1973).

Implications of the Current Study for Future Research

An exciting outcome of this study is that it suggests many topics for further investigation. From a practitioner's point of view, the most pressing need is to validate the current findings over extended time durations. While the current study dealt specifically with repetitive tasks of short duration that are amenable to self-control procedures, questions could be raised about the desirability of employing cognitive restructuring procedures over extended periods such as months or career spans.

A related issue is the generalizability of the present findings to more ecologically valid settings. Although the current investigation may have simulated adequately repetitive tasks as performed by some computer operators, the monitoring of physiological indices in particular, and the experimental environment in general, obviously introduced a high degree of artificiality into the study. Recent advances in telemetric communications open a host of possibilities for further studies on cognitive boredom-coping strategies in more ecologically valid settings (e.g., Csikszentmihalyi, 1975).

In terms of developing a programatic research strategy, questions related to the acquisition of cognitive boredom-coping strategies also need to be addressed. The current study attempted experimentally to manipulate cognitive strategies, but did not address the important question of whether persons are able to adopt different strategies, able to alter cognitive strategies within task, and/or able to acquire alternate cognitive strategies not already in their repetoire. The predisposition of bored subjects to persist at repetitive tasks despite boredom and the aversiveness associated with boredom, suggests that further research is necessary to answer these questions.

Questions related to peripheral responding also are raised. Increases in frontal EMG were found to be related to boredom rather than cognitive strategy. However, the global nature of frontal EMG measures incites speculation on the underlying physiological mechanisms that relate frontal EMG to attentional processes. While frontal EMG continues to be related to important psychological and affective processes, in this case boredom, identification of the precise muscle potentials causing these effects would further the understanding of processes involved in boredom.

Lastly, an area of future research concerns the persistence of bored persons in performing repetitive tasks that they find boring and, by self-report, aversive. What type of self-regulatory mechanisms do such person's employ that leads them to maintain performance? Current psychoanalytic explanations in terms of socialized repressive barriers and cognitive interpretations in terms of motivated selective attention, are embedded in explanations that are unamenable to conventional experimental manipulations. Research strategies that assess systematically cognitive structures (e.g., Meichenbaum & Gilmore, 1984) may better address this interesting question.

Conclusion

The principle findings of this study were that cognitive strategies are differentially effective in reducing boredom; that cognitive strategies have different performance costs associated with them; and that task parameters rather than boredom per se engender physiological stress responses. These three findings have important implications for the choice of cognitive strategy to reduce boredom during repetitive task performance. The cognitive strategy one employs to reduce boredom ought to take into account the difficulty of the task and the performance standards one is required to maintain. In addition, self-report of boredom may be, but need not be, accompanied by a physiological stress response. Reports of boredom, therefore, ought to be followed by a functional analysis of personal and situational variables that co-occur with boredom before conclusions that boredom is related to stress are made.

Finally, the current investigation has demonstrated the importance of task difficulty in mediating self-report of boredom and peripheral physiology. Future research on boredom, therefore, ought to take into account task difficulty as well as attempt to identify other dimensions along which self-report of boredom may vary.

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APPENDIX A

Physiological Recording Equipment and Calibration

Frontal EMG

Stainless steel Frontal EMG electrodes following standard clinical procedures, were applied on an imaginary line an inch and above and horizontal to the eyebrow line with a central electrode equidistant from the two active electrodes serving as the reference for recording (Basmajian & Blumenstein, 1980; Lippold, 1967). Overall impedences of 20,000 ohms or less, and impedences of 5,000 ohms or less between active electrodes were maintained throughout recording. Input was channeled through a CI S75-01 hi-gain bioamplifier set at maximum gain and using 1 to 1000 Hz. bandpass filters, to cumulating resetting integrator with a time constant of 100 mvseconds. Calibration was achieved using both an internal calibration signal, and a Glass square wave signal generator.

Heart Rate

HR was measured by a photoreflective densitometer attached to the the thumb of the nondominant hand. The signal was transmitted to a CI S71-40 pulse monitor optical densitometer to produce a logical pulse at output for digital heart rate measurement. A derived measure of heart rate variability calculated as the standard deviation of heart rate over the experiments duration was used.

Skin Resistance

Basal skin resistance was monitored from two stainless steel electrode patches attached to the palmar surfaces of the nondominant hand, and input directed to a CI S71-20 skin resistance module. Calibration was achieved using both internal and external resistances.

Peripheral Skin Temperature

Peripheral skin temperature was measured using a Yellow Springs thermistor applied to the ventral surface of the middle finger of the nondominant hand and monitored through a CI S71-30 temperature module.

Body Movement

Body movement was measured by two strain gauges applied to a metal plate perpendicular to the seating position. Changes in resistance due to changes in tension of the strain gauges as a result of seat movement were amplified and recorded. A variable windowing apparatus enabled constant recordings to be maintained without manual recalibration if shifts in body position deviated from initial baseline calibration settings. Sensitivity calibration was achieved using a behavior checklist against body count during pilot runs. Sensitivity was set so that body movements necessary for task performance were not included in the count. The result was that lower body movement was monitored.

APPENDIX B

Instruction Protocols and Time Sequence

Task Restructuring Protocol

For the next 50 minutes you will be asked to identify a number of African proverbs. A series of letters followed by either a plus sign or a minus sign will appear on the screen. If a plus sign follows a letter, your task is to type in the letter that immediately follows that letter in the alphabet. If a minus sign follows a letter, your task is to type in the letter that immediately precedes that letter in the alphabet. For example, if B+ occurs, the correct answer is C. If B- occurs, the correct answer is A. In order to answer the question, simply type in the correct letter on the keyboard.

In order to discover the African proverbs, each missing letter combines with the succeeding letters to form a proverb. An example of the type of proverb you might expect to discover is: "evil knows where evil sleeps". Your task is to respond with the correct letter as accurately and as quickly as possible, and to see how many proverbs you are able to discover. To assist you in identifying the proverbs, the letters as you have entered them, will appear across the upper portion of the screen.

Before beginning the task, please rate your current feelings or attitudes on the rating scales to be presented next. These rating scales will occur from time to time throughout the task and be followed by more letter completion tasks.

Goal Restructuring Protocol

For the next 50 minutes you will be asked to earn money by doing an alphabetical completion task as accurately and as quickly as possible. A series of letters followed by either a plus sign or a minus sign will appear on the screen. If a plus sign follows a letter, your task is to type in the letter that immediately follows that letter in the alphabet. If a minus sign follows a letter, your task is to type in the letter that immediately precedes that letter in the alphabet. For example, if B+ occurs, the correct answer is C. If B- occurs, the correct answer is A. In order to answer the question, simply type in the correct letter on the keyboard.

You can earn $1.00 for every 50 letters you answer correctly. For example, you can earn $1.00 for getting 50 items correct, $2.00 for getting 100 items correct, $3.00 for getting 150 items correct, and so on to a maximum of $12.00. A counter in the upper right hand corner of the screen will tell you how many correct answers you have accumulated, and how much money you have earned so far.

Before beginning the task, please rate your current feelings or attitudes on the rating scales to be presented next. These rating scales will occur from time to time throughout the task and be followed by more letter completion tasks.

Control Protocol

For the next 50 minutes you will be asked do an alphabetical completion task as accurately and as quickly as possible. A series of letters followed by either a plus sign or a minus sign will appear on the screen. If a plus sign follows a letter, your task is to type in the letter that immediately follows that letter in the alphabet. If a minus sign follows a letter, your task is to type in the letter that immediately precedes that letter in the alphabet. For example, if B+ occurs, the correct answer is C. If B- occurs, the correct answer is A. In order to answer the question, simply type in the correct letter on the keyboard.

What we are interested in, is measuring a person's normal response to completing this type of task. As you type in the correct letters your physiological responses will be monitored, and you will be asked to rate your feelings or attitudes on a set of rating scales.

Before beginning the task, please rate your current feelings or attitudes on the rating scales to be presented next. These rating scales will occur from time to time throughout the task and be followed by more letter completion tasks.

Difficult Conditions

Instructions for the difficult conditions were identical to the first three conditions with the exceptions that the instructions required subjects to increment or decrement the presented letter by five letters; and that the incentives in the goal-restructuring condition will be $1.00 for every 25 correct letters typed.

Time Sequence

Following initial instructions, the time sequence was as follows:

-Rating Scales.

-Letter Completion Tasks: ten minutes.

-Rating Scales including additional manipulation confirmation scales.

-Letter Completion Tasks: ten minutes.

-Rating Scales including additional manipulation confirmatory scales.

-Letter Completion Tasks: 10 minutes.

-Rating Scales: including additional manipulation confirmatory scales.

Finish

This is the end of the letter completion tasks and of the rating scales. For the last 5 minutes please remain still while the recording device continues to monitor physiological indices. Thank you very much.

APPENDIX C

Proverbs Used

The proverbs used were adapted from an anthology of African proverbs compiled by Leslau and Leslau (1962). They were as follows:

1. Hunger is felt by a slave and hunger is felt by a king.
2. What is bad luck for one person is good luck for another person.
3. One cannot both feast and become rich.
4. A person with too much ambition cannot sleep in peace.
5. When you are rich you are hated. When you are poor you are despised.
6. Being well dressed does not prevent one from being poor.
7. You do not teach the paths of the forest to an old gorilla.
8. What is inflated too much will burst into fragments.
9. One who runs alone cannot be outrun by another.
10. Cactus is bitter only to those who taste of it.
11. Anticipate the good so that you may enjoy it.
12. The fool is thirsty in the midst of water.
13. He who is being carried does not realize how far the town is.
14. It is better to travel alone than with a bad companion.
15. The opportunity that God sends does not wake them that are asleep.
16. An intelligent enemy is better than a stupid friend.
17. Quarrels end but words once spoken never die.

18. Do not be so much in love that you cannot tell when the rain comes.
19. Ashes fly back into the face of those who cast them.
20. One camel does not make fun of another camel's hump.
21. Knowledge is like a garden. If it is not cultivated, it cannot be harvested.

APPENDIX D

Rating Scales

Rating scales appeared immediately after instructions, and at the conclusion of each ten minute task period. The rating scales were as follows:

1. Please move the cursor to the number below that best describes your current feelings or attitudes:
-Bored........Moderately bored ....Not bored
2. Please move the cursor to the number below that best describes your current feelings or attitudes:
-Attentive ....Moderately attentive ....Not attentive.
3. Please move the cursor to the number below that best describes your current feelings or attitudes:
-Frustrated...Moderately frustrated ...Not frustrated.
4. Please move the cursor to the number below that best describes your current feelings or attitudes:
Fatigued .....Moderately fatigued .....Not fatigued.
5. Please move the cursor to the number below that best describes your current feelings or attitudes:
-Restless .....Moderately restless...Not restless.
6. Please move the cursor to the number below that best describes your current feelings or attitudes:
-Strained .....Moderately strained...Not strained.

At the end of each task period two further scales were included. All Subjects were asked to make ratings on the following scale:

Please rate the percent of time you have spent daydreaming, or thinking about something other than the task.

0 % ....100 %.

To assess the degree of subject conformity to experimental manipulations, the following conditions rating scales were presented to individual conditions:

Cognitive Task Restructuring Conditions

Please rate the extent to which you are trying to figure out the proverbs.

0 % 100%

Cognitive Goal Restructuring Conditions

Please rate the extent to which you are attempting to earn the incentive.

0% 100%

Boredom Control Conditions

Please rate the percent of time you feel bored.

0 % 100%

APPENDIX E

Analysis of Variance Summary Tables

Analysis of Variance for Self-Report of Boredom Difficulty x Strategy x Time

Source	SS	DF	MS	F	p
Between subjects					
Strategy	260.558	2	130.279	18.770	.000
Difficulty	1.067	1	1.067	.154	.697
Strategy x Difficulty	66.058	2	33.029	4.759	.012
Subjects w. groups [error(between)]	374.800	54	6.941		
Within subjects					
Time	342.683	3	114.228	68.183	.000
Strategy x Time	96.141	6	16.024	9.564	.000
Difficulty x Time	13.433	3	4.478	2.672	.049
Strategy x Difficulty x Time	21.841	6	3.640	2.173	.048
Time x Subjects w. groups [error(within)]	271.400	162	1.675		

Multivariate Analysis of Variance for Performance Measures, and Univariate Analyses of Dependent Measures

Multivariate Analysis for Performance

Effect	Wilks	Approx. F	Hypothesis D.F	Error D.F.	Signifigance of F
Constant	.00112	11375.631	4	51	.000
Difficulty	.13612	80.915	4	51	.000
Strategy	.44809	5.499	8	102	.000
Difficulty x Strategy	.52681	4.816	8	102	.000

Univariate Analyses for Dependent Variables

Effect	Variable	D.F.	Hypoth SS	Error SS	Hypoth MS	Error MS	F	Signifigance
Difficulty	Attempt	1,54	243206.667	53898.600	243206.667	998.122	243.664	.000
	Accuracy	1,54	.556	1.587	.556	.029	18.916	.000
	Loglatency	1,54	3.280	1.708	3.280	.032	103.688	.000
	Consistency	1,54	.005	.439	.005	.008	.624	.433
Strategy	Attempt	2,54	18161.433	53898.600	9080.717	998.122	9.098	.000
	Accuracy	2,54	.035	1.587	.018	.029	.603	.551
	Loglatency	2,54	.147	1.708	.073	.032	2.323	.108
	Consistency	2,54	.163	.439	.082	.008	10.011	.000
Difficulty x Strategy	Attempt	2,54	2569.233	53898.600	1284.617	998.122	1.287	.284
	Accuracy	2,54	.162	1.587	.080	.029	2.749	.073
	Loglatency	2,54	.047	1.708	.023	.032	.738	.483
	Consistency	2,54	.065	.439	.032	.008	3.978	.024

Multivariate Analysis of Variance for Physiological Measures, and Univariate Analyses of Dependent Measures

Multivariate Analysis for Physiological Measures

Source	Wilks Lamda	Approx. F	Hypothesis D.F	Error D.F.	Signifigance of F
Difficulty x Strategy x Time	.70217	2.475	32	787.10	.000
Strategy x Time	.69062	2.957	32	787.10	.000
Difficulty x Time	.87024	1.895	16	651.36	.018
Time	.26918	22.403	16	651.36	.000

Univariate Analyses for Dependent Variables

Source	Variable	D.F.	Hypoth SS	Error SS	Hypoth MS	Error MS	F	Signifigance
Difficulty x Strategy x Time	EMG	8,216	80.988	329.230	10.123	1.524	6.642	.000
	PST	8,216	12.645	503.568	1.581	2.331	.678	.711
	SC	8,216	36.199	1036.417	4.525	4.799	.943	.482
	BM	8,216	11.070	147.318	1.384	.682	2.029	.044
Strategy x Time	EMG	8,216	94.885	329.230	11.860	1.524	7.781	.000
	PST	8,216	15.370	503.568	1.921	2.331	.824	.582
	SC	8,216	18.134	1036.417	2.267	4.798	.472	.875
	BM	8,216	8.930	147.318	1.116	.682	1.637	.116
Difficulty x Time	EMG	4,216	6.711	329.230	1.693	1.524	1.110	.352
	PST	4,216	37.603	503.568	9.401	2.331	4.032	.004
	SC	4,216	36.101	1036.417	8.775	4.798	1.829	.124
	BM	4,216	2.179	147.318	.545	.682	.799	.527
Time	EMG	4,216	276.634	329.230	69.518	1.524	45.373	.000
	PST	4,216	81.778	503.568	20.444	2.331	8.769	.000
	SC	4,216	771.725	1036.417	192.931	4.798	40.209	.000
	BM	4,216	39.944	147.318	9.986	.682	14.642	.000