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PSYCHOPHYSIOLOGICAL CORRELATES OF STRESS IN CHILDREN

Psychology

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PSYCHOPHYSIOLOGICAL CORRELATES OF COPING AND COGNITIVE STYLES IN CHILDREN

Physiological reactions to repeated filmed presentations of vicarious and shock threat were studied in a group of normal children. In the vicarious condition, several measures of skin conductance and heart rate indicated the initial, unexpected impact of harm was not as stressful as subsequent anticipated presentations of the same threat. In the shock threat condition, tonic measures of skin conductance indicated habituation over trials, or a homeostatic return to resting level, while another measure of skin conductance reflected increasing arousal as the probability of shock increased. Marked heart rate deceleration was noted for each presentation of the shock threat cue. The significance of a variety of skin conductance and heart rate response measures was discussed.

The relationship between coping and cognitive styles and psychophysiological response to stress were also investigated. Results suggest that the reality-oriented child is less affected autonomically by vicarious threat than the child who typically denies reality. The relationship of coping style to shock threat is less clear. The cognitive style of reflection-impulsivity shows some relationship to vicarious threat, with the impulsive, error-prone child exhibiting more autonomic ability than the reflective, accurate child. Results concerning

field dependence-independence suggest that some sort of basic physiological difference may exist between field dependent and field independent _S_s.

PSYCHOPHYSIOLOGICAL CORRELATES OF COPING

AND COGNITIVE STYLES IN CHILDREN

by

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INTRODUCTION

Stress research has become increasingly popular during the past two decades, and has featured prominently in many areas of psychological investigation, including the study of psychopathology and the fields of personality, social, experimental and physiological psychology. Many contributions to the understanding of psychological stress have been made by psychophysiologists. Almost without exception, studies in this area have involved adult Ss. Perhaps for ethical reasons, children have seldom been used. Yet children are continually faced with frustrations, threat of failure and many other stresses in their daily encounters with family, school, and peers. An understanding of how they deal with frustration and what physiological impact some stresses may have is an intriguing area for investigation.

The present study attempts to isolate some of the physiological effects of two different forms of stress on children. Some of the conditions which determine whether and to what degree a situation is threatening will be investigated. An assessment will also be made of different forms of coping, to determine whether the ability to cope realistically with unpleasant circumstances is related to physiological responses during stress.

Many of these questions have been posed and partially answered in research using adult Ss. Some studies have dealt with stressful events occurring in real-life situations (Fenz & Epstein, 1967; Korchin & Ruff, 1964; Weybrew, 1963) while other, more controlled studies have been carried out in the laboratory.

Many of these investigations have generated hypotheses to account for the different ways individuals react to threatening events. Others have attempted to assess the effect of various aspects of the stressful situation itself, such as the intensity of the stress, the S's ability to anticipate it, and uncertainty about when or whether it will occur.

The Concept of Stress

It was not until World War II that the term 'stress' was introduced into the literature, although this concept has long been studied by psychologists under the heading of emotion. Investigations of the many physical and mental hardships, deprivations and threat to life that the war imposed, focussed attention on adaptive mechanisms and the extreme variability in the capacity to cope that was evident in those who were subjected to stress. It became increasingly obvious that 'stress' was not a simple concept nor was it something which could be studied from the stimulus side alone. Many factors were involved the timing of stress; the type of threat involved; and, in addition, the meaning or perception of it to the individual; the resources upon which he could call; his characteristic coping mechanisms, and the effectiveness of these mechanisms in dealing with different types of stress.

The early theoretical approach to stress leaned heavily on observations of crises occurring naturally in life: grief (Lindemann, 1944); threat of surgery (Janis, 1958); parachute training (Basowitz, Persky, Korchin & Grinker, 1955); and imprisonment in concentration camps (Bettelheim, 1960), to mention a few. Rising out of these observations there evolved an interest in the methods that individuals use to deal with both physical and psychological stress. Theories were developed which encompassed such related fields as biochemistry, sociology and psychology. For example, the biochemical model of Seyle (1956) hypothesized a three-stage process of adaptation to physical stress: alarm, or general mobilization against the stressor; resistance, or the internal responses available; and finally, exhaustion if the stressor continued for an extended time. Individual differences in vulnerability or adaptability were strongly emphasized. Similarities to Seyle's model are evident in Dohrenwend's (1961) sociological model of stress, which was applied to studies of the prevalence and distribution of mental disorders in the social environment. Here again, stress was defined as a state intervening between constraints and the consequent efforts to reduce these constraints. Janis' model (1954) similarly involves three basic elements: the traumatic situation such as threat of surgery or man-made calamities or natural disasters; the intra-psychic determinants of the responses available; and finally the various types of reaction that followed. A common factor in all of these theories appears to be the mediating influence of the individual in determining his response to threatening events.

The Interaction of Personality Variables and Reactions to Stress

Striking individual differences have been observed in the manner in which individuals react to threatening situations. Some show impaired performance while in the case of others performance may actually be improved. Terms such as "perception" (Appley, 1962) or "appraisal" (Lazarus, 1966) have been used to explain some of the individual differences which have been observed. Two areas of research which have dealt with relevant kinds of individual differences are the studies on coping and cognitive styles.

Coping style. Much of the literature on coping styles or defence mechanisms received its inspiration from the writings of Freud. The term "defence" was first used by Freud in 1894 to refer to the repression of a painful idea. He later broadened the term to include several mechanisms of defence of which repression was one (Freud, 1936). Some of these mechanisms involved greater distortion than others, the discrepancy between actual and reported perceptions reflecting the degree of pathology involved. Early psychoanalytic writings, therefore, emphasized the pathological aspects of defence mechanisms and were strongly influenced by the theory that the ego is wrought out of conflict with the id and superego. With the advent of "ego psychology," however, there was a growing recognition of the adjustive aspects of some of the defence mechanisms (Munroe, 1955; Heyns, 1958). For example, denial, which involves a blotting out of painful or frustrating events, would be considered normal in young children who have "not yet learned to bear pain" (Freud, A., 1949), since it protects them during the period when they are vulnerable. Yet, if carried over into adulthood, denial can be extremely maladaptive. Developmental studies have shown that as the child matures he becomes more able to cope with and accept frustration. Hence, denial gives way to more realistic forms of coping (Douglas, 1958).

There have been many attempts to classify coping or defensive mechanisms according to the behaviour observed or the processes involved. Haan (1963) concentrates on observed behaviour rather than assumed processes to differentiate defensive, pathological behaviour from that of coping. According to Haan, coping implies dealing with the realities of external and internal threats. It is therefore adaptive, although it may not necessarily lead to a reduction in anxiety or conflict. Conversely, defensive pathological behaviour does not deal with reality: it is more stimulus bound and involves distortions, primary process thinking and impulse gratification. In this sense it is maladaptive, although the individual may experience less anxiety or conflict than one who copes realistically. Other attempts to classify defensive behaviour have concentrated on the processes involved in coping. One mechanism which has been investigated extensively is repression, which defends the individual against internal danger by disclaiming anxiety-provoking or disturbing thoughts (Lewin, 1950). Various subscales of the Minnesota Multiphasic Personality Inventory (MMPI) (Byrne, 1961; Little & Fisher, 1958; Ullman, 1962; Welsh, 1956) have been used to measure an individual's tendency either to verbalize or repress anxiety-arousing thoughts.

A major difficulty with these scales, however, is that anxiety is in fact too global and complex a term for an operational definition. The nature of anxiety is still not fully understood. Freud's "signal theory" (1936) proposed that anxiety is overcome when an individual uses repression against disturbing thoughts or impulses. According to Freud, therefore, anxiety acts as a signal to cause repression. A different approach to the explanation of anxiety was made by Sappenfield (1954), who suggested that repression is adaptive in solving internal conflicts but in so doing may create anxiety. Thus, in this case, repression leads to anxiety. Despite this lack of agreement as to the nature of anxiety, these scales have been widely used in research. One example of this is the Repression-Sensitization Scale (R-S) (Byrne, 1961).

The approach-avoidance continuum inherent in the Repression-Sensitization Scale was strongly influenced by the post-war perceptual studies of Bruner and Postman (1947), who considered perception as a "form of adaptive behaviour," reflecting "the dominant needs, attitudes and values of the organism. For perception involves a selection by the organism of a relatively small fraction of the multiplicity of potential stimuli to which it is exposed at any moment in time" (p. 300). Tachistoscopic presentation of words, for example, revealed some Ss had faster recognition times for anxiety-provoking words than for neutral words, whereas others showed the reverse trend: recognition of anxiety-provoking words took much longer than neutral words. The notion of avoidance or sensitization to threat thus stimulated research.

In contrast to Hann's approach, the R-S Scale implies that some maladaptive behaviour occurs in both styles. Repressors are those who avoid anxiety-arousing stimuli by using repression, denial, or rationalization. Sensitizers are those who approach or control the anxiety-provoking stimuli through intellectualization or obsessive ruminative-type worrying. Depending on the criteria used or the situation involved, conflicting results have been obtained using the R-S Scale as a measure of coping style. Research has shown, for example, that in terms of self report, repressors appear to be better adjusted than sensitizers (Altrocchi, Parsons & Dickoff, 1960; Block & Thomas, 1955; Byrne, Barry & Nelson, 1963). Physiological and performance measures also showed repressors to be more involved and goal-oriented in group discussions than sensitizers (Parsons, Fulgenzi & Edelberg, 1969). In contrast, other studies have shown that although repressors may report less anxiety they are actually more vulnerable when confronted with threatening stimuli (Chodorkoff, 1954; Lomont, 1965). Lefcourt (1966) has even suggested that the "healthier" self reports of repressors may be due to their attempts to appear more normal and less emotional. In this connection, psychophysiological studies have revealed discrepancies which exist between self report measures of repression or denial and physiological indicators of stress (Weinstein, Averill, Opton & Lazarus, 1968).

In the present study a simple dichotomy will be adopted for classifying children's coping styles. It involves the extent to which a child is reality-oriented. In this respect it is similar to Hann's approach. If in the face of frustration the child is capable of dealing with reality and accepting some of the painful aspects that are involved, he will be classified as a compromiser. If on the other hand he distorts or denies reality in order to gratify his own impulses he will be classified as a denier.

Cognitive styles. Cognitive style is another dimension of personality on which characteristic differences have been revealed in the way individuals perceive or process information. Cognitive styles have been defined as "stable individual preferences in the mode of perceptual organization and conceptual categorization of the external environment" (Kagan, Moss & Sigel, 1963, p. 74). Research into this area was also stimulated by the new look in perception inspired by Bruner et al. (1947), and as with coping styles, the adaptive function of certain cognitive styles has been emphasized (Gardner, 1962; Witkin, Dyk, Faterson, Goodenough & Karp, 1962). Several cognitive styles have been isolated (Broverman, 1960, Kagan, Rosman & Phillips, 1964; Klein, 1958; Witkin et al., 1962). Two of these which have been closely linked to personality differences will be considered in the present study: field dependence-independence (Witkin et al., 1962) and reflection-impulsivity (Kagan et al., 1964).

Field dependence-independence: In tests which tap this dimension the individual is required to separate an object from compelling or confusing background forces. The Embedded Figures Test, the Rod and Frame Test, and the Tilting-Room-Tilting Chair Test (Witkin, Lewis, Hertzman, Machover, Meissner, & Wapner, 1954; Witkin et al., 1962) have all been used to assess "psychological differentiation" in adults. Karp and Konstadt (1963) developed the Children's Embedded Figures Test to measure this style in children. Field dependence-independence has been related to such personality variables as independence, preferred mechanisms of defence, conformity and impulse control (Witkin et al., 1962). According to Witkin, the field independent individual perceives the world analytically rather than globally. He does not conform easily, and in dealing with reality he relies more on intellectualization and rationalization than on denial. In contrast, the field dependent individual is reported to be more emotionally dependent, and is more likely to resort to primitive defences of denial and repression.

Some recent studies have suggested that field dependent individuals may differ from field independent individuals in the way they selectively attend to stimuli (Harrison, 1971; Hettema, 1968). Using third and sixth grade children as subjects, Harrison obtained significant correlations between analytic-nonanalytic cognitive styles and scores on a test of selective attention. The results of a series of experiments dealing with optical illusions and speed and flexibility of closure led Hettema to the conclusion that individual differences in field dependence-independence may be due to differences in stimulus selection mechanisms, or the ability to selectively filter and process visual stimuli. Finally, in a review of a series of studies involving normal and hyperactive children, Douglas (in press) investigated the relationships between measures of attention and cognitive styles. Significant correlations were found in normal and hyperactive groups of children between field dependence-independence and scores on a continuous performance test, a reaction time task and a tone discrimination task, all of which require sustained attention.

The stability of field dependence-independence from childhood to adulthood has been well documented (Witkin, Goodenough, & Karp, 1967) although there are developmental trends: as children mature they become more field independent (Campbell, 1969; Witkin, 1959) but their relative position vis-à-vis their peers tends to remain the same (Witkin et al., 1967). There are also indications that field independence in the child is positively related to the cognitive style of the mother (Witkin et al., 1962) and the father (Corah, 1965). The influence of child rearing practices has been well established (Witkin et al., 1967), but there has been no research on genetic inheritance.

Studies with adults have shown a relationship between field dependence and response to sensory deprivation (Silverman, Cohen & Shmavonian, 1959; Silverman, Cohen, Shmavonian & Kirshner, 1961), with field dependent Ss showing greater arousal than field independent Ss following two hours' sensory deprivation. Differences in response to stimulant and sedative drugs have also been found for Ss who differ on this cognitive style (Reckless, Cohen & Silverman, 1962; Cohen, Silverman & Shmavonian, 1962). Furthermore, in a stressful experimental situation involving both uncertainty and perceptual isolation, Culver, Cohen, Silverman & Shmavonian (1964) found field dependent individuals showed greater arousal than field independent Ss.

Thus differences in response to stress have been obtained between field dependent-independent adult Ss but have so far not been investigated in children. It was decided, therefore, to include this cognitive style in the study.

Reflection-impulsivity: This cognitive style is most apparent in situations where there is a high degree of uncertainty. The impulsive child is one who responds quickly without a thorough scanning of alternatives. He tends to commit more errors than the reflective child who takes time to consider all alternatives.

The test devised to tap this ability is the Matching Familiar Figures Test (MFF). Consistent negative relationships have been found on this test between speed and accuracy of response (Kagan et al., 1964). Developmental trends have been revealed with impulsivity decreasing with age (Campbell, 1969; Kagan et al., 1964), indicating an increase in the ability to inhibit responses. In addition to predicting performance on such academic tasks as reading (Kagan, 1965) and inductive reasoning (Kagan, Pearson & Welch, 1966 [a]), this test also correlates with behavioural measures: the child classified as impulsive exhibits greater motor activity and distractability, as well as less ability to sustain attention than the reflective child (Douglas, in press; Kagan et al., 1964; Sykes, Douglas, Weiss & Minde, 1971). The impulsive child also shows greater pessimism in the face of frustration (Campbell & Douglas, 1972).

Douglas (in press) has found differences between reflection-impulsivity and measures of sustained attention and impulse control. She investigated these relationships in normal and hyperactive groups of children and found the impulsive child to be deficient on continuous performance and reaction time tasks, as well as on tests measuring the ability to discriminate between loudness of tones and to plan ahead in problem-solving situations. Relationships were also found between impulsivity and responses to a story completion test reflecting the ability to cope realistically with frustrating events: the impulsive child was found to resort more frequently to denial and aggressive-type solutions than the reflective child.

Attempts to modify impulsivity by direct instruction (Kagan, Pearson & Welch, 1966 [b]) or positive reinforcement (Briggs, 1966) have resulted in longer latencies but no reduction in errors. Observation of film mediated models, however, has been reported to be more successful with respect to both latency and errors (Ridberg, Parke, & Hetherington, 1971). Furthermore, a significant improvement in performance was also found when impulsive children were trained to verbalize aloud each step in a problem-solving situation (Meichenbaum & Goodman, 1969, 1971).

Kagan has hypothesized that possible antecedents of impulsivity may be expectation of failure or very high task involvement. Constitutional predisposition has also been suggested (Kagan et al., 1964).

Consistent differences in the ability to inhibit responses have thus been found between impulsive and reflective children. In addition, differences have also been found in the way they cope with frustration. It seemed worthwhile, therefore, to investigate whether this cognitive style would have some relationship to the pattern of physiological response during a stressful frustrating situation.

Reactions to Stress

Life situations. The concept of anxiety figures prominently in much of the literature dealing with personality variables which influence reactions to threatening real-life situations. The role of anxiety in adapting to stress, however, has not been clearly defined. In some cases refusal to admit to anxiety has been interpreted as an indication of adjustment (Altrocchi et al., 1960; Block et al., 1955). Yet when measures other than verbal report are used, results have been reported which suggest the contrary (Hare, 1966). Further complications arise when the stressful situation itself is considered. Some conditions may permit the practice of avoidance or denial to the extent that it is completely effective in reducing physiological reactions to stress (Oken, 1966; Wolff, Friedman, Hofer & Mason, 1964), whereas in other situations it may be impossible to use any form of denial (Basowitz et al., 1955).

One approach has been to regard reasonable levels of anxiety as an adaptive, motivating force. The theory proposed by Janis (1958) is based on "emotional drive" theory (Miller & Dollard, 1941; Mowrer, 1956) and suggests that in some threatening situations, such as when an individual must prepare himself for surgery, fear causes adaptive behaviour. A curvilinear relationship predicts that moderate levels of fear will promote the "work of worry" and hence facilitate recovery (Janis, 1958). An emphasis has been placed on "rehearsal" as a means by which the individual practices mastering the stress. Bond (1952) also mentions the repetitive conversations of war-time pilots concerning the hazards of the day and the fact that mastery through repetition lay at the core of the "toughening process." Supporting this also are the findings of Egbert, Battit, Welch & Bartlett (1964) who found that patients recovered earlier when they had been individually instructed by their anaesthetist, and when there had been a long-standing process of rapport-building. In Janis' model, individual differences in the ability to do the "work of worry" are recognized. Those experiencing high levels of fear would adapt poorly, as would those who experience abnormally low levels through the use of denial.

Attempts to apply Janis' theory have not met with much success (e.g., Wolfer & Davis, 1970). Instead, it has been suggested that speed of recovery is effected by the perception of threat, and the belief that one has some control over the situation (Johnson, Leventhal & Dabbs, 1971). Control in this latter study was measured by Rotter's (1966) scale of internal-external control of reinforcements, on which a score reflecting internal control indicates the belief that one's own actions or efforts determine one's fate. Related to this is a study by Geer, Davison and Gatchel (1970) which showed that when Ss believed they could control the duration or intensity of shock it resulted in decreased skin conductance measures. This was true even in the case where the belief was incorrect. Similarly, in a study in which noise was used as the noxious stimulus, it was found that adverse post-adaptive effects as measured by tolerance for frustration were substantially reduced if the subject believed he had control over the termination of the noise (Glass, Singer & Friedman, 1969).

A conclusion to be drawn from many of these studies is that response to stress is strongly influenced by the individual's perception or interpretation of the situation. In this connection, several investigators have found that physiological reactions to threatening situations can be reduced if an interpretation is given which harmonizes with the S's coping style (Lazarus et al., 1964; Piorkowski, 1967; Speisman, Lazarus, Mordkoff & Davison, 1964). Andrew (1970) adopted this approach in her study of patients undergoing surgery. She hypothesized that patients whose preferred coping style was intellectualization, or vigilance toward stressful stimuli, should benefit from information concerning their impending surgery, and should recover faster than those whose preferred coping style was that of avoidance. On the basis of responses to a story completion test, patients were rated as sensitizers, avoiders or neutrals. All three coping style groups were given passages to learn containing information about the impending surgery. The results did not support the prediction that sensitizers would benefit from this stress reduction method; only the middle group, or neutrals, showed a speedier recovery. In Andrew's study a story completion test had been used to assess "sensitizers" and "avoiders." The criteria involved resulted in a division similar to that of the empirically-derived Repression-Sensitization scale. Using the latter, some studies have suggested a curvilinear relationship, with repressors and sensitizers both showing less adaptation to stress than those scoring in the middle (Ullman & McReynolds, 1963; Byrne, Golightly & Sheffield, 1965).

Although the method used by Andrew played into the patient's coping style, it was not effective in reducing stress resulting from surgery. In contrast, in a study using dental patients, the reading of orientation passages which emphasized beneficial as opposed to disturbing aspects of dental surgery did result in lower levels of physiological and subjective measures of stress (Mead, 1970). Furthermore, those scoring high on the Denial scale of the MMPI indicated less overall stress while anticipating treatment than those scoring low.

In summary, studies involving the interaction of coping styles and reactions to life threat have thus far led to conflicting results. It would seem that the conditions imposed and the types of illness involved have been too diverse to make legitimate comparisons. A situation which offers greater amenability for controlled study is parachute jumping, which has been studied by a number of researchers using different approaches (Basowitz et al., 1955; Fenz et al., 1967; Epstein & Fenz, 1962, 1965; Walk, 1956).

Walk relied on a self-rating scale to assess the trainee's reaction to the jump. He found that the degree of fear experienced or admitted to was in proportion to the estimate of danger involved and the level of confidence expressed by the trainee. In a recent series of studies on sport parachute jumping (Epstein et al., 1962, 1965; Fenz et al., 1967), standardized procedures for assessing anxiety and coping were used. In addition, heart rate and skin conductance measures were monitored telemetrically on the day of the jump as well as several weeks before and after. While experienced parachutists appeared capable of exerting control over their emotions, novice parachutists were sometimes overwhelmed by fear. Yet their perseverance in mastering this sport suggested that the value they placed on it outweighed the advantages of a comfortable withdrawal. The resolution of this conflict was the focus of the studies of Epstein and his colleagues. The importance of these studies lies in the insight they give into some of the mechanisms involved in overcoming conflict in stressful situations.

One of the earlier findings regarding novice parachutists involved comparison of physiological response measures and verbal measures of approach-avoidance (Epstein et al., 1962). While physiological measures reflected increasing arousal, self report showed a parallel increase in focus of attention to cues related to parachuting. The content of the modified Thematic Apperception Test responses, however, revealed that this "approach" was of a defensive nature. Denial of fear to pictures of high relevance was accompanied by an increase in fear to pictures unrelated to parachuting: the source of fear was denied but not the fear itself. Thus in mastering the anxiety involved there was sensitization to cues associated with parachuting but denial of cues associated with fear of it.

Analyzing physiological measures, Fenz (1964) revealed some of the mechanisms which may have been involved in this inhibition of anxiety and denial of fear. For example, in the case of experienced parachutists, skin conductance was much higher on days prior to the jump than it was on the day of the jump: as the time of the jump approached, conductance decreased monotonically. Since this did not occur with novice parachutists it was hypothesized that this decreasing gradient reflected the active inhibition being practiced by the experienced jumpers. Moreover, on the day of a jump, when emotionally-laden words such as "fatality" and "injury" were presented to experienced parachutists, they gave rise to sudden increases in skin conductance measures. Cognitive performance also declined, as reflected in the misperception of neutral words following these words of high relevance.

It will be remembered that verbal measures had indicated denial of fear related to parachute jumping. It appears, therefore, that when the men were forced to recognize the fear inherent in jumping, by being presented with words such as "fatality" or "injury," denial was no longer effective. Hence physiological as well as performance measures reflected increasing arousal and disorganization. The inference is that denial can be effective in reducing both physiological and verbal measures of anxiety as long as it is not challenged. Successful coping thus reduces physiological stress reactions. Similar findings derived from studies using vicarious threat are discussed below.

Vicarious threat. In one of the earliest experiments involving the use of film to present threatening stimuli, it was noted that scenes depicting crude surgical operations created significant stress reactions. This was reflected in elevated heart rate and skin conductance measures, as well as verbal reports of disturbed affect (Lazarus, Speisman, Mordkoff & Davison, 1962). The greatest stress reactions were obtained during the most harmful scenes. Consequently, Lazarus and his colleagues hypothesized that if attention could be diverted from the harmful events depicted in the film, physiological reactions to the stress should be reduced. Similarly, it was reasoned that if beliefs about the harm produced in the film could be changed, stress reactions should be altered.

Experiments were then conducted using this same film with the aim of manipulating the "appraisal" of threat (Speisman, Lazarus, Mordkoff & Davison, 1964; Lazarus & Alfert, 1964). Different interpretations were attributed to the surgical operations by preparing three separate sound tracks. One of these emphasized the harmful features and was called "trauma." Another presented a more detached attitude, similar to the unemotional descriptions of anthropologists, and was entitled intellectualization. The third was entitled denial since the more pleasant aspects were accentuated and the unpleasant aspects not mentioned. A silent version served as a control. It was found that both the denial and intellectualization versions of the film produced significantly lower physiological stress reactions than the silent version. Moreover, the defence-oriented versions were more successful when they corresponded to the individual's characteristic coping style. For instance, if paper and pencil tests had indicated that an individual had a propensity for denial in confronting anxiety, then the denial-oriented interpretation was more successful in alleviating stress reactions. A further finding led Lazarus to experiment with what he termed "short-circuiting" of threat: when film commentaries preceded the film there was a greater reduction in disturbance than when they accompannied the film.

Similar effects were obtained using other traumatic films (Lazarus, Opton, Nomikos & Rankin, 1965; Nomikos, Opton, Averill & Lazarus, 1968). In these studies the variable of anticipation was also introduced. Using flashback techniques it was possible to study how the individual reacted to the anticipation of harm which he knew was inevitable. Increases in skin conductance and heart rate measures were found to correspond to the periods of anticipation. The accident itself produced some further increase, but the greatest increase in physiological measures occurred prior to the anticipated accidents.

The films have also been used in cross cultural studies. When Japanese Ss were studied an interesting factor to emerge was the remarkable discrepancy between physiological and verbal report measures during the rest period preceding the film, and prior to any administration of threat (Lazarus, Tomita, Opton & Kodoma, 1966). Physiological measures revealed a much higher degree of arousal than was reflected in self report measures. In explanation of this, two factors were considered: one involved the experimental setting itself; the other involved the supposed compliance of the Japanese to respond in a way which they felt was expected of them. It was hypothesized that the Japanese were unusually sensitive to the experimental situation. Studies of their national character have shown that they tend to be threatened by being observed (Benedict, 1946). Hence physiological measures were thought to reflect this apprehension prior to the viewing of the film. Since verbal report did not reflect this anxiety, however, it was reasoned that they were responding in a way which appeared to them to be appropriate. Discrepancies between physiological and behavioural measures have also been reported by other investigators (Block, 1957;

Jones, 1950), who have hypothesized that these discrepancies reflect different ways of coping with the environment. It will be recalled that research dealing with the anxiety of parachute jumping also revealed discrepancies between physiological and self report measures, which provided insight into some of the processes involved in defensive strategies.

In a reanalysis of several studies using the vicarious threat films cited above, Weinstein et al. (1968) studied this problem of response discrepancy. Defensive style was assessed by means of various scales of the MMPI and discrepancy scores were computed between self report and physiological measures of stress. The greatest discrepancies were found for repressors, who revealed much greater autonomic than self report reaction to stress. Sensitizers, on the other hand, characteristically reported more anxiety than that indicated by physiological measures. However, although there were greater discrepancies between physiological and self report measures for repressors, in five out of the six experiments analyzed by Weinstein et al., they did not find higher levels of skin conductance for repressors than for sensitizers: in coping with threat the two types of defence were apparently equally effective in controlling autonomic reactions to the vicarious threat film.

This problem of response discrepancy between physiological and self report data is further complicated if one considers that factors other than defensive style may be involved, such as, for example, individual differences in perception of visceral sensations (Mandler, Mandler, Kremen & Sholiton, 1961; Schacther, 1966) or social desirability (Bergs & Martin, 1961). Nevertheless, it should be underscored that while self report appears to tap defensive style, it may not necessarily reflect the individual's physiological reactions to stress. Hence it is not surprising that correlations between psychological and physiological measures are not obtained in studies which use post-experimental subjective reports.

Personality variables other than defensive style have also been used to assess individual differences in response to films depicting vicarious threat. Roessler & Collins (1970) investigated the physiological responses of high and low Ego Strength Ss (Barron, 1956) to a bland and a stressor film. Since previous findings had shown high Ego Strength Ss to be more physiologically responsive to simple stimuli (Roessler, Alexander & Greenfield, 1963; Roessler, Burch & Childers, 1966), it had been hypothesized that they would similarly be more responsive than low Ego Strength Ss to the stressor film. Skin conductance and heart rate were used as measures of physiological reactivity. Differences were found in the hypothesized direction for skin conductance only. One of the conclusions drawn was that high Ego Strength Ss appeared to be more responsive to the environmental stimuli, whereas low Ego Strength Ss, who showed less physiological responsivity, may have been employing more pervasive and indiscriminate forms of perceptual defence. The measure of skin conductance used in this study was the mean of ten one-second values taken throughout the film. It is questionable whether this measure of tonic skin conductance provides sufficient evidence on which to base conclusions regarding processes of "perceptual defence."

Contrived stress in the laboratory. In the controlled setting of the laboratory, efforts to find connections between personality and response to stress have been numerous. Some of these have used trait measures such as denial (Houston, 1971 [b]) ego strength (Roessler et al., 1966) anxiety (Hodges & Spielberger, 1966) and measures of internal-external control (Phares, Ritchie & Davis, 1968). Others have included operationally-defined measures of coping (Houston & Hodges, 1970), personality inventories (Opton & Lazarus, 1967), Rorschach indices of emotionality (Lacey, Bateman & Van Lehn, 1952) and ratings based on self report (Folkins, 1970). Some of the most frequently imposed forms of psychological stress have been ego threat (Efran, 1963; Hodges, 1968; Lipp, Kolstoe & Randall, 1967; Phares, 1968; Spence & Spence, 1966; Spielberger, 1962; Spielberger & Smith, 1966; Zuckerman, 1960), cognitive-type tasks (Hodges et al., 1969; Houston, 1971 [b]; Houston et al., 1970; Sarason & Mandler, 1952) and shock-threat (Deane, 1961; Folkins, 1970; Geer et al., 1970; Hodges et al., 1966; Houston et al., 1970; Schacther, 1957).

Perhaps the personality construct which has generated the most confusion in stress research is that of anxiety. Consequently, hypotheses concerning its multidimensional nature have been proposed. Some investigators have suggested "fear of failure" as one of the components of anxiety (Atkinson, 1964; Rotter, 1954; Spielberger, 1966). Supporting this are studies demonstrating the detrimental effect of anxiety on academic performance (Alpert & Haber, 1960; Sarason, 1957). Distinctions have also been made between transitory or state anxiety and anxiety as a permanent personality trait (Cattell & Scheier, 1961; Spielberger, 1966). In developing the trait-state anxiety scale (1966) Spielberger conceived state anxiety to be characterized by subjective feelings of apprehension and increased autonomic nervous system arousal. Trait anxiety, on the other hand, involved differences in anxiety proneness or the disposition to react with state anxiety in stressful situations. Thus trait anxiety may correspond to Lazarus' (1966) description of individuals who are likely to "appraise" situations as threatening.

Use of Spielberger's scale has revealed that the shock threat type of experiment does not have a differential effect on Ss rated high or low in trait anxiety: both groups show increased physiological reactions to shock threat (Hodges et al., 1966). Ego threat, in contrast, affects these Ss differently. Only high trait anxiety Ss appear to react with increased anxiety and greater performance deficit when confronted with stress of this nature (Hodges, 1968; Spence et al., 1966; Spielberger et al., 1966). For Ss differing in trait anxiety, therefore, the type of stress must be taken into account when hypotheses are made concerning reactions to stress.

One personality trait which has been related to differences in reactions to shock threat is fear of pain (Hodges et al., 1967; Pearson & Thackray, 1970; Thackray & Pearson, 1968). In these studies the S's attitude toward receiving shock was assessed by means of a questionnaire administered prior to the experiment. When Ss were threatened with shock, significant differences in heart rate (Hodges et al., 1966) as well as effects on perceptual motor performance (Thackray et al., 1968) were found between Ss classified as having high or low fear of shock (although shock was never given). Under the shock threat condition Ss with high fear of shock exhibited greater increases in heart rate, as well as greater impairment in performance on a perceptual motor task, than those with low fear of shock. These performance and physiological differences were later confirmed in a study by Pearson et al (1970) where cognitive interference as well as perceptual motor performance were studied under shock threat conditions.

Mention has previously been made of Rotter's scale (1966) measuring internal versus external control, or the extent to which one believes one can control environmental reinforcements. "Internals" are those who feel they are effective agents in determining or controlling rewards, whereas "Externals" believe fate, chance, or forces beyond their control are responsible. Rotter's scale has been used in stress research by investigators who have hypothesized that this type of belief may also reflect confidence in the ability to cope with threatening situations.

Several studies had indicated that under non-threatening conditions "Internals" were more likely than "Externals" to confront a problem directly. "Internals" were also more likely to seek information relevant to problem solving (Phares, 1968), showed better retention of information (Seeman & Evans, 1962) and were more likely to take overt action to effect social change (Gore & Rotter, 1963). Under threatening conditions, however, opposite results have been obtained. In a situation where Ss were required to recall negative information about their own personality, Phares et al. (1968) found "Externals" to have significantly greater recall than "Internals." It appears, therefore, that "Internals" may be more vulnerable to personally-relevant threats. Two investigations support this hypothesis: Efran (1963) found "Internals" much more likely to forget failures than "Externals," and Lipp et al. (1967) discovered higher tachistoscopic thresholds for physically-handicapped "Internals" when they were presented with pictures of other physically-handicapped individuals. It would seem, therefore, that "Internals" are more likely to resort to denial when faced with ego-involving threat.

In summary, those studies involving measures of anxiety, fear of shock and internal-external control suggest that personality traits are related to stress reactions only when the trait being measured has some relationship to the type of stress imposed.

The relationship of coping mechanisms to reactions to laboratory-induced stress is somewhat confused. When questionnaire measures of defensiveness have been employed those categorized as deniers have shown deterioration in performance on stressful cognitive-type tasks (Ruebush, Byrum & Farnham, 1963; Hill & Sarason, 1966). Similarly, in a situation involving threatening sexual words, Repressors performed less well than Sensitizers on a concept attainment task (Petzel, 1970). These studies have all used trait definitions of denial which measure a general disposition to deny the presence of threat.

An alternative approach to measuring defensiveness involves a comparison of physiological and self report measures. Those who report less discomfort but evidence greater physiological arousal would be called "situational deniers," whereas those who show less physiological arousal but report greater discomfort would be called "accentuators." Using this operational definition several studies have in fact found deniers to be at an advantage in threatening situations. Houston & Hodges (1970) found the performance of "situational deniers" superior to that of "accentuators" when the Ss were required to perform a digits-backward task under ego and shock threat conditions. They report that "accentuators" seemed to be "particularly vulnerable to adverse effects of stress" (p. 726). A later study by Houston (1971 [b]) adds to the confusion. His study investigated two types of deniers: "situational deniers"; and "trait deniers" categorized according to responses on the Little and Fisher Denial scale (1958). Confirming his previous findings, Houston found "situational deniers" to perform better under ego threat conditions than "accentuators." Contrary to the findings of other investigators, however, when compared to nondeniers "trait deniers" showed better performance under stress than in the absence of it.

A more comprehensive approach to measuring coping style in response to shock threat was adopted by Folkins (1970). He used Haan's (1969) tripartate model of ego functioning, which involves the mechanisms of coping, defense and ego failure. Self report data corresponding to different intervals during the anticipation period were rated according to this model. Correlations were then computed between S's coping style and five measures of stress reaction. Two of these involved peak heart rate and skin conductance measures, and the remaining three were self report measures of tension and anxiety. Only one significant correlation was obtained: there was a negative relationship between the self report measures of tension and defence.

In summary, measures of defence or coping style have not shown consistent relationships with performance under contrived stressful situations. Much of the confusion appears to stem from the multiplicity of measures used to tap coping styles, as well as the variety of tasks and stressors administered.

Central to many of the studies reported above has been the element of anticipation or uncertainty regarding the distressing or harmful event. Several investigators have studied the importance of these variables and have used physiological measures as indices of psychological states. Prior to a discussion of these investigations a brief outline of some of the theories concerning patterns of physiological response to stress will be made.

Physiological Response Patterns

Two concepts which have been used frequently in recent years are the orienting response (OR) and the defensive reflex (DR). According to Sokolov (1963) the OR occurs in response to novelty or stimulus change, whereas the DR occurs to intense or noxious stimuli. While the function of the OR is to heighten perceptual sensitivity and hence increase the intake and processing of information, the DR decreases perceptual sensitivity and thereby limits the impact of the stimulus.

Traditionally the cephalic vasomotor response has been used to distinguish the OR from the DR: the OR is accompanied by vasodilation and the DR by vasoconstriction of the skin of the forehead (Sokolov, 1963). Recently, however, this distinction has been challenged by Raskin, Kotses & Bever (1969 [a]) who found that cephalic vasomotor responses do not differentiate between OR's and DR's.

The skin conductance OR is reflected in an increase in amplitude occurring within a few seconds of stimulus onset. When a stimulus of moderate intensity is presented a number of times an adaptive reaction occurs which is reflected in decreased amplitude, or "habituation." In the case of intense stimuli a DR occurs and is also reflected in increased amplitude of response. To quote Lynn (1966, p. 6): "Typically the orientation reaction occurs first and is replaced after a number of trials by an adaptive reaction in the case of weak and moderate stimuli and a defensive reaction in the case of intense stimuli. One of the striking differences between orientation reactions and adaptive and defensive reactions is that only the orientation reaction is subject to quick habituation."

With respect to the heart rate OR there has been some confusion as to its form. Some investigators have concluded that short latency heart rate deceleration is obtained in response to simple stimuli of weak intensity, and heart rate acceleration to moderate and intense stimuli (Raskin et al., 1969 [a]; 1969 [b]). In a comprehensive review of the literature dealing with the heart rate OR, Graham and Clifton (1966) concluded that the criteria for an orienting reflex were satisfied by heart rate deceleration, and that instances of heart rate acceleration probably reflected a "defence" or "startle" response. Smith and Strawbridge (1969) similarly suggest heart rate deceleration may be a component of the orienting response, but in their view heart rate acceleration is not an orienting, defensive or adaptive response but is largely secondary to respiratory changes.

Cardiac deceleration has also been associated with attention to external stimuli. Several investigators have found cardiac deceleration to reflect perceptual attention in infants (Kagan & Lewis, 1965; Lewis, Kagan, Campbell & Kalafat, 1966; Meyers & Cantor, 1967) and in adults (Graham et al., 1966; Lacey, Kagan, Lacey & Moss, 1963; Jennings, Averill, Opton & Lazarus, 1970). When the task involves verbalization, however, this distinction may no longer apply: in this case the decelerative pattern may be changed to one of acceleration (Campos & Johnson, 1966, 1967;

Johnson & Campos, 1967; Edwards & Alsip, 1969). Two competing theories have been offered to explain the functional significance of cardiac deceleration during attention. The hypothesis of Lacey (1967; Lacey et al., 1958) suggests that cardiac deceleration reduces afferent impulses from the baroreceptors to bulbar centres which otherwise exert an inhibitory influence on higher cortical mechanisms. Thus cardiac deceleration facilitates "intake" or sensory-motor integration. The alternative hypothesis proposed by Obrist, Webb, Sutterer & Howard (1970) suggests instead that cardiac deceleration is perhaps only one aspect of a general cessation of somatic activity accompanying attention-like states. Thus according to them deceleration results from attention rather than facilitating it.

Several investigators have discovered triphasic and diphasic accelerative-decelerative patterns to be associated with attention to, or anticipation of stimuli. Goyeche (1971), for example, found that when a signal preceded a stimulus by ten seconds, beat-by-beat heart rate showed a triphasic pattern: a slight deceleration, followed by acceleration and deceleration. When a fifteen-second interval between signal and stimulus was used, the anticipatory cardiac response revealed only a diphasic pattern: acceleration followed by deceleration.

A quotation from Lynn (1966, p. 10) may serve to emphasize the complexity of this field: "...the presentation of pictures to human subjects elicits a variety of perplexing reactions. Pictures of nude females presented to male college students elicit vasoconstriction in both fingers and head, together with deceleration of heart rate: in the Russian system this would be classified as a defensive reaction, which would hardly seem appropriate to the stimulus. A picture of a starving man, on the other hand, elicits a qualitatively different reaction, including acceleration in heart rate. Female students react differently again. These are only examples of the many different patterns of autonomic reaction which can be obtained with different types of stimuli. Nevertheless the trichotomy of the Russian workers of adaptive, orientation and startle-defensive reactions may be useful as an initial classification."

Critical Variables in Stress Situations

Intensity of the Stimulus

In one of the rare investigations dealing with the presentation of stressful stimuli to children, Osborn and Endsley (1971) studied galvanic skin responses to film episodes depicting violence. Human and cartoon versions of violence and non-violence were used. Results indicated greater increases in skin conductance during both human and cartoon versions of violence with the greatest increases occurring in response to the human version. Personality variables such as coping or defence styles were not measured. When Dysinger and Ruckmick (1933) studied the effects of film situations depicting conflict and danger among human characters, they found that young children reacted with greater skin conductance response than adolescents or adults. In contrast, Sternbach (1962) failed to find any changes in conductance in response to the more frightening scenes in the film "Bambi," which featured a young deer as the main cartoon character.

Thus it seems that more realistic films have a greater impact: the closer the film characters approached reality the greater was the (emotional) physiological impact. A further inference may also be drawn from the study of Dysinger et al. Their findings suggest a developmental trend in the ability to cope: given the same stimulus situation, age appeared to lessen the emotional impact.

In addition to vicarious threat films, slides have also been used with adult Ss. Hare, Wood, Britain & Shadman (1970) investigated heart rate and skin conductance response to slides of varying degrees of affective intensity: neutral objects, nude females and homicide victims. Half the Ss saw the same slide 30 times, while the other half saw a different slide of the same series on each trial. Since the homicide scenes were considered extremely gruesome it might have been expected that viewing them would result in some form of defensive response, or "rejection of the environment" (Lacey, 1967). Heart rate, however, showed marked deceleration for Ss shown different homicide slides on each trial. For Ss who were repeatedly shown the same homicide slide, decelerative responses were relatively small. Furthermore, heart rate deceleration and number of non-specific fluctuations in skin conductance were greater for Ss shown a different slide on each trial. Magnitude of skin conductance response to each trial was also computed for each ten-second period of slide presentation. Habituation of this measure was more rapid for Ss shown the same slide, whereas Ss who were shown a different homicide slide on each trial showed no habituation at all over trials. The interpretation given by these investigators was that the physiological responses were similar to those generally associated with the orienting response: increase in skin conductance and cardiac deceleration.

Since heart rate deceleration has also been shown to reflect "attention" it is noteworthy that there was continued vigilance to the series of different homicide scenes. This group also showed the greatest skin conductance response with respect to magnitude and nonspecific fluctuations, both of which may be said to measure the degree of "emotional response."

In summary, studies using a variety of stimuli have shown that intense or novel stimuli increase physiological measures of arousal. Some of the studies also indicate beat-by-beat deceleration or "environmental intake" for stimuli rated as complex, novel or even "gruesome."

Anticipation of Stressful Stimuli

The investigations of Lazarus et al. (1965) and Nomikos et al. (1968) have already underscored the effect of anticipation on physiological responses: in the case of both heart rate and skin conductance, response prior to the harmful event was greater than to the event itself. The importance of anticipation was also demonstrated in an experiment involving hypnotized Ss, where it was found that anticipation of a pin prick alone was sufficient to produce increased galvanic skin response (Barber & Coules, 1959).

It might be expected that the time one has to prepare for a threatening event would have an effect on physiological stress reactions. Some researchers have investigated different periods of anticipation in an attempt to answer this question, but have obtained conflicting results. Nomikos et al. (1968) using a threatening film and Breznitz (1967) using electric shock as the anticipated harm both found that relatively longer anticipation times were related to greater physiological reactions. Similarly, when Ss were given an opportunity to choose between zero, 2, 4, 6 or 8 seconds' delay in an experiment involving inevitable shock, they predominantly chose minimal delays (Cook & Barnes, 1964). In contrast, Freedman (1965) reported sudden shock was more stressful than anticipating shock over a period of ten minutes, but Gerard & Fleisher (1965) in a comparable experiment obtained opposite results. It may be that the confounding results of Freedman and Gerard et al. were due to the self report measures of arousal which were used in their experiments.

In a delayed conditioning paradigm using intervals of from four to twelve seconds between unconditioned (tone) and conditioned (shock) stimuli, Dronsejko (1972) found that changes in temporal relationships modified the form of the cardiac response. Significant heart rate acceleration occurred for the four-second interval but as the time increased to twelve seconds the accelerative pattern consistently reached its peak within five seconds after the onset of the warning (tone) signal. Heart rate deceleration occurred for periods longer than six seconds and appeared to be a direct function of the time interval between unconditioned and conditioned stimuli. In interpreting these results Dronsejko maintained that the accelerative component was a "defensive" response, since it was elicited in each case by the warning signal regardless of the time interval. Moreover, it was suggested that heart rate deceleration was a "homeostatic phenomenon of 'vagal rebound' (Sternbach, 1966)," and that it could therefore be "regarded as reflecting a highly effective mechanism for coping with a stressor" (p. 11). In a series of three studies Deane (1969) came to essentially the same conclusions with regard to heart rate acceleration but not with respect to deceleration. In these experiments time intervals were manipulated by presenting a sequence of numbers on a memory drum. Ss were warned that they would receive an aversive stimulus when a certain number appeared. Commenting on the results, Deane suggested that heart rate "acceleration may be a component of an anxiety response" but that the decelerative response apparently occurs in anticipation of any stimulus regardless of whether or not it is aversive.

There have also been several studies involving real-life situations. Janis (1958) in his study of surgical patients maintained that extended periods of time could be used to evolve methods of coping, with concomitant reduction in reactions to the anticipated harmful event. He arrived at the same conclusions from his research on the effects of bombing in Britain (1951). Analogous findings are reported by Epstein et al. (1965), who established that experienced parachutists showed a decline in physiological reactions as the time for the jump approached.

The investigations of Janis (1951, 1958) and Epstein et al. (1965) involved time periods which covered days, weeks, or months, whereas the investigations of Nomikos et al. (1968), Breznitz (1967), Cook et al. (1964) and Dronsejko (1972) involved only seconds or minutes. Comparison of these studies, therefore, is made more difficult by the variety of stress situations and time intervals involved.

Finally, one study attempted to assess physiological reactions and coping styles during varying periods of anticipation. Inspired by the studies of Lazarus (1966, 1968) and Averill et al. (1969), which had emphasized reappraisal as a form of coping, Folkins hypothesized that longer time intervals would permit the individual "to seek out reassuring situational cues and to engage in cognitive defensive strategies" (p. 173). Threat of shock was used as the stressful stimulus. Ss were divided into groups according to the time interval between warning and anticipated shock, which varied from five seconds to twenty minutes. Only one trial was given, and although the threat involved shock, it was never administered. Post-experimental interviews concerning thoughts during the various anticipation intervals provided the data for the rating of coping. Three categories were developed: coping, defence, and ego failure. Interestingly, the results indicated a curvilinear or quadratic relationship between anticipation intervals and physiological stress reactions: a rise in degree of stress response was found for periods of up to one minute, but as the period increased further, a drop in stress reactions was found for the three and five-minute intervals, followed by a slight increase at the twenty-minute interval. Furthermore, coping was found to be related to physiological stress reactions: effective coping occurred most frequently during periods when the lowest physiological stress reactions were observed, whereas ego failure predominated at the 30-second and 1-minute intervals when the greatest stress reactions were recorded. As mentioned previously, when Folkins attempted to correlate individual coping styles with stress reactions he did not find any relationship.

Folkins interpreted his results as indicating that thoughts involving a reappraisal of the situation, which were made possible by the anticipation intervals, were instrumental in altering stress reactions. For example, there was probably little opportunity for the five-second group to comprehend fully the threat involved. Hence physiological stress reactions were less at that time than at one minute when there was ample time to understand the significance of the harm but not sufficient time to "generate effective ways of coping with it" (p. 182).

Taken together, the above studies indicate that anticipation time to a harmful event does play an important part in determining the degree of stress reaction. It would seem, however, that optimum time for reappraisal may vary according to the threat imposed.

Uncertainty of Stressful Stimuli

It has been suggested that fear of the unknown leads to anxiety. The sudden fear reaction of the chimpanzee to the sight of the trainer in unexpected and unfamiliar clothing has often been quoted as an example of how unfamiliarity may lead to aroused or fear-like states (Hebb, 1946). Studies have shown how ambiguous situations produce more frustration than structured ones (Cohen, Stotland & Wolfe, 1955) and how the need for certainty increases following stressful conditions (Brim & Hoff, 1957). Furthermore, high and low anxiety Ss, as rated by the Taylor Manifest Anxiety Scale (1953), have been shown to react differently to uncertainty (Shimkunas, 1970): when expectation of performance was measured, conditions of uncertainty did not alter the expectancies of low anxiety Ss, whereas those of high anxiety Ss were markedly lowered.

These and many other studies reviewed by Berlyne (1960) suggest a positive relationship between uncertainty and levels of arousal as reflected in frustration, fear, or anxiety. The following review of some of the recent research using physiological indices of arousal tends to support this contention. In addition, an interesting facet is introduced: some of these physiological studies suggest there may be heightened attention or vigilance for uncertainty-removing cues during stressful conditions of uncertainty.

In several studies in which a conditioning paradigm was used and the timing of shock was sometimes uncertain, heart rate was found to be higher in anticipation of an uncertain shock than in anticipation of shock which was certain (Deane, 1966; Elliott, 1966; Lovibond, 1968). The use of skin conductance measures has led to similar conclusions. In another conditioning paradigm using shock, Bowers (1971 [b]) found that number of galvanic skin responses reflected greater autonomic activity during uncertain stressful conditions.

Frequent use has been made of an experimental paradigm which uses a count-up to the presentation of a noxious stimulus (Deane, 1969). A sequence of numbers is presented on a drum, and the S is warned that he may receive shock when a certain number occurs. In a review of studies using this paradigm (Zeaman & Smith, 1965), it was reported that Ss who had received fairly high intensity shocks exhibited decreases in heart rate on later trials when shock was expected but not received. In contrast, Ss who had not received shock but were told to expect it did not show the same decrease in heart rate.

Using this same experimental paradigm Epstein & Roupenian (1970) divided Ss into three "expectancy of shock" groups: 5%, 50% and 95%. In the 5% group, for example, Ss were told that on 5% of the trials when a certain number occurred, they would receive shock. An original hypothesis had been that the 50% group would exhibit the greatest physiological arousal, due to the combined effects of fear and maximum uncertainty. However, it was the 5% group which exhibited the earliest and greatest arousal in anticipation of the noxious stimulus. This was reflected in increased magnitude of skin conductance response to each of the numbers in the count-up sequence. When heart rate measures were compared, both the 5% and the 50% expectancy groups showed greater heart rate levels than the 95% group over the whole session. One of the conclusions of this study was that "a high level of expectancy regarding the nature of a threatening event and the likelihood of its occurrence is associated with reduced anticipatory arousal" (p. 26).

Lovibond (1969) investigated the effect of uncertainty on habituation of the OR response. Once again a conditioning paradigm was involved, although noxious stimuli were not used. Using light as the unconditioned stimulus and a 70 decibal auditory stimulus as the conditioned stimulus, the rate of change of skin conductance was studied as a function of 10, 20, 50, 80, 90, or 100% reinforcement. Rate of habituation was found to be inversely related to the uncertainty of the stimulus. Lovibond interpreted these results in terms of information processing: when a stimulus is certain and expected there is less information to be processed and hence habituation occurs more quickly than in the case of uncertainty.

Several other experiments involving primarily beat-by-beat heart rate measures emphasize the attentional demands involved under conditions of uncertainty. Wilson & Duerfeldt (1967), using shock as the unconditioned stimulus, demonstrated that as the difference between reinforced and unreinforced conditioned stimuli became less discriminable, heart rate deceleration became more pronounced. When they became identical, heart rate deceleration was most apparent. They hypothesized, therefore, that this deceleration was a function of increased vigilance for slight, even nonexistent differences between the conditioned stimuli. Similar findings were obtained by Bowers (1971) who again suggested vigilance for uncertainty-removing cues during uncertain unconditioned stimuli trials.

In an experiment by Jennings et al. (1970) the influence of noxiousness, perceptual versus motor task requirements, and uncertainty were investigated. One of the major conclusions to be drawn from their results was that although all of these variables may have an influence on anticipatory cardiac deceleration, a more important variable controlling cardiac changes appeared to be attention, which they defined as "the degree to which the organism is focussing on one event to the exclusion of others" (p. 208).

In summary these studies suggest that the greater the uncertainty the greater the arousal as reflected in overall heart rate and skin conductance measures. In addition, physiological measures also indicate vigilance or attention to cues which may lead to a reduction in uncertainty.

The foregoing studies suggest a possible hypothesis to explain the findings. Perhaps when a threatening event is certain to occur, certain individuals may resort to cognitive strategies or defence mechanisms to reduce threat. On the other hand, where the situation is uncertain no adaptive instrumental behaviour is readily available. This situation would be expected to lead to increasing arousal and heightened attention for cues to reduce this state of conflict.

AIMS OF THE STUDY

Studies dealing with life situations and experimental conditions manipulating stress have involved a variety of criteria for evaluating the effects of stress. This lack of uniformity has led in many cases to conflicting results. The aims of the present study are directed at clarifying some of these issues. They involve:

1. A comparison of two different stressful conditions.
2. An investigation of the significance of a variety of skin conductance and heart rate response measures.
3. An assessment of the relationship between an individual's typical coping and cognitive styles and his psychophysiological response to stress.

1. Two types of stressful conditions which have been used frequently with adults are vicarious threat, presented in film form, and threat of shock. The effects of these two forms of stress on children are investigated in the present study. To maintain as much similarity between the two stressful conditions as possible, the same children serve as Ss in both conditions. Furthermore, films are used to present both threatening stimuli. In the vicarious threat condition the sight of a hammer hitting the finger of the

main character in the film constitutes the vicarious confrontation with harm. In the shock threat condition a signal occurring during a relatively bland film serves as the cue for potential shock: before presentation of this film the child is warned that on one of the trials he will receive a shock when this signal occurs. There has been no explicit distinction between these two forms of stress to date. An implicit assumption seems to be that they are similar: to quote Lazarus (1966, p. 51), "There is evidently a great deal in common in the psychodynamics of vicarious and direct threats." Yet there is evidence that there are essential differences. Using vicarious threat, Lazarus et al. (1964) obtained correlations between coping styles and physiological measures of arousal and adaptation. In a study by Folkins (1970) using shock threat, however, no relationship between these measures was found. This issue will be investigated by comparing skin conductance and heart rate responses to these two forms of stress.

The two films mentioned above also provide an opportunity to assess the effects of intensity of threat, as well as anticipation and uncertainty. Various measures are used to evaluate the relative intensity of stress produced by the two films. The impact of the two stressful films is also compared with that of a neutral film.

The literature has indicated that anticipation of an unpleasant experience may be more stressful than the actual confrontation with it. It has also been suggested that longer periods of anticipation may help reduce the impact of a stressful experience. In order to study the effects of anticipation of threat each of the films is presented five times. In this way it is possible to study how the child adapts over trials to repeated presentations of the same stressful situation. It is also possible, in the vicarious threat condition, to study whether the initial, unexpected confrontation with harm is more or less stressful than subsequent anticipated presentations.

Uncertainty is introduced in the shock threat condition by telling the child that shock will be administered once while he is viewing the film. He knows at what point in the film the shock may be given, but he does not know on which trial this may occur. Thus, the effects of uncertainty can be assessed by studying the pattern of skin conductance and heart rate response to successive presentations of the signal for potential shock.

2. A second purpose is to investigate the significance of a variety of physiological measures. Comparison of the studies cited in the literature is extremely difficult because different investigators employed different response measures. For example, Epstein et al. (1962) used magnitude of skin conductance response to stimuli of high relevance in order to assess physiological arousal and the effectiveness of defence mechanisms. In contrast, Folkins' (1970) study of coping mechanisms involved peak measures of heart rate and skin conductance taken at 10-second intervals. Other studies emphasizing attentional demands as opposed to

arousing qualities of stressful situations have used either heart rate deceleration or skin conductance orienting response (Jennings et al., 1971; Lovibond, 1969; Wilson et al., 1967). Furthermore, it has been suggested that basal GSR (or tonic level) reflects the state of alertness or emotional state of the organism but that it is not indicative of immediate response to specific stimulation (Woodworth & Schlosberg, 1954). Thus, it seems likely that each of these response measures may be reflecting different aspects of an individual's adjustment to the experimental situation. The present study proposes to compare several measures of skin conductance and heart rate. It is expected that the effect of variables such as intensity, anticipation or uncertainty may be reflected in some of these measures but not others. Information on this issue should help clarify which measures are most suitable for studying particular variables.

3. The final aim of the study concerns the interaction between children's coping and cognitive styles and the two types of stressful situation. The relationships between coping styles and physiological responses to stress which have so far been investigated in adult Ss would suggest that the child who is able to cope effectively with reality should be less affected physiologically by a life-like vicarious frustration than the child who characteristically denies reality (Lazarus et al., 1964, 1965; Speisman et al., 1964). On the other hand, findings such as those of Folkins (1970) suggest that shock threat would show no

interaction with this form of coping. An analysis of the physiological responses of these children should reveal whether these coping styles have any relationship to the two forms of stress under study.

Although there have been many attempts, using adult Ss, to investigate the relationship between coping styles and physiological responses to stressful situations, there have been relatively few studies to investigate the relationship between physiological responses and cognitive styles. Those that have been published have dealt almost exclusively with the interaction between field dependence-independence and psychological and physiological responses to perceptual and sensory isolation (e.g., Cohen, et al., 1962; Edelberg & Burch, 1962). However, various measures of cognitive style in children have recently been featured in the literature. Two which seem to be particularly relevant to the present study are reflection-impulsivity and field dependence-independence. In a review of a series of investigations Douglas (in press) has suggested that these two tests appear to be measuring similar and overlapping dimensions of personality: both tests appear to tap the ability to cope with situations where control of impulses or a planned analytic approach to problem solving is required. Supporting this are several findings indicating that these two tests are related to the same psychological attributes. For example, each has been correlated with children's ability to respond realistically to frustrating situations depicted in stories (Campbell et al., 1972; Douglas, in press). Both tests have also been correlated with several other measures reflecting an ability to sustain attention and to control impulses (Douglas, in press). Boys known to be impulsive have consistently shown poor performance on both of these tests (Campbell et al., 1969). Finally, scores on the two tests have been related to a child's ability to control impulses in social situations, and to restrain judgment or action until all aspects have been taken into consideration (Schleifer & Douglas, unpublished manuscript; Douglas, in press). In addition to the above findings, there is evidence that these two tests are intercorrelated; Campbell (1969), and Marton and Douglas (unpublished manuscript), found significant correlations between Ss' scores on field dependence-independence and reflection-impulsivity, independent of the effects of intelligence and age. Analysis of the physiological responses to the vicarious and shock threat conditions should indicate whether the ability to control impulses, which both styles appear to tap, is effective to the same degree in these two different forms of stress.

EXPERIMENT 1

Physiological Concomitants of Vicarious and Shock Threat

Method

Subjects

39 Grade IV boys attending three Montreal area schools participated in the study. Because of reported sex differences in physiological research (Graham, Cohen & Shmavonian, 1966; Kimmel & Kimmel, 1965), it was decided to restrict the sample to males. All of the boys were from middle class backgrounds, enrolled in regular classes, and none had a history of problem behaviour in school. The ages of the boys ranged from 9 years 3 months to 10 years 6 months, with a mean of 9 years 9 months.

Physiological Recording Apparatus

Continuous recordings of skin conductance and heart rate were made using a Grass Model 7 polygraph. The recording instruments were located in a room adjacent to the experimental room. The two rooms were connected via a door and a one-way mirror through which *E* could observe *S* and the film stimuli. The temperature in both rooms was maintained at a constant 72°F.

Skin conductance. Skin conductance was measured directly by means of the constant voltage method (Lykken, 1965) and read from a 10-turn potentiometer on the polygraph preamplifier. A constant voltage of .5 volt was connected in series with the *S* and a 500-ohm potentiometer and the signal fed into the polygraph preamplifier. Zinc discs 3/8 inch in diameter encased in lucite were used as electrodes. Prior to placement of the electrodes the skin at the electrode site was cleansed with 95% alcohol. Following this, a Dr. Scholls No. 458 corn pad was placed over the centre of the fingerprint of the second and third fingers of the left hand and half filled with electrode paste. A solution of Z_nSO_4 and neutral base (Parke-Davis "Unibase"), in the proportion .05 M Z_nSO_4, served as electrode paste. The use of corn pads both limited the area of contact and maintained it constant for all subjects. The electrodes were then fitted into the depression and secured with adhesive tape.

Heart rate. Beat-by-beat changes in heart rate were measured through the tachograph circuit of the polygraph. Electrodes were attached to the upper left arm and right shin, and consisted of two silver plates 2 x 1 1/4 inches. The electrode paste, a 3.0 M solution of KCl and "Unibase," was lightly spread on the electrodes prior to placement. To ground the S, a third electrode was placed on the right upper arm.

Presentation of Stimuli

A "Da-Lite" screen, measuring 3 x 4 1/2 feet, was placed approximately 8 feet from S. Closed-loop coloured silent films were projected on to this by means of a "Technocolor 800 instant movie projector."

Neutral film. The neutral film depicts a young boy slowly opening a folded piece of tissue to reveal a flower. The boy gently takes the flower in his hand, smells the bloom, and then sits back in his chair with a happy, relaxed smile on his face. This film lasts for 53 seconds.

Vicarious threat film. This film depicts a boy building what appears to be a box, with planks of wood, nails and a large hammer. When the box is almost complete the boy accidentally hits his finger with a hard strike of the hammer. All body and facial gestures indicate that the accident is very painful. At the end, the film zeroes in on the very sad and pained expression on the boy's face. This film lasts 90 seconds and the point at which the boy hits his finger with the hammer occurs at the 56th second. The one second during which the hammer hits the finger was marked on the physiological records as the point of stimulus onset for vicarious confrontation with harm.

The neutral and vicarious threat films were alternated. The neutral film was shown first, and after an interval of 4 seconds the vicarious threat film was presented. Following this there was a further interval of 4 seconds before the neutral film recommenced. This sequence was repeated 5 times. The 5 presentations of the neutral film constitute the neutral condition, and the 5 presentations of the second film represent the vicarious threat condition.

The mild form of vicarious threat described above was chosen for two reasons. The type of films which have been used with adults have depicted such traumatic scenes as crude surgical subincision rites of young adolescent boys, or fatal accidents in a woodmill, where limbs were severed or planks of wood pierced the body (Lazarus et al., 1962; Lazarus et al., 1965; Nomikoś et al., 1968). Previous findings have indicated, however, that it is not necessary to use severely traumatic films to arouse young children (Dysinger et al., 1933; Osborn et al., 1971; Sternbach, 1962). In addition, this mild form of threat depicted an accident which could very well happen to these boys. It was expected, therefore, that they could easily empathize with the hero and presumably vicariously experience the threat.

Shock threat. This film commences with a young artist standing in front of a blank canvas, paint and brush in hand. He quickly paints what appears to be a self portrait. At this point another young man comes on the screen and shakes hands with the artist. As they are both standing back and evidently admiring the painting there is a red flash lasting 1 second. (A section of over-exposed film was spliced into this film to provide this discrete 1-second stimulus signal.) The painting is then shown to be completely ruined, with splashes of paint all over the canvas. The second young man shakes his head in disapproval and walks away while the young artist looks very sad and disappointed. This film lasts 105 seconds, after which there are 4 seconds of blank film before the loop recommences. The red flash, or 1-second stimulus signal, occurs at the 79th second of the film.

Although this film was originally designed as a vicarious threat film, in pilot studies it had given little indication of being stressful or arousing. Sample polygraph records taken from this pilot study appear in Appendices 1-5. It can be seen that heart rate and skin conductance show very few changes in magnitude throughout the whole film. In addition, frequent questioning had revealed that young boys found it rather meaningless. It was therefore chosen as a stimulus over which to superimpose shock threat. The children were told that they might receive a shock when the red flash occurred. This 1-second stimulus signal therefore served as a cue for potential shock.

Further pilot studies were conducted using this film under shock threat conditions. The sample consisted of Grade II and Grade III boys. Several problems soon became apparent. Firstly, it was difficult to keep children of that age in the experimental situation for a sufficient length of time to present both a shock threat film and an alternating neutral film. Secondly, several Ss were unwilling to watch 5 presentations of the shock threat film. Thus it was decided to use older Ss, and although it presented difficulties for the experimental design, it was further decided to drop the neutral film in order to shorten the period of testing.

Procedure

All Ss were individually tested between the hours of 9 a.m. and 3 p.m. The test session lasted approximately 1 hour. On entering the experimental room each S was told that he would see some short films and that electrodes would be attached to his arms and legs in order to see how his body reacts to the different situations depicted in these films. After being reassured that the electrodes were not painful he was seated in a semi-reclining chair. The electrodes were then placed and S was instructed to make himself as comfortable as possible. E then told S to close his eyes and relax for approximately 10 minutes. Withdrawing to the adjoining room, E extinguished all lights in the experimental room. A minimum of 10 minutes' relaxation was recorded, during which E monitored skin conductance and heart rate resting levels. Following this, E re-entered the experimental room and informed S that he was now going to see the films. The importance of sitting as still as possible throughout the whole session was impressed upon him, and he was asked particularly to try not to move his arms and legs. He was asked just to keep watching the films until E returned to the room. At this time no mention was made of the fact that the films would be shown several times.

S then viewed 5 presentations of the neutral and vicarious threat films. In the adjoining room concurrent skin conductance and heart rate recordings were monitored by E and appropriate marks made on the polygraph record to indicate the beginning of each film as well as specific events occurring within them.

Following this, E again entered the experimental room, put on the lights and sat next to S. The shock threat film was then explained to S as follows:

> "You are now going to watch another film. This will also be shown several times like the others, but this time, on one, only one of the presentations you will get an electric shock."

At this point most Ss expressed apprehension. E continued as follows:

> "All of the other boys who have watched these films have stayed for this part of the experiment, so I'm sure you will too. Remember there is only going to be one shock. You do not know on which presentation of the film you will receive it, although I will tell you about the film so that you will know exactly at which point in the film you may expect to receive this shock. One other thing I am not going to tell you is how many times you will see the film, only that you are to keep watching it for as many times as it is shown, and that on one, only one of the presentations you will get an electric shock.
>
> "Now I will tell you what the film is about. It tells the story of an artist who paints a picture. Just as he finishes his painting another man comes along and shakes hands with the artist. While they are both looking at the picture there is a red flash which completely covers the painting. You will then see that the painting is all splashed with paint. The second man shakes his head and walks away, leaving the artist looking disappointed. Now I want you to watch particularly for the red flash, because that is the only point in the film when you may receive that one electric shock. Let me repeat again so that you understand: it is only on one of the times you will see the film that you will receive a shock, and it is only at the point when you see the red flash that you may expect to receive it".

After E was assured that S had completely understood what was going to happen, a questionnaire[1] was administered to S. This lasted approximately 5 minutes, whereupon E returned to the adjoining room, extinguished all lights in the experimental room and monitored tonic skin conductance and heart rate levels.

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[1]This consisted of the Spielberger State Anxiety questionnaire for children (1966). Results concerning this questionnaire will not be reported in this study.

In most cases, shock threat orientation resulted in increased tonic skin conductance levels, and hence necessitated readjustment of the 10-turn potentiometer. Approximately 2 minutes elapsed between the time E left the experimental room and the time the film began. Five presentations of film 2 then completed the experimental session. It should be stressed that electric shock was never actually administered. All boys participated for the 5 complete trials.

After the fifth trial of the film E put on all lights in the experimental room, discontinued the polygraph recording and entered the experimental room to inform S that the film session was over. The majority of Ss expressed surprise that they had not received a shock. Following the removal of the electrodes, the same questionnaire which was administered prior to the shock threat film was again administered. All Ss expressed interest and enthusiasm in learning about the polygraph and in looking at sections of the records. On leaving, most Ss said that they had enjoyed taking part in the experiment.

It was realized that results of the experiment could have been influenced if the children had been aware of the details prior to testing. Two precautions were therefore taken. Since the Ss came from 3 schools in different areas of Montreal it was decided to test children from one school at a time and concentrate this testing over one weekend. This avoided the possibility of discussion of the experiment during school hours. Secondly, it was impressed upon the children how important it was that the other boys know absolutely nothing about what was going to happen when they came to the experiment. It was explained to them that we were trying to study how the body reacts to things which sometimes surprise or frighten us.

Experimental Design

The experiment can be divided into 3 stages: a rest period, exposure to neutral and vicarious threat films, and finally shock threat orientation followed by exposure to the shock threat film. In addition to studying the effects of 2 types of stress on the electrodermal and heart rate systems, the design also permits an investigation of the influence of the following three variables: intensity, anticipation, and uncertainty.

Vicarious vs. shock threat. The vicarious and shock threat conditions are similar in that 5 presentations of both films are given but different in the type and timing of threat involved. The differences between the two conditions are as follows: (1) In the vicarious threat condition confrontation with harm is introduced unexpectedly toward the end of the first presentation, whereas the orientation for shock threat is given prior to the beginning of the film (c.f. procedure). (2) Vicarious threat and the subsequent confrontation with harm occurs on each of the 5 trials; for the shock threat condition no shock is actually delivered, only a cue signalling potential shock. (3) As mentioned above the vicarious threat film was alternated with a bland neutral film; the shock threat film was not alternated with a neutral one.

Intensity. Comparison of the vicarious and shock threat conditions should provide information about the relative intensity of these two situations. Furthermore, the impact of these two stressful situations can be compared to that of a neutral condition. It may be expected, for example, that in the vicarious threat condition the child would show some form of adaptation to threat, since he is repeatedly exposed to the same confrontation with harm. It might also be expected that the neutral film would contribute to this trend because tonic levels would have an opportunity to stabilize after each vicarious threat trial. In contrast, responses to the shock threat condition may be less likely to habituate: as each trial passes without shock, the child may consider shock all the more likely on the following trial.

The above, of course, ignores the possibility of individual differences in mediating defence strategies, which will be discussed in the second experiment.

Anticipation. Up until the point at which the hammer hits the finger in the vicarious threat film, there is no reason for the child to anticipate threat. Thus it is possible on this first trial to study the effect of sudden confrontation with vicarious experience of harm. In each consequent showing of the film, however, anticipation is present. The physiological effects of anticipated threat can therefore be studied by comparing trial 1 with subsequent trials. Adaptation over successive presentations may also be studied by comparing trials 2 to 5.

Uncertainty. Although anticipation of threat is present prior to and throughout the whole of the shock threat film, there is, in addition, a strong element of uncertainty. The child has no way of knowing on which trial shock will be given. Thus an analysis of the pattern of physiological response to successive presentations of the visual signal for potential shock may reveal what effect this situation has on the child.

Treatment of Data

Sampling

A summary of the autonomic sampling procedures appear in Table 1. Many problems arise when physiological data are used to make inferences about psychological states. Some of these involve the tendency for patterns of physiological response to be specific to the individual, to the stimulus situation, or the individual's subjective appraisal of it. Further difficulties arise with respect to response intensity: since individuals differ in respect to prestimulus physiological levels, the comparison of poststimulus scores may not be justified. Two methods of circumventing this last problem are statistical transformation of the data, which will be discussed under the section dealing with data analysis, and the use of change scores rather than absolute values. Change scores have been used in the present study, in a manner similar to that adopted by other investigators (Averill, 1969; Blaylock, 1972; Germana & Klein, 1968; Hare et al., 1970; Lacey & Lacey, 1963; Miller & Bernal, 1971). In addition, several skin conductance and heart rate scores are

Table 1

Summary of Autonomic Sampling Procedures

Autonomic System	Relaxation Period	Neutral Condition	Vicarious and Shock Threat Conditions		
Skin Conductance	Resting Tonic Level (RTL)	Spontaneous Responses (GSR's)	Stimulus Response	Trial Response	Trial Response relative to resting level
	Mean level at 15 sec. intervals	No. of spontaneous responses greater than .1 µmho emitted during all 5 trials	Orienting Response (OR)	Tonic Level (TL)	Change in Tonic Level (CTL)
			Largest conductance change greater than .1 µmho and occurring within .5 - 4 sec. of stimulus onset	Level at beginning of each trial presentation, ignoring specific GSR's	Difference between RTL and TL at the beginning of each trial
				Spontaneous Responses (GSR'S)	Change in Maximum Skin Conductance level (CML)
				Number of spontaneous responses greater than .1 µmho emitted during all 5 trials	Difference between RTL and maximum skin conductance recorded for each trial
				Maximum Trial Increase (MTI)	
				Difference between TL and maximum skin conductance recorded during each trial	

<u>Heart Rate</u>	<u>Resting Heart Rate Level(RHRL)</u> Mean of median of 5 beats occurring at 15 sec. intervals	<u>Beat-by-beat (TS-6→TS+6)</u> 6 beats pre-stimulus 6 beats post-stimulus and beat or mean of beats during 1 sec. stimulus <u>Acceleration/ Deceleration</u> Mean of beats TS-6, -5, -4, -3, subtracted from subsequent 9 beats	<u>Peak Rate</u> Peak heart rate during 5 sec. intervals for 30 sec. prestimulus & 10 sec. post-stimulus

derived to reflect different aspects of reaction to stress.

Tonic Levels of Autonomic Activity

Skin conductance tonic levels were determined for the last minute of the resting period, and for the first second of each trial presentation of the films. Resting skin conductance tonic level (RTL) was obtained by taking the average of 5 readings at 15-second intervals during the last minute of relaxation. Tonic level (TL) at the beginning of each trial was determined by drawing a line connecting skin conductance recordings 5 seconds prior to and following film onset, ignoring specific momentary galvanic skin response fluctuations. The point at which this line intersected the time marker for the start of the film gave the appropriate skin conductance tonic level reading.

Tonic heart rate was also computed from 15-second readings during the last minute of the relaxation period. The median of the 5 heart beats occuring at each 15-second point was determined. These were then averaged to give a resting heart rate level (RHRL). This procedure takes into account the cyclic variation in heart rate associated with respiration (sinus arrythmia).

Spontaneous Response to Neutral and Stress Films

Number of spontaneous galvanic skin responses (GSR's) were computed for the neutral, vicarious and shock threat conditions. A spontaneous response was scored for each deflection in the skin conductance record exceeding .1 micromho (μmho) in magnitude. Total number of GSR's were recorded for the 5 trials of each condition.

Orienting Response

A skin conductance orienting response (OR) was scored for each change in skin conductance greater than .1 μmho and occurring within .5-4.0 seconds of stimulus onset for the vicarious confrontation with harm or the cue for potential shock. Thus this measure reflects the immediate autonomic response elicited by each of these stressful conditions.

For heart rate, beat-by-beat readings were taken immediately preceding and following stimulus onset. For each trial, 13 beats were analyzed. The beat occurring during the one-second stimulus was recorded as threat stimulus (TS). In cases where two or more beats occurred during this one-second stimulus a mean was computed. The first full beat prior to TS and the first full beat following were labelled TS-1 and TS+1, respectively. Hence, the 6 beats prior to and following stimulus were labelled TS-1 to TS-6, and TS+1 to TS+6, respectively.

Heart rate change scores were also computed for each S (Germana & Klein, 1968). For each trial, beats TS-6, TS-5, TS-4 and TS-3 were averaged and this mean subtracted from each of the subsequent 9 beats. The 9 scores thus derived reflected for each S a measure of acceleration (positive values) or deceleration (negative values) for the 2 beats prior to, one beat during and 6 beats following stimulus onset.

Autonomic Response to Each Trial Presentation

For skin conductance the score used to measure autonomic response to each trial presentation of the films will be termed

Maximum Trial Increase (MTI). It reflects the total physiological impact of each trial presentation, which may include the anticipation of threat as well as immediate response to confrontation with it. Thus the magnitude of skin conductance increase during each trial presentation was determined by computing the difference between the tonic level at the beginning of each trial and the maximum skin conductance recorded during that trial. This is directly analogous to a method employed by Hare et al. (1970), where difference scores between tonic and maximum levels were used to assess the impact of stressful slides.

For the heart rate response to each trial, the method used was one suggested by Opton, Rankin & Lazarus (1966). They used maximum peak rate scores over 10-second intervals. Since the film in the present study is of much shorter duration, 5-second intervals were selected. For each trial, therefore, the 30 seconds preceding and 10 seconds following stimulus onset were divided into 5-second intervals and the maximum heart rate reached during each of these intervals was recorded. Mean heart rate (MHR) during the 1-second stimulus was also measured.

Autonomic Change Over Trials Relative to Resting Level

Two further measures of skin conductance were derived to reflect the extent to which tonic levels and peak skin conductance levels changed over trials when compared to the individual's resting level. They reflect, therefore, degree of arousal or habituation over the whole session

Change in tonic level. Change in tonic level (CTL) was obtained by subtracting resting tonic level from the tonic level at the beginning of each trial. Thus a positive score reflects increase and a negative score decrease in tonic level. Furthermore, because tonic level varies directly with the emotional state of the organism (Woodworth & Schlosberg, 1954), CTL may be expected to reflect increases or decreases in emotional state as a result of successive presentations of vicarious and shock threat.

Change in maximum skin conductance level. Change in maximum skin conductance level (CML) is derived by subtracting resting tonic level from the maximum skin conductance recorded during each trial. As mentioned previously, the maximum response recorded during each trial reflects the total physiological impact of each presentation. Hence, it may be expected that increases in CML over trials would reflect increasing arousal and trial-to-trial decreases in CML would reflect habituation or adaptation to the stressful situation.

Data Analysis

Statistical transformation of autonomic response data. In psychophysiological research there are at least three important variables to consider when deciding upon units of measurement to express autonomic responses. Each is interrelated: one deals with normality of distribution, another with correction for individual differences in range, and a third with the Law of Initial Values (Wilder, 1962).

It has often been reported that skin conductance levels and amplitude of response exhibit a wide range of individual differences which cannot be explained in terms of psychological variability alone (e.g., Lykken, Miller & Strahan, 1968). One method of circumventing this problem is to establish minima and maxima for each S and to then study the variation within these limits (Lykken, Rose, Luther & Maley, 1966). It has been stressed, however, that absolute minima and maxima must be established in order for this correction to be valid. To obtain a maximum value, a very intense stimulus (such as shock) is necessary and for minimum values a state of complete relaxation is required. Since neither of these criteria could be met in the present study the range correction formula was not used.

The Law of Initial Values (LIV) asserts that the magnitude of response to stimulation is closely related to the prestimulus level: the lower the prestimulus level the greater will be the change in response to stimulation. The product-moment correlation between prestimulus and response values has been used to describe the LIV (Benjamin, 1967). To assess whether the LIV applied to the data in the present study, correlations were computed between prestimulus and response scores for the first trial of each condition. Only the first trial was chosen since it has been shown that repeated stimulations result in decreased correlation (Lacey, 1962). When prestimulus level and response amplitude (OR) were correlated the LIV was upheld for the vicarious threat condition ($r = .33$, 37 df, $p < .04$) but not for the shock threat condition ($r = .23$, 37 df, $p < .16$).

Several statistical techniques have been used to take account of the LIV and non-normality of distribution. Two of the most frequently-used techniques are square root (Kaplan, 1970; Ohman, 1972; Thayer, 1970) and logarithm transformations (Bernal & Miller, 1970; Montagu & Coles, 1966; O'Gorman, Mangan & Gowen, 1970). Thus, in order to allow for individual differences in prestimulus levels and range of response, log transformations were used in the present study. Skin conductance values were converted to log scores and all skin conductance change scores were expressed as the difference between these log scores.

Statistical Treatment of the Data

For skin conductance, t-tests for correlated samples were used where the analysis focussed on first and last trials only. In cases where a trial-by-trial comparison was warranted, one-way analysis of variance was used, and for comparison of vicarious and shock threat conditions, two-way analysis of variance with repeated measures was employed. The most frequent statistical technique used for the heart rate analysis was three-way analysis of variance, repeated measures design. Summaries of all analyses appear in the appendices.

Handling of Irregularities

Heart rate records were the most sensitive to movement artifact, particularly with regard to beat-by-beat measures. A criterion for omitting records with excessive movement artifact was established: three or more unscorable beats on any one trial excluded the record from the analysis. Where only one beat was unreadable a mean of the beat prior to and following was substituted. For two consecutive missing beats an extrapolation into the interval was made and the two values substituted for the missing data. Two Ss consistently gave records distorted by movement artifact in both stressful conditions. One S similarly produced an unscorable record for the shock threat condition. These three Ss were therefore dropped from the analysis, leaving a S sample of 36 for the heart rate beat-by-beat data.

Skin conductance involved only one instance of irregularity. On one trial of the vicarious threat condition the OR of one S was unscorable. The trial mean for the group was therefore substituted for this missing data.

Results

Assessment of Vicarious and Shock Threat Conditions

Five measures of skin conductance and three measures of heart rate are analyzed to assess the different physiological effects of vicarious and shock threat. Analysis of skin conductance includes specific responses to threatening stimuli, magnitude of response to trial presentations, and indices of overall arousal. The heart rate analysis investigates short-term beat-by-beat changes and decelerative scores, as well as peak rate measures over relatively longer periods of time.

Skin Conductance

Spontaneous responses. Since this measure has been recognized as a simple index of autonomic or emotional arousal it was anticipated that an increase in stress would be reflected in a corresponding increase in spontaneous galvanic skin responses (GSR's). Total number of spontaneous responses for the five trials of neutral, vicarious and shock threat were used in comparing the three conditions, with scores for vicarious threat being pro-rated to exclude the first non-anticipatory threat presentation. Means for neutral, vicarious and shock threat conditions were 6.74, 17.25 and 19.97 respectively[1]. One-way analysis of variance using repeated measures yielded a significant conditions effect ($F = 29.76$, df 2,76, $p < .001$) (Appendix 6). Comparison of means by the Sheffé method revealed

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[1]The mean for the vicarious threat condition before pro-rating was 16.86.

significant differences between the neutral condition and both forms of stress. There was no significant difference between the vicarious and shock threat conditions.

Orienting response. Figure 1 graphically illustrates the orienting response (OR) to the sight of the hammer striking the finger (vicarious threat) and to the visual signal for potential shock (shock threat). It can be seen that the skin conductance response to the cue for potential shock diminishes rapidly from trial 1 to trial 5: it follows the trend for rapid habituation which Sokolov (1963) has suggested is typical of the OR response to repeated stimuli of moderate intensity. In contrast, the skin conductance response in the vicarious threat condition clearly departs from this pattern. On trial 1 when the child is unexpectedly presented with the harmful experience the magnitude of orienting response is comparable to that elicited by the first presentation of the shock threat cue. On trial 2, however, when the child both anticipates and experiences vicarious harm the skin conductance response elicited is of much greater magnitude. Thus, the pattern resembles the defensive response described by Sokolov (1963) and Lynn (1966, pp. 6-10) in that stimulus repetition leads to a more intensified response on trial 2.

To assess habituation, t-test comparisons were made. A comparison of first and last trials in the shock threat condition revealed a significant decrease ($t = 2.28$, df 38, $p < .05$). For vicarious threat there was no significant difference between

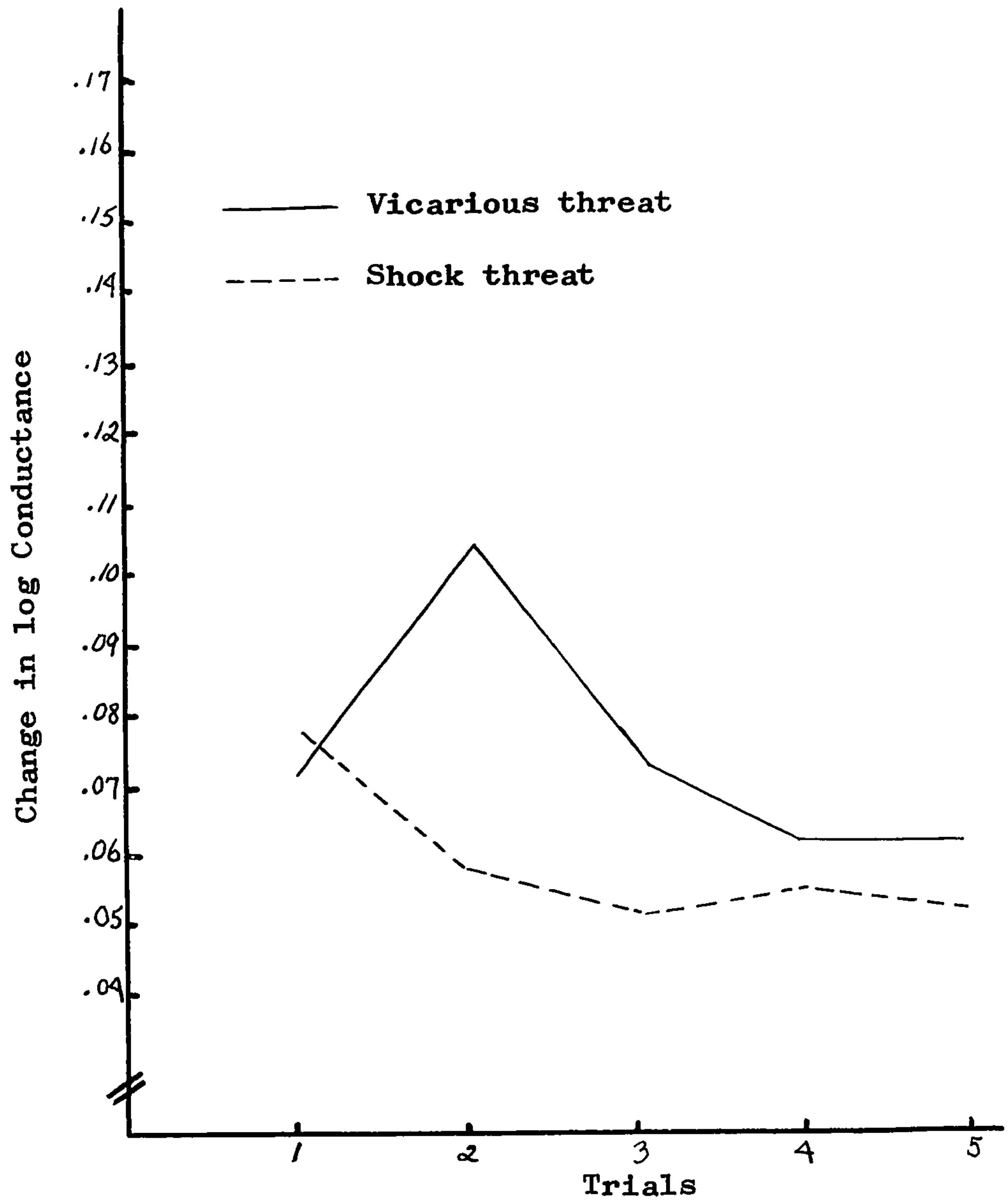

Figure 1. Orienting response (OR) to the threat stimulus during each presentation of the vicarious and shock threat films.

trial 1 and trial 5 ($t = 0.82$, df 38, N.S.). It may be argued that in this condition a comparison of first and last trials does not provide an appropriate test of habituation: although the child is responding to the same vicarious harm on each of the five trials, it is only on trials 2 to 5 that the harm is anticipated. A comparison of trials 2 and 5, therefore, may be necessary to indicate the extent to which habituation may occur to anticipated harm. A t-test comparing trials 2 and 5 revealed a significant decrease ($t = 2.56$, df 38, $p < .02$).

To estimate whether the magnitude of OR response differed in the two conditions, t-test comparisons were used. Comparison of trial 1 for the vicarious and shock threat conditions revealed no difference in the OR response to the two threatening stimuli ($t = 0.22$, df 38, N.S.). Comparison of trial 2 yielded a significant difference ($t = 2.92$, df 38, $p < .01$), pointing to the presence of a significantly more intense, or defensive response to the anticipated vicarious harm experience.

Maximum increase in skin conductance during each trial (MTI). Figure 2 illustrates the pattern of maximum trial increase (MTI) in skin conductance during each presentation of the films. It can be seen that vicarious threat produces a greater increase on trials 2 and 3 than does shock threat. It is not clear however, whether this is due to differences in the impact of vicarious and shock threat, or whether differences in administration of the two films (c.f. method) may also be contributing to this effect. After each presentation of vicarious threat, skin

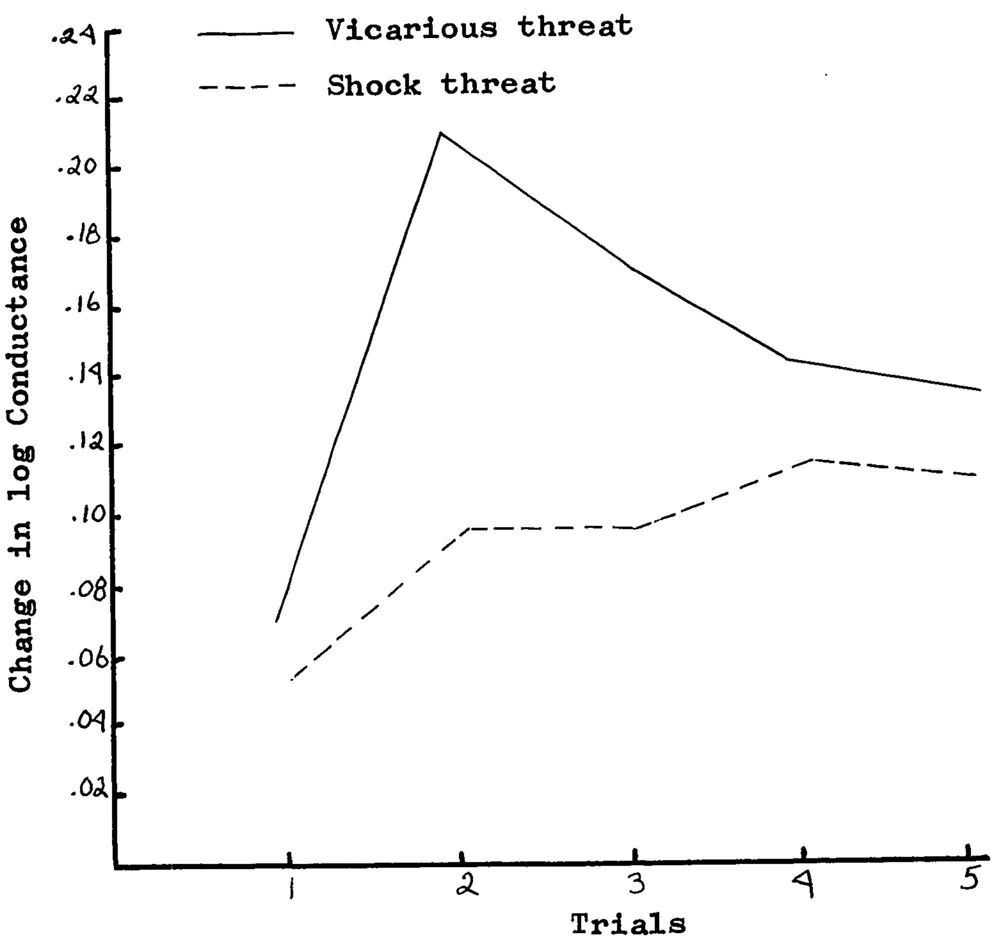

Figure 2. Maximum increase in skin conductance (MTI) during each trial presentation of the vicarious and shock threat films.

conductance was given an opportunity to decrease during the bland neutral film. Thus lower levels of tonic skin conductance at the beginning of each vicarious threat trial permit greater increases to occur during that trial. Since no such alternation occurred in the shock threat condition, it may be expected that each successive presentation maintained skin conductance at higher tonic levels, thus giving rise to increases of lesser magnitude.

One-way analyses of variance were used to assess differences in skin conductance increase over the five trials. For vicarious threat this yielded a significant trials effect ($F = 5.61$, df 4,152, $p < .001$) (Appendix 7). Multiple comparison of trial means by the Sheffé method revealed that on trial 1 skin conductance increase was significantly less than on all other trials. The greatest difference in MTI occurred between trials 1 and 2, and thereafter there was a stepwise decline. There was also a significant difference between trial 2 and trials 4 and 5.

For the shock threat condition, one-way analysis of variance again yielded a significant trials effect ($F = 8.20$, df 4,152, $p < .001$) (Appendix 8). Subsequent comparison of means produced significant F ratios between trial 1 and all other trials. In contrast to vicarious threat, however, there is a significant increase in MTI responses over trials.

In order to separate the effects of anticipation of threat from the immediate response to the sight of vicarious harm or the cue for potential shock, two skin conductance measures were

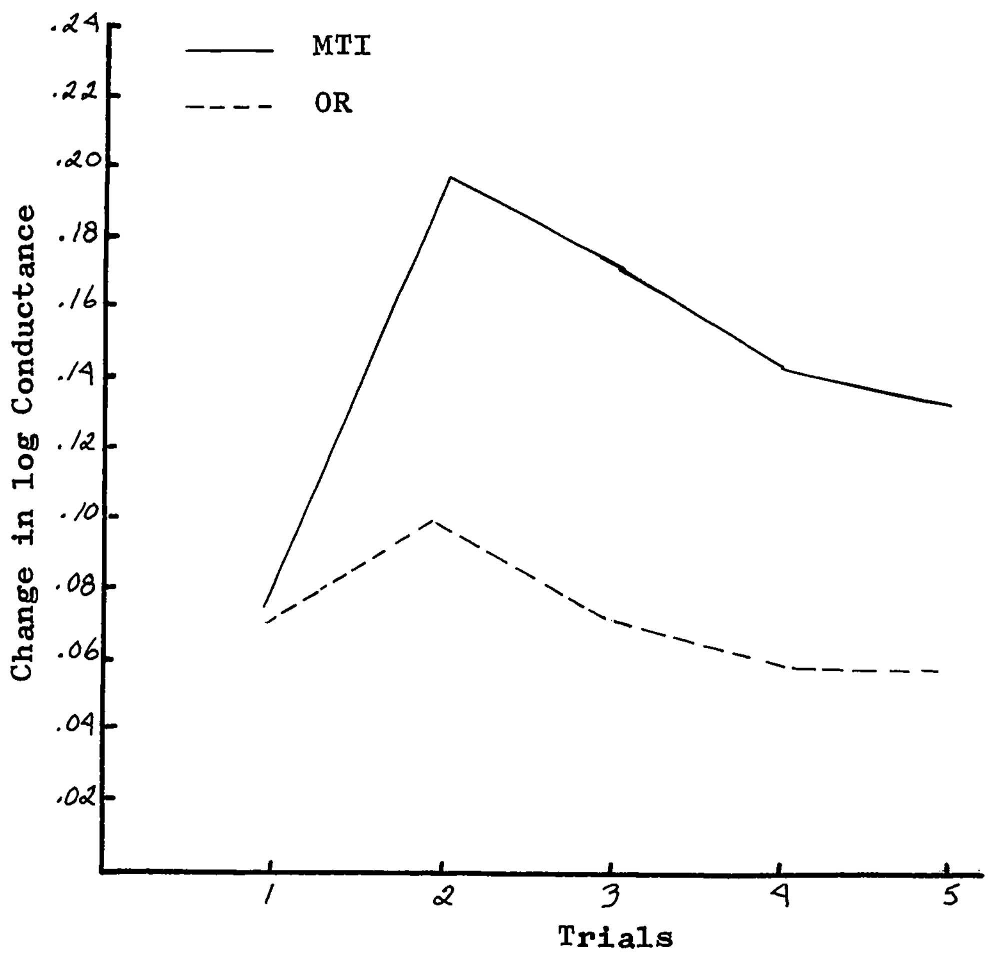

Figure 3. Comparison of orienting response (OR) and maximum trial increase (MTI) in skin conductance during each presentation of the shock threat film.

compared. These were MTI and OR, which measure respectively the maximum increase in skin conductance during each trial presentation, and the immediate response within 4 seconds' latency to vicarious harm or cue for potential shock. For the vicarious threat condition, 2-way analysis of variance using these two measures yielded a significant trials x measures effect ($F = 3.88$, df 4,152, $p < .01$) (Appendix 9). Analysis of individual means by the Sheffé method revealed significant differences between the two measures on all but the first trial. As can be seen from Figure 3, the maximum skin conductance increase elicited during trial 1 is almost identical to the OR. Inspection of individual polygraph records confirmed that in many cases the maximum skin conductance recorded during this trial occurred immediately following and in response to the vicarious harm. Prior to this there was very little, if any, increase in skin conductance from the beginning of the trial. On succeeding trials, however, considerably greater increases in skin conductance were evident prior to the impact of vicarious harm. It is on these trials, 2 to 5, that the _S_ is aware of the impending threat.

Figure 4 compares the MTI and OR measures, for the shock threat condition. A significant trials x measures interaction is again evident ($F = 10.64$, df 4,152, $p < .001$) (Appendix 10). Subsequent comparison of means revealed significant differences between the two measures on all but the first trial. As can be seen from Figure 4, the maximum increase in skin conductance

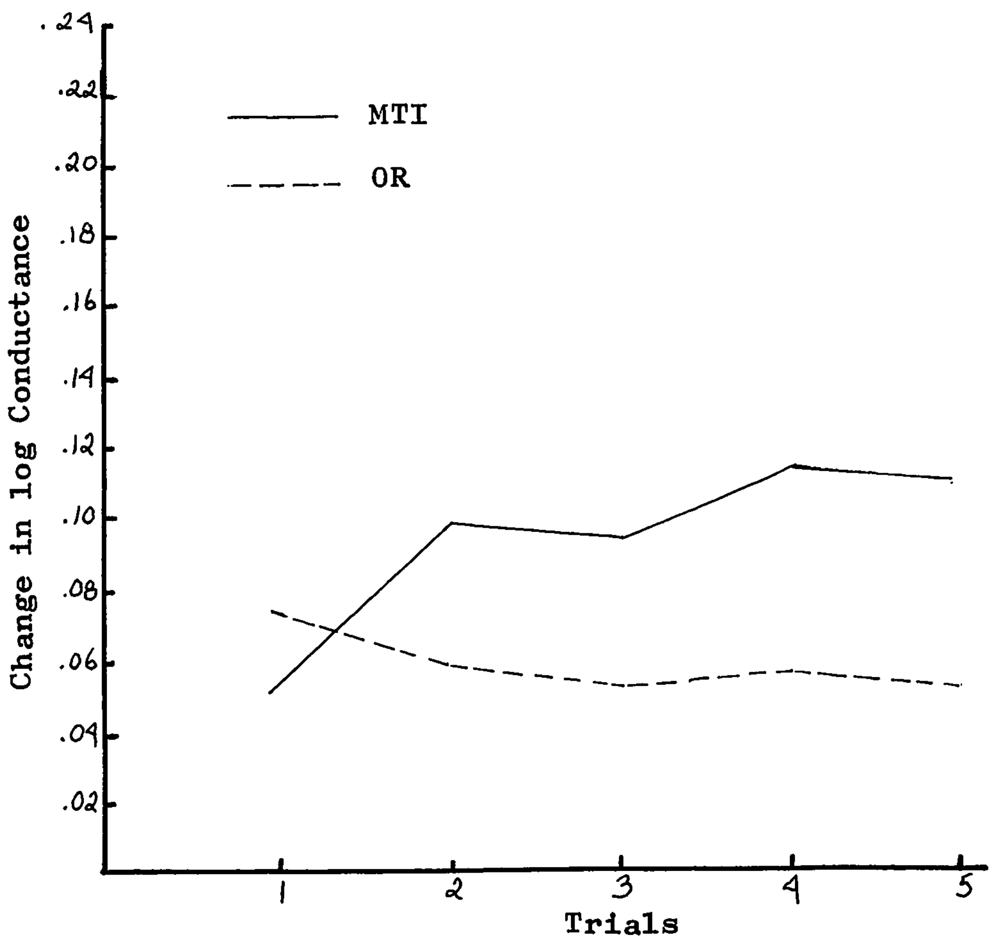

Figure 4. Comparison of orienting response (OR) and maximum trial increase (MTI) in skin conductance during each presentation of the shock threat film.

(MTI) during trial 1 is less than the amplitude of OR to the cue for potential shock. Thus the sight of the shock cue elicits a greater response than anticipation of it. On following trials it appears that anticipation of shock is increasing and that response to the shock signal itself is decreasing.

Change in tonic level over trial presentations (CTL). This measure reflects whether tonic level at the beginning of each trial is less or more than resting tonic level. One-way analysis of variance comparing trial differences in CTL for the vicarious threat condition yielded a significant trials effect ($F = 2.88$, df 4,152, $p < .05$) (Appendix 11). Comparison of means revealed trial 2 to be significantly different from all other trials. Referring to Figure 5 it can be seen that there is a considerable drop in tonic skin conductance at the beginning of this trial, whereas tonic level at the beginning of all other trials differs very little from resting tonic level. Tonic levels have been observed to decline over even short periods of time when the S is in a relaxed state and stimulation is reduced to a minimum. Since tonic level had decreased significantly by the beginning of trial 2, it appears that the first presentation of the neutral and vicarious threat film had a physiological effect similar to that produced by relaxation. This finding, however, may cast doubt on the significance of a previous analysis involving MTI. In that analysis, skin conductance increase was measured by comparing maximum skin conductance with tonic level at the beginning of each trial. Thus the significant

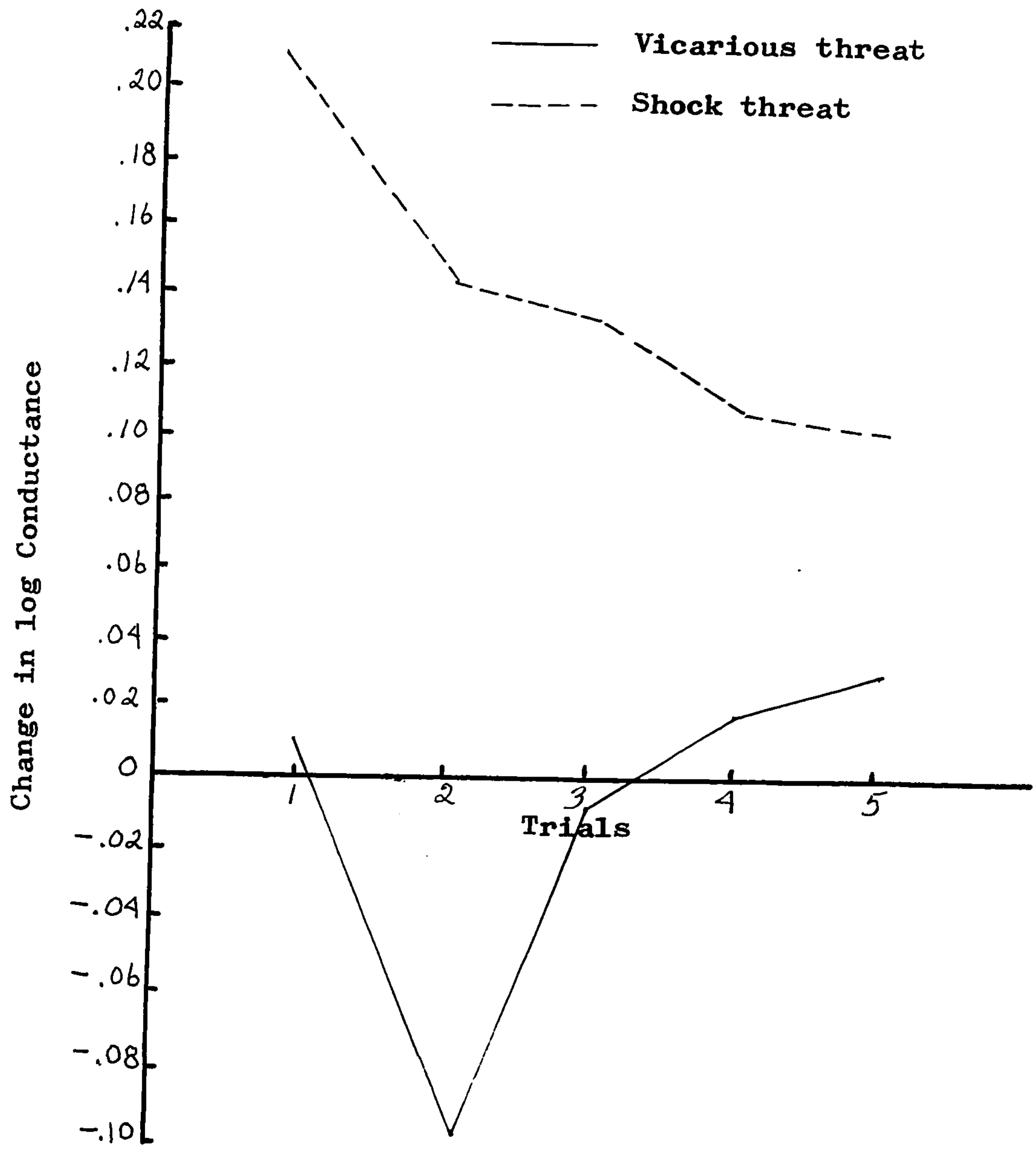

Figure 5. Change in tonic level (CTL) at the beginning of each presentation of the vicarious and shock threat films

effect which was found for trial 2 in that analysis was no doubt enhanced by the considerable drop in tonic level at the beginning of that trial. A further analysis comparing skin conductance increase with resting tonic level is therefore needed to assess whether the increase on trial 2 is significant. This will be done in the following section.

For the shock threat condition, one-way analysis of variance yielded a significant trials effect ($F = 21.94$, df 4,152, $p < .001$) (Appendix 12). Comparisons of means showed the increase in tonic level on trial 1 to be significantly greater than that for all other trials. Thus there was a significant trend for tonic level to decrease from trial 1 to trial 5.

When a two-way analysis of variance was used to compare change in tonic level for the two conditions, a significant conditions effect was found ($F = 14.53$, df 1,38, $p < .001$) (Appendix 13). Means for the two conditions revealed that shock threat produced a greater increase in tonic level over all 5 trials. The fact that shock threat was not alternated with a neutral film may have contributed to this effect. The two-way analysis also yielded a significant conditions x trials interaction ($F = 5.03$, df 4,152, $p < .001$). Trial means were then compared. It was found that shock threat and vicarious threat differed significantly on trial 1. When means were compared for trial 5 there was no significant difference in tonic level change: by trial 5 tonic level in the shock threat condition had decreased sufficiently that it was no longer significantly different from tonic level in the vicarious threat condition. Contributing to this also was the increase, although not statistically significant, in the vicarious threat condition.

Change in maximum skin conductance level over trials (CML). Change in maximum skin conductance level (CML) indicates the difference between resting tonic level and the maximum skin conductance recorded during each trial (c.f. method). An increase in CML over trials reflects increasing arousal, whereas a decrease reflects adaptation. Figure 6 illustrates the pattern of CML for both conditions. It will be remembered that the significant trial 2 increase in MTI was later questioned when change in tonic level indicated a significant decrease on this trial, to a point well below that of resting level. It is particularly interesting, therefore, to note the increase in maximum skin conductance level from trial 1 to trial 2.

To estimate the extent to which arousal or habituation changed over trials, t-test comparisons were made between trial 1 and trial 5. Shock threat revealed significant habituation ($t = 2.09$, df 38, $p < .05$). The apparent increase over trials for vicarious threat did not reach significance ($t = 1.59$). It may be noted that the variance in this case was much greater than that for shock threat.

When the two conditions were compared on this same measure, two-way analysis of variance yielded a significant conditions effect ($F = 6.52$, df 1,38, $p < .025$) (Appendix 14). Mean CML was much greater for shock threat than for vicarious threat. A significant conditions x trials interaction was also found

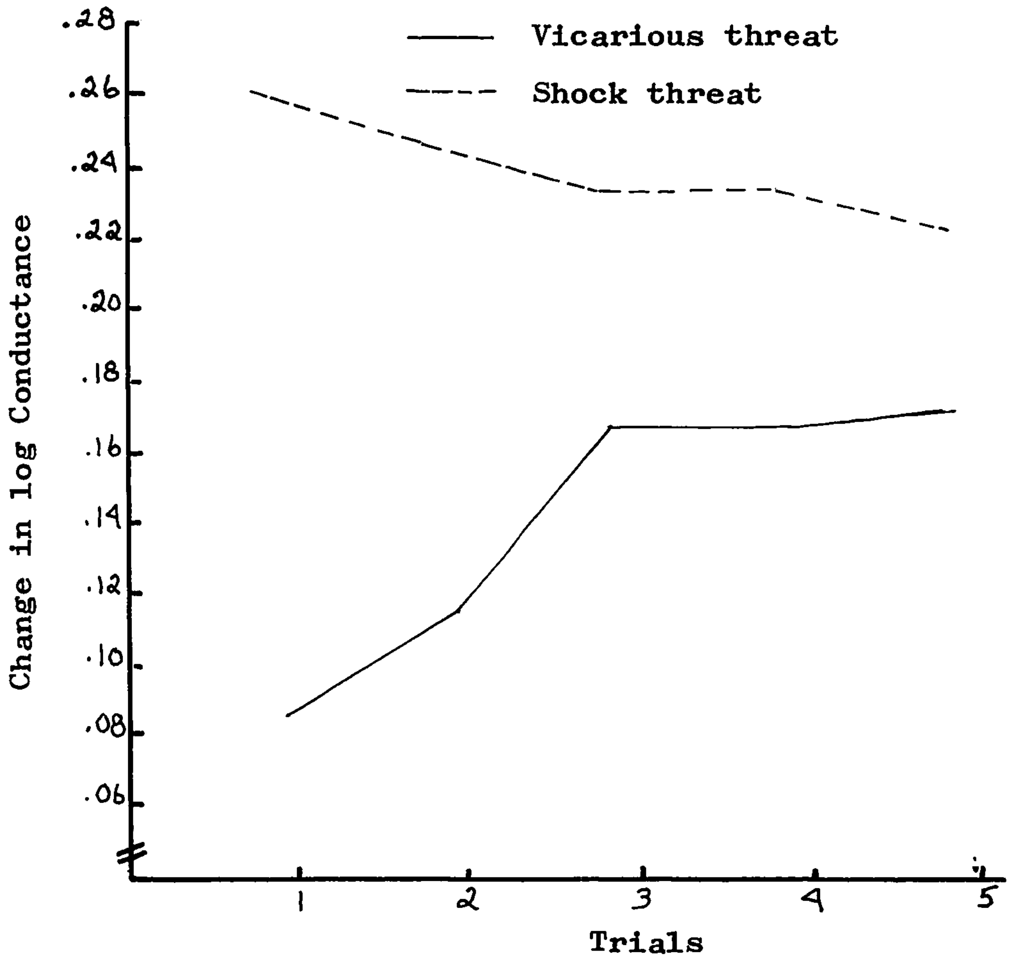

Figure 6. Change in maximum skin conductance level (CML) for each presentation of the vicarious and shock threat films.

(F = 3.06, df 4,152, $p < .025$). Comparison of means revealed a significant difference between the two conditions in maximum level of skin conductance (CML) on trial 1. Consonant with the results for change in tonic level, comparison of CML on trial 5 was not significant: habituation over trials in the shock threat condition had reduced maximum skin conductance level to the extent that the difference between the two conditions was no longer significant by trial 5. Again, the increase in the vicarious condition, which no doubt contributed to this, was not statistically significant.

Heart Rate

Beat-by-beat analysis. Beat-by-beat analyses were performed to investigate the pattern of cardiac response in anticipation of and in response to vicarious harm and the signal for potential shock. Figures 7 and 8 illustrate the cardiac pattern for trials 1 and 5 in both conditions.

Results for the 2 x 5 x 13 analysis of variance, comparing conditions, trials and beats, appear in Appendix 15. Due to the possible lack of homogeneity of covariance in a repeated measures design, conservative degrees of freedom are recommended (Winer, 1962). Hence, only the significant findings for the conditions and beats main effects and the conditions x beats interaction will be discussed since the other significant effects may be questioned.

Higher mean heart rate for shock threat contributes to the significant main effect for conditions (F = 14.61, df 1,35,

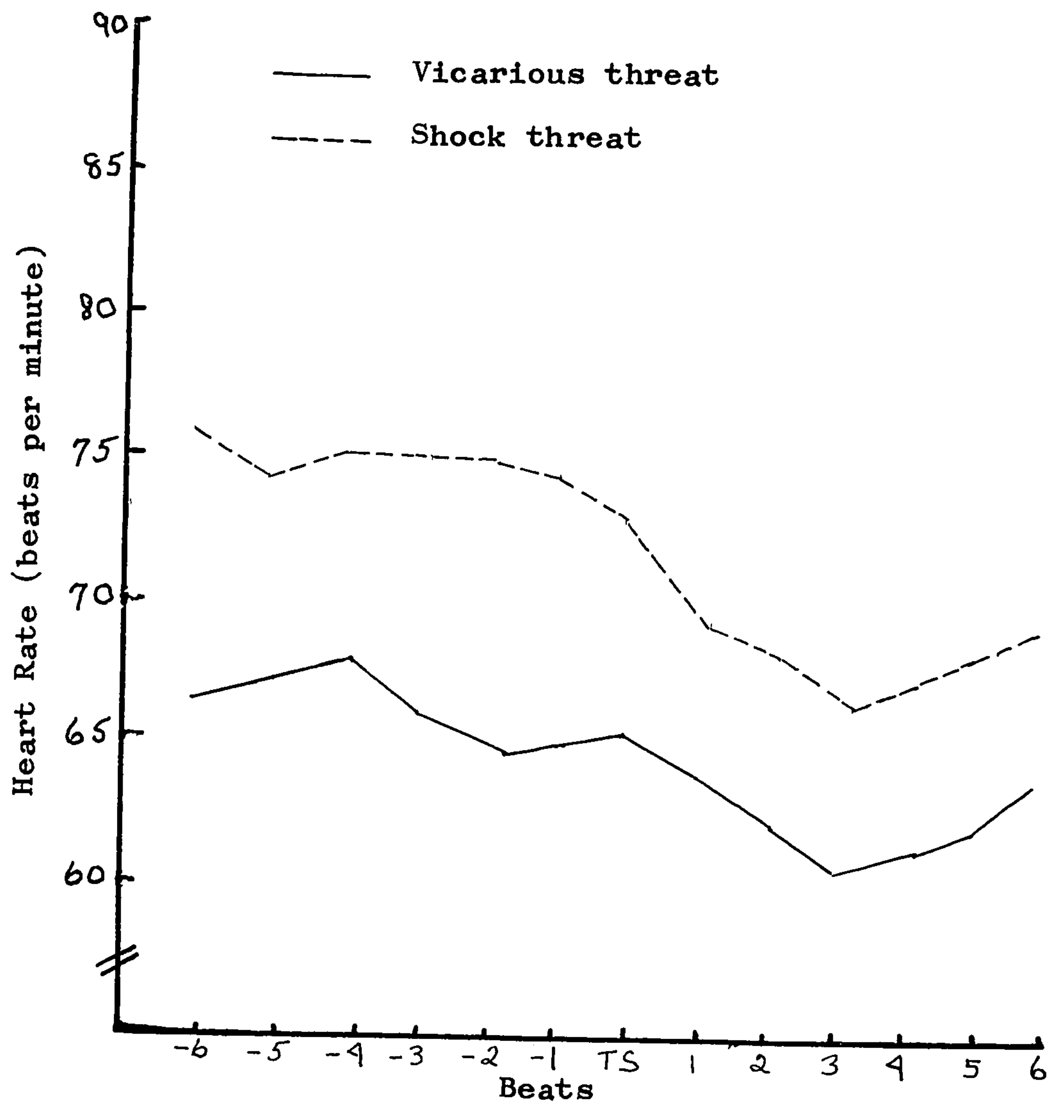

Figure 7. Pattern of cardiac response on Trial 1 for 6 beats preceding through 6 beats following visual impact of threat in vicarious and shock threat films.

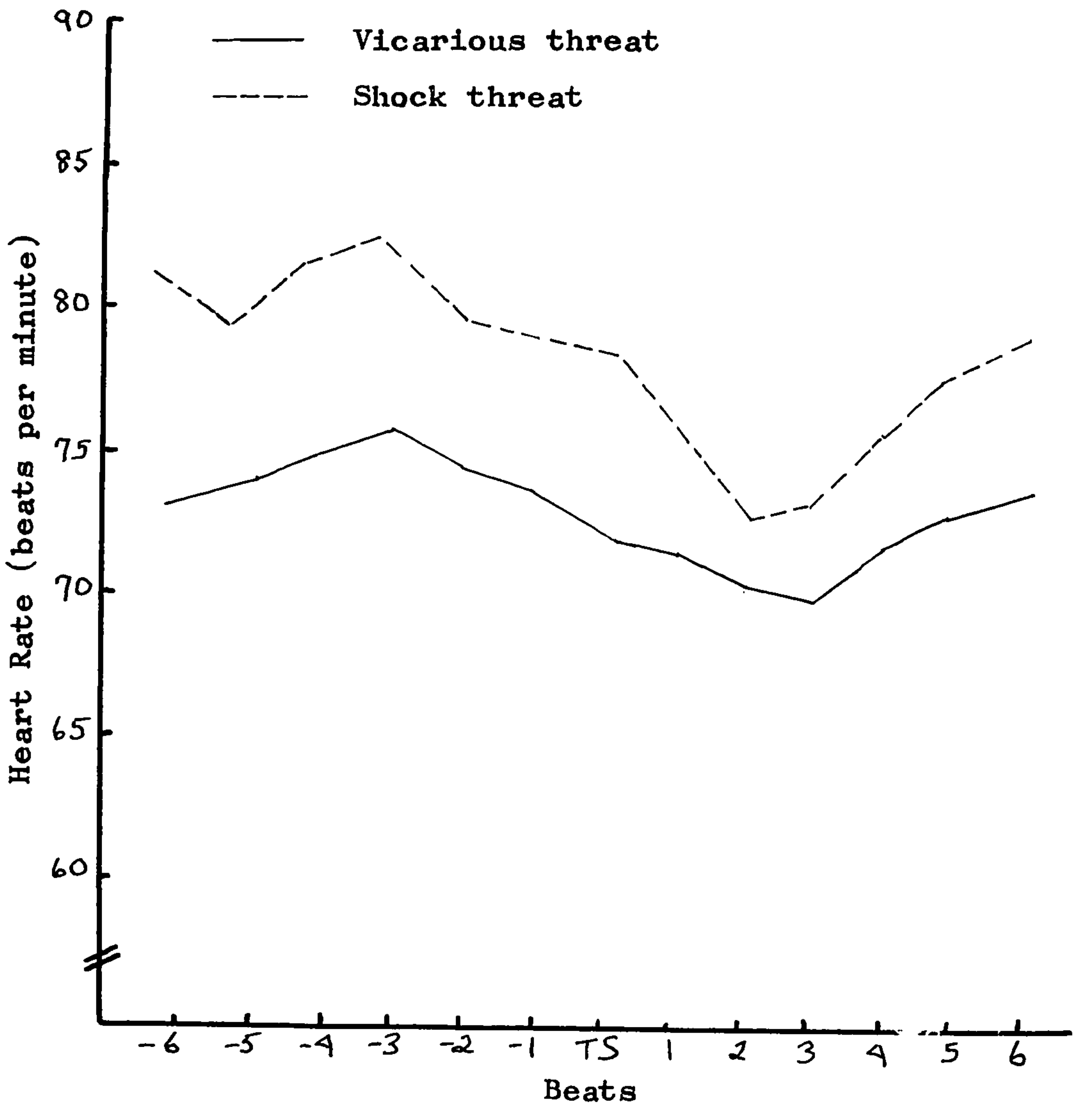

Figure 8. Pattern of cardiac response on trial 5 for 6 beats preceding through 6 beats following visual impact of threat in vicarious and shock threat films.

$p < .001$). Combining both conditions, the significant beats main effect reflects the decelerative trend which reaches a maximum on beat 3 following impact of the threatening stimuli. To assess the meaning of the conditions x beats interaction ($F = 6.94$, df 12,420, $p < .001$), means for beats TS-6 and TS+3, and beats TS-1 and TS+3 were compared in each condition. The third beat post stimulus (TS+3) has previously been shown to represent the point of maximum deceleration in response to signal onset (Cohen, 1970). Hence if this beat is compared with beat TS-6 it should reveal whether there is a significant deceleration starting from 6 beats prior to the threatening stimulus and reaching a maximum at the third beat after stimulus. Similarly, the TS-1 and TS+3 comparison should reveal whether deceleration commences 1 beat prior to stimulus onset and reaches a maximum 3 beats after. Comparison of these means revealed that there was significant deceleration in the shock threat condition only. The TS-6 and TS+3 beats comparison yielded a significant difference. (Hence, deceleration commenced 6 beats prior to stimulus onset.) There was no significant difference between beats TS-1 and TS+3.

A two-way analysis of variance, comparing beats for trials 1 and 2 only, was also conducted. This was designed to assess whether the introduction of anticipation on the second trial of the vicarious threat condition had an effect on the pattern of cardiac response. The results for this analysis, for each condition separately, appear in Appendices 16 and 17. In the shock threat condition, the lack of an interaction between trials and beats suggests no difference in the pattern of response from trial 1 to trial 2 ($F = 0.28$, df 12,420, N.S.) Observation of the means reveals deceleration to be present on both trials. Vicarious threat, however, produced a significant trials x beats interaction ($F = 2.06$, df 12,420, $p < .025$). For trial 1 the mean deceleration was 5.83 b/p/m as compared to 1.72 for trial 2. Statistical comparison of the means for beats TS-6 and TS+3 confirmed that significant deceleration occurred on trial 1 only.

Accelerative/Decelerative Scores

This analysis attempts to assess directly the degree of acceleration or deceleration immediately prior to and following the threatening stimuli. Appendix 18 presents the results of a 2 x 5 x 9 analysis of variance, comparing conditions, trials and accelerative/decelerative scores. The conditions main effect ($F = 16.01$, df 1,35, $p < .001$) results from the greater mean deceleration in the shock threat condition than in the vicarious threat condition: -4.5385, as compared to -1.7831. A significant beats main effect ($F = 14.02$, df 8,280, $p < .001$) once again reveals the third beat post stimulus as the point of greatest deceleration. The significant conditions x beats interaction ($F = 7.23$, df 8,280, $p < .001$) for the five trials combined is illustrated in Figure 9. As can be seen, greater deceleration occurs in the shock threat condition.

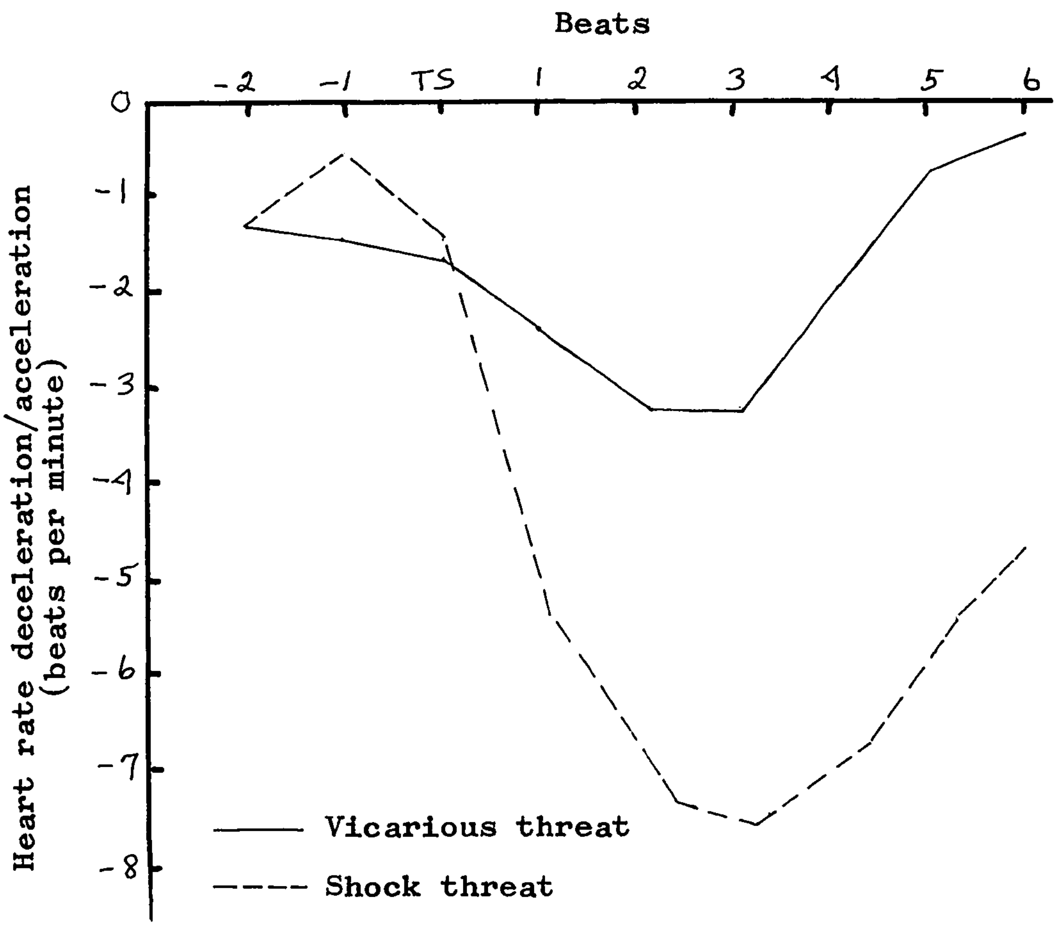

Figure 9. Mean pattern of deceleration over trials for the vicarious and shock threat conditions.

Peak Heart Rate Scores

This analysis of heart rate measures covered a period of 40 seconds: 30 seconds prior to impact of the threatening stimulus and 10 seconds post. Figures 10 and 11 illustrate trial 1 and trial 5 peak heart rate values for each condition. Analysis of variance for conditions, trials and peak rate scores served to confirm some of the findings for the beat-by-beat analysis. A significant conditions main effect ($F = 19.73$, df 1,37, $p < .001$) (Appendix 19) was again due to greater mean heart rate values for the shock threat condition. A trials effect ($F = 6.15$, df 4,148, $p < .001$) reflected the trend for increased mean heart rate values over trials. Inspection of means suggested the conditions x peak rate interaction ($F = 6.08$, df 8,296, $p < .001$) may be due to a longer period of deceleration in the shock threat condition. Comparison of means for heart rate 5 seconds prior to and at the point of impact revealed significant deceleration in both conditions. However, when a further comparison was made for shock threat between peak rate 5 seconds prior to and 5 seconds post impact, the difference approached but did not reach significance.

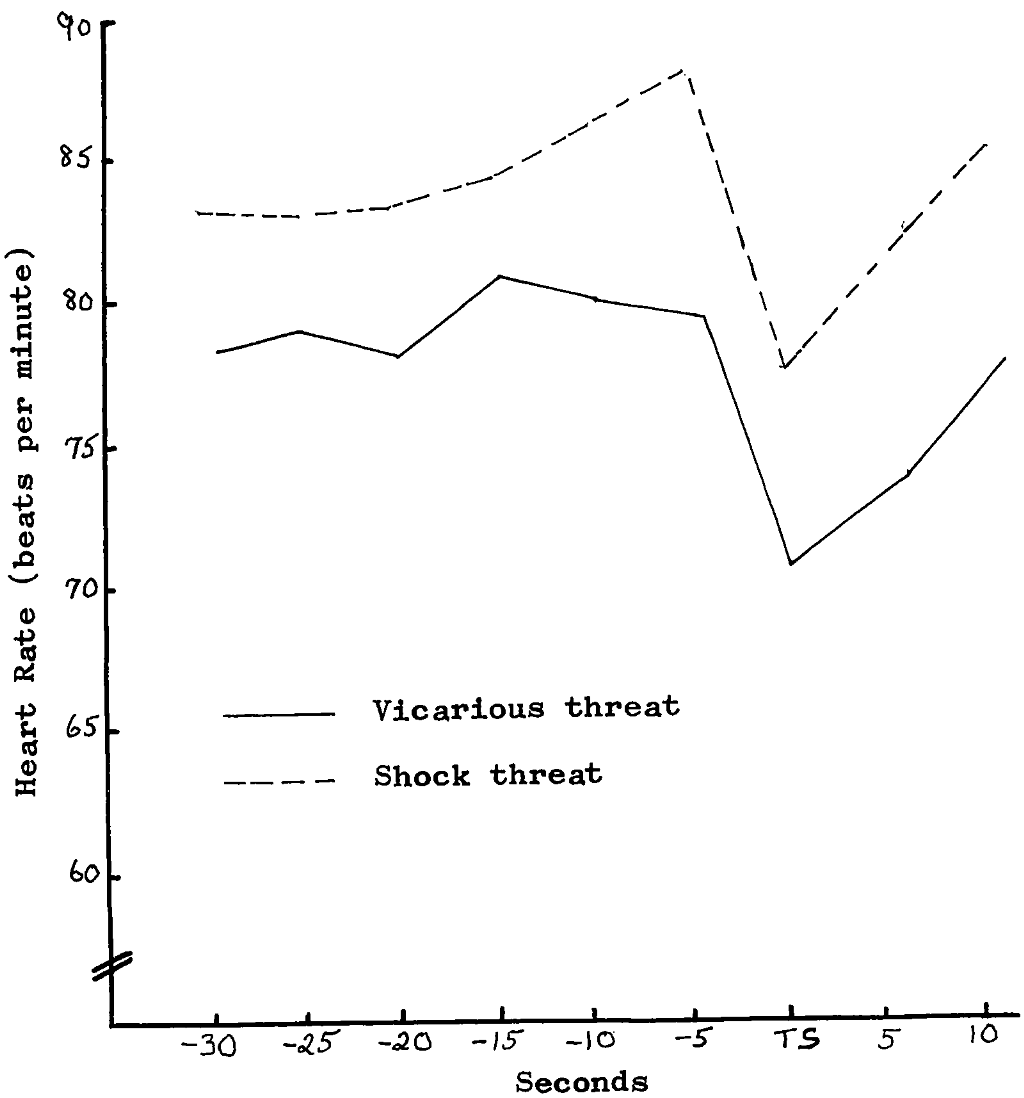

Figure 10. Peak rate scores during trial 1 presentation of vicarious and shock threat films.

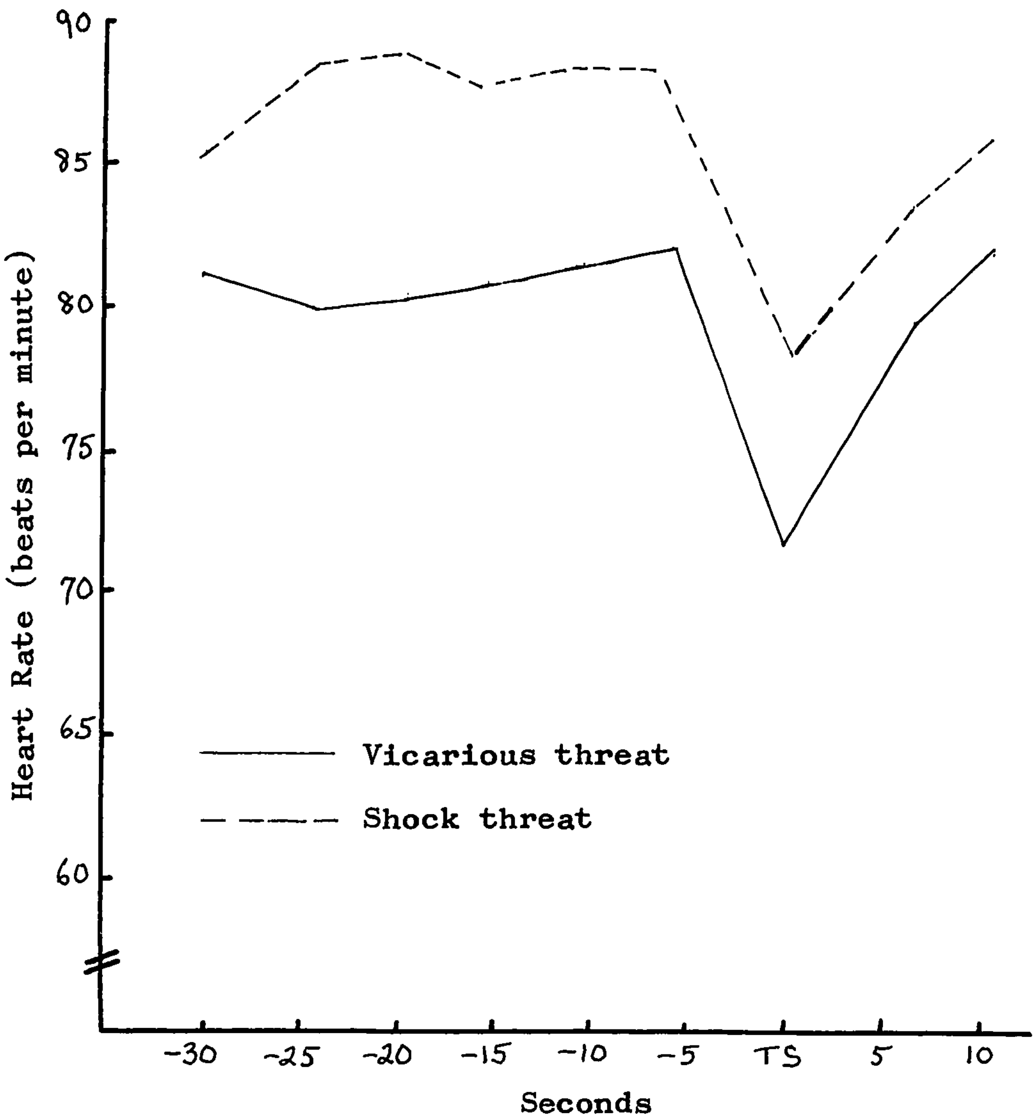

Figure 11. Peak rate scores during trial 5 presentation of vicarious and shock threat films.

Summary

I. Stressful vs. Nonstressful Films

1. Both films designed to induce stressful situations were significantly more emotionally arousing than a neutral film, as judged by spontaneous skin conductance fluctuations.

2. Nonspecific GSR's do not appear to be a sensitive indicator of the quality of stress. Although other measures yielded significance, according to this measure there was no significant difference between vicarious and shock threat.

II. Physiological Concomitants of Vicarious Threat

1. The initial, unexpected presentation of vicarious threat results in minimal physiological reactivity in each of the following skin conductance variables: orienting response, maximum skin conductance increase during the whole trial presentation, and change in tonic level.

2. The cardiac pattern reflects significant deceleration in response to the first visual presentation of vicarious harm.

3. When the painful sequence is repeated on trial 2, and thus when anticipation is present, the following skin conductance measures all show greater increases than on any other trial: orienting response, maximum increase during trial presentation, and change in tonic level.

4. The cardiac response to the second, anticipated presentation of vicarious threat shows neither acceleration nor deceleration.

5. Repeated exposures to vicarious threat suggest physiological arousal is inversely related to the period of time from initial exposure, or the number of exposures, or to a combination of both. This is revealed in significant habituation from trial 2 to trial 5 in the following measures: maximum skin conductance increase during trial presentation, and orienting response.

6. Although both change in tonic level and maximum skin conductance level show increases from trials 2 to 5, these increases do not reach statistical significance.

7. The cardiac pattern to repeated presentations of vicarious threat shows habituation of the decelerative response.

III. Physiological Concomitants of Shock Threat

1. Five trials of shock threat, with no shock administered, result in much greater mean values of skin conductance and heart rate when compared to an equal number of vicarious threat trials with vicarious harm being repeatedly administered.

2. Trial one tonic level and maximum skin conductance level are significantly greater in the shock threat condition than in the vicarious threat condition. Significant habituation of these measures in the shock threat condition reduces this difference to the extent that it is no longer significant by trial 5.

3. The orienting response similarly habituates significantly from trial 1 to trial 5.

4. In contrast, maximum increase in skin conductance during each trial presentation significantly increases from trial 1 to trial 5.

5. Finally, pattern of cardiac response shows continued deceleration over all five trials, with no evidence of habituation.

Discussion

Discussion of the results will focus first on the physiological responses to the two stressful situations and the different impact each had physiologically on the child. The effects of anticipation of vicarious threat, and uncertainty of physical threat, are dealt with in this context. Secondly, the need for care in the choice of physiological measures will be discussed: it seems clear that different measures reflect different physiological processes and thus different conclusions may be drawn. Results will therefore be interpreted in terms of some theories dealing with the significance of heart rate and skin conductance response patterns. Finally, brief comments are made on the implications of the results and their possible application to behaviour therapy.

Assessment of Vicarious and Shock Threat, Anticipation and Uncertainty

Previous research using adult Ss has established the use of spontaneous GSR's as an index of emotional arousal (Kaiser & Roessler, 1970; Bowers, 1971 [b]). Both Kaiser et al., using bland and stressor films, and Bowers, using neutral, shock certain and shock uncertain trials, found number of GSR's to differentiate between neutral and stressful conditions. The present results involving children as Ss add to their findings. Furthermore, they suggest, as did Bowers' results, that this simple measure of the galvanic skin response does not discriminate between different threat conditions.

It is interesting to note in the present study that a relatively mild film can be very effective in producing physiological evidence of stress in children. If judged only by spontaneous GSR's the conclusion could have been that vicarious threat was as physiologically arousing as shock threat. The present results suggest that children do identify with and actively experience the situations depicted in film. Similar results have also been reported using slides of scenes from fairy-tales (Trunova, 1970). Simple films and slides can therefore be used as a very effective and realistic medium for studying the impact of threat and subsequent coping behaviour of young children.

In one of the pioneering studies using films with adults, Alfert in her doctoral dissertation (1964; later published in 1966) compared the physiological reactions to anticipation of three wood-mill accidents with those to anticipation of shock threat. In the latter condition, a series of 'clicks' preceded a mild shock. Since heart rate, skin conductance and self-reported anxiety increased for almost all Ss in both situations, the validity of the vicarious threat film was considered to have been established. Although it was recognized that reactions to the two conditions were different for some individuals, the emphasis in that study, as well as in others using the same data (Opton et al., 1967), was on the personality differences of Ss who reacted more to one situation (shock) than the other (film). Since then, interest has turned more toward studying coping with vicarious threat (Goldstein, Jones, Clemens, Flagg & Alexander, 1965; Lazarus, 1966; Roessler & Collins, 1970), coping with anxiety (Epstein, 1967; Kelly, 1971), or contrasting shock threat with ego threat situations and studying the physiological reactions and self reported anxiety to these two situations (Hodges, 1968; Katkin, 1965). The present results point up some very important differences between vicarious and shock threat which have not previously been stressed and which may have implications for the investigation of coping with various stressful situations.

A striking difference to emerge between the two conditions in the present study was in respect to degree of arousal. Most measures of heart rate and skin conductance suggest that the shock threat situation was considerably more arousing for these children than vicarious threat. This is observed in significantly higher means for heart rate and skin conductance during the combined five trials of shock threat. A further difference between the two conditions concerns pattern of response habituation. In the shock threat condition heart rate deceleration occurred over all five trials, which suggests that the children were maintaining vigilance for uncertainty-removing cues (Bowers, 1971 [a]; Wilson et al., 1967). This pattern did not occur with vicarious threat. Skin conductance response similarly differed for the two conditions. It has been widely noted that uncertainty contributes to anxiety and hence heightened arousal (Berlyne, 1960). In particular, studies using threat of noxious stimuli have found anticipatory arousal to be directly related to degree of uncertainty (Deane, 1966; Elliott, 1966; Zeaman et al., 1965). In the present experiment, threat of shock is confounded with uncertainty. Since these two effects probably combined, it is difficult to ascertain whether the children were responding more to the fear of shock per se or to the uncertainty of receiving it.

Analysis of the various skin conductance responses revealed habituation in some physiological measures of arousal in the shock threat condition. At the same time, however, there were indications of continued heart rate vigilance and alerting similar to that found in adult studies involving uncertainty of shock. Habituation occurred from trial 1 to trial 5 in three out of four electrodermal measures: orienting response (OR), change in maximum skin conductance level (CML), and change in tonic level (CTL). A simple explanation of this could be that the child was adapting to the situation and hence finding it less stressful. However, when the specific response for each trial presentation (MTI) is considered, a more complex explanation seems warranted. Two of the measures which decrease are derived by comparing tonic and peak skin conductance levels for each trial with initial resting level (CTL, CML). Thus it may be hypothesized that decrease in these measures reflect a homeostatic stabilization toward resting level. Simultaneously, however, greater increases in skin conductance response (MTI) are observed for each successive shock threat trial, which would suggest that the child is becoming more anxious or aroused each time he is confronted with the probability of shock. If these two opposing trends of habituation and increasing arousal are taken into consideration, a theoretical explanation which takes into account both the 'state' of the organism and its 'response' would seem more appropriate. The observed pattern of tonic and phasic responses may well be reflecting two simultaneous or even opposing processes that are developing as the child adjusts to threat. The feasibility of such an approach to understanding threat perception receives support from at least two recently-developed theories. Both attempt to explain how the organism copes with intense stimuli over time.

A dual process theory of response habituation has recently been proposed by Groves & Thompson (1970). Two processes are assumed to develop independently in the central nervous system. One is assumed to take place in specific stimulus-response (S-R) pathways, whereas the other is assumed to reflect the general level of responsiveness, or state of excitation or arousal of the organism. A basic assumption of this theory is that every stimulus that evokes a response has two properties: it influences the 'state' of the organism and it elicits a response. These two inferred processes develop independently of one another but interact to produce the net response to repeated stimulation. Groves' et al. approach is experimental and based largely on animal research. They have proposed a neurophysiological model which they support with considerable behavioural and neurophysiological evidence. If we attempt to explain the phenomena observed in the present study in terms of this theory, it may be reasoned that these two inferred processes are reflected in the two forms of skin conductance response which show opposing trends toward habituation and increasing arousal. For example, high levels of tonic and peak skin conductance were observed at the beginning of the shock threat session, but both of these measures showed decreases over trials. Thus they may be reflecting the increased state of excitation of the organism, which gradually habituated over trials. On the other hand, the specific response to each trial presentation (MTI) may be compared to the S-R process which theoretically is responsible for eliciting a response. In the present experiment, where shock was repeatedly anticipated but never received, a significant increase in this measure was observed over trials.

Another theoretical approach is that of Epstein (1967). Developed in large part from observation of human behaviour during stressful situations, it is similar in assuming a two-process theory. To explain the mastery of anxiety he has proposed the existence of "a highly orderly psychophysiological system for modulating the intensity component of all stimulation" (op. cit., p. 3). Having observed the development of increasing gradients of inhibition which counteract gradients of anxiety, he hypothesized that as exposure to stress continues, anxiety becomes inhibited at earlier points in time, or at earlier points on a dimension of cues relevant to the source of stress.

Hence, with increasing mastery, physiological levels are brought more under control, permitting the organism to cope effectively when the impact occurs. Analogously, in the present case, decreasing tonic level (CTL) at the beginning of each trial may be reflecting inhibitory mechanisms, or the 'state' of the organism, while increasing trial-to-trial response (MTI) reflects the anxiety gradient, or immediate 'response' to the stimulus. The net result is peak level attained on each trial (CML), which decreases significantly over trials. If we assume that the children as a group considered shock to be more inevitable as each trial was presented, this would mean that trial 1 to trial 5 represents a dimension of proximity to shock. Thus, as the children approached shock the inhibitory gradient, or decreasing tonic level, was sufficiently effective to counteract the anxiety gradient, or increase in skin conductance response during each trial (MTI). Hence, these opposing processes would explain the decreased levels of skin conductance (CML) which were observed over trials.

In the above interpretation an assumption was made regarding the subject's acceptance of the fact that a shock was inevitable. After each experimental session the children were questioned informally to discover what they were thinking during presentation of the shock threat film. Approximately two thirds of the sample reported that as each trial passed they began to "grit their teeth and wait for the shock to come."

Considering now the pattern of orienting response to the shock threat stimulus, heart rate and skin conductance appear to show rather different effects. Heart rate deceleration is observed over all 5 trials, whereas the skin conductance OR is shown to habituate significantly from trial 1 to trial 5. There has been some controversy regarding the cardiac component of the OR. Although Sokolov made only brief mention of cardiac reactions (Sokolov, 1963), it may be inferred from his discussion of the OR reflex that heart rate acceleration accompanies this response. The majority of other investigators, however, have proposed that the criteria for an OR are met by heart rate deceleration (Graham et al., 1966; Lacey, 1959; Obrist, 1963; Obrist et al., 1970). If this latter criterion is adopted to interpret the results of the present experiment, it would mean that cardiac "awareness" accompanied electrodermal "habituation." Each system, therefore, appears to be responding to different components of the stimulus situation. The occurrence of electrodermal habituation supports Sokolov's (1963) notion that a 'neuronal' model of the visual array has been formed. For the shock threat film, Ss were told exactly when to expect the red flash. They also knew it would be repeated many times. In terms of visual stimulation, therefore, each trial was just a repetition of the first, and so habituation might be expected to occur. In contrast, heart rate appears to be sensitive to more than just the stimulus array: the element of uncertainty appears also to be influencing this response. Previous research has established that when Ss are uncertain about the nature or timing of a stressor, heart rate acceleration may be observed right up to the time of its occurrence (Deane, 1961). Alternatively, when almost "zero ... uncertainty" (Lacey, 1967) exists, deceleration occurs preparatory to a stressful stimulus, even in anticipation of strong shock (Obrist, Wood & Perez-Reyes, 1965). In the present experiment Ss were maximally uncertain as to the trial on which they would receive shock, yet they did know at which point it might occur during the film. Consequently, we find elevated heart rate values on each trial prior to the stimulus signalling shock, and heart rate deceleration commencing a few beats prior to and reaching a maximum three beats following stimulus onset. Since this pattern is consistent across trials, with no evidence of habituation, it suggests that the decelerative component of the heart rate response is performing an "alerting" function for the organism, directing attention and preparing it for the forthcoming stimulus. Inasmuch as the skin conductance OR is not responsive to this element of uncertainty, or preparedness, it would seem that a differentiation between OR responses in these two physiological systems is warranted.

When the vicarious threat situation is considered perhaps the most striking phenomenon is the relatively minimal physiological arousal that occurs with the first unexpected impact of vicarious harm. Even tonic level during presentation of trial 1 decreases to a point well below the initial resting level. It is only on the second trial, when S is fully aware of what is going to happen, that there are indications of stress. All electrodermal measures increase significantly during trial 2: tonic level (CTL), orienting response (OR), and maximum skin conductance response during the trial (MTI). Comparison of skin conductance OR and trial response (OR-vs.-MTI) revealed a significant difference between these two measures on all but the first trial: from trials 2 to 5 MTI was much greater than OR. Thus on each of the trials when threat was anticipated, there was a significant increase in skin conductance over and above that elicited by the harmful stimulus itself. The pattern of OR is also revealing when it is compared with the OR to the shock threat signal, which showed significant habituation following trial 1. In the vicarious threat situation, the very noticeable increase in amplitude of OR on trial 2 led to the inference that the sight of the hammer striking the finger had a greater physiological effect when it was anticipated than when it was not anticipated. It is noteworthy that this increased OR on trial 2 appears to resemble closely the defensive reflex as defined by Lynn (1966) and Sokolov (1963).

In the literature on habituation there are numerous other examples where stimulus repetition gives rise to increased response before habituation begins to occur. Although it has been noted in cases where the stimulus has positive reinforcement value (Hinde, 1966), it occurs more frequently when stimulation involves strong or aversive stimuli (Clifton, Graham and Hatton, 1968; Eisenberg, Coursin & Rupp, 1966; Hutt, von Bernuth, Lenard, Hutt & Prechtl, 1968). A common factor in all these studies was the fact that stimuli of moderate to strong intensity were employed. In real-life situations as well as shock-threat experiments, greater physiological reactivity has also been found when there was a strong element of anticipation of threat. It was observed, for example, that parachutists exhibited greater fear of jumping before the second or third jump than before the first. (Fenz, 1964). Similarly, in a shock threat experiment, Epstein (1971) found greater physiological reactivity to a strong shock stimulus on the second and third days. This led to the assumption that more definite and vivid information leads to the cognitive elaboration of fear. Epstein hypothesizes, however, that after several experiences with threat the individual appraises the situation as one that can be coped with, and thus habituation finally occurs.

The pattern of heart rate response was also quite different for the vicarious and shock threat conditions. On the first presentation of the vicarious threat film there was significant deceleration to the signal for harm; this did not occur on the second trial, when there was in fact no pattern of either acceleration or deceleration. Lacey (1967; Lacey, Kagan, Lacey & Moss, 1963) has proposed that heart rate deceleration is associated with increased sensitivity to stimulation, or "environmental intake." Conversely, he has hypothesized that heart rate acceleration should facilitate "rejection of the environment," and should occur in situations where stimulation is either painful or unpleasant, or where external distractions are likely to interfere with cognitive activity or internal problem solving. Furthermore, in situations requiring both "intake" and "rejection," as for example when visual information is needed for a cognitive task, heart rate should respond as if it were the algebraic sum of these opposing forces. It may be that in the present experiment heart rate is reflecting both "intake" and "rejection," since neither acceleration nor deceleration occurred on trial 2. Thus, as the child is faced with anticipated vicarious threat, there is an indication that some form of cognitive activity or "appraisal" may be taking place while the child is watching or "taking in" the film. The skin conductance orienting response would also appear to add weight to this argument. It will be remembered that trial 2 reflected what appeared to be a "defensive" reflex. This would suggest, therefore, that some form of conflict may be taking place on this second trial as the child "appraises" threat.

Considerable emphasis has been placed thus far on the increased skin conductance response for trial 2. On later trials, however, two skin conductance measures (OR and MTI) showed decreased response to successive presentations of the film: OR reflected habituation to the sight of vicarious harm, and MTI reflected habituation over each trial presentation. They appear to give evidence, therefore, that repeated presentations of anticipated threat have less of an impact over trials.

In conclusion, it would appear that the initial impact of vicarious harm was not as stressful as the same harm when it was anticipated. Moreover, habituation in some physiological measures suggested that some form of adaptation was taking place over trials. It is not clear from the present experiment, however, whether this adaptation was due to repeated exposures to the same threat, or whether an extended period of time over trial presentations permitted some form of cognitive appraisal to take place. In this connection, it is interesting to note that when an extremely traumatic vicarious threat was used with adults (Lazarus & Opton, 1966), habituation of physiological responses did not occur over trials within the same day, but did occur over days. The authors interpreted these findings as suggesting that "cognitive elaboration" was facilitated by an extended time period. Since the relatively mild threat used in the present study did lead to habituation over trials within the same day, it would seem reasonable to assume that the speed of habituation of physiological stress reactions is directly related to the intensity of the threat with which S has to cope. When the threat is "appraised" as less intense, less time is needed to habituate. This may have further implications for the investigation of individual differences in coping: if some Ss perceive the situation as more threatening than others, and therefore more intense, it may take them longer to habituate to the threat then Ss who perceive the situation as less threatening.

The Significance of Physiological Measures

In the above discussion a factor to emerge repeatedly was the sensitivity of different physiological measures to different aspects of the experimental situation. Not only do heart rate and skin conductance respond in diverse ways, but separate measures taken within either of these systems also appear to be responding to different dimensions, such as attention or arousal. Thus, the present study reveals the importance of the choice of measure for investigating specific phenomena.

The advantage of using several physiological measures has long been recognized by psychophysiologists. Ax, for example, used multiple physiological recordings to obtain qualitative descriptions of the emotional states of fear and anger (1953), and to investigate psychophysiological patterns in chronic schizophrenia (Ax, Beckett, Cohen, Frohman, Tourney & Gottlieb, 1962). His measures have included variables such as heart rate, skin conductance, skin temperature, blood pressure, muscle potential and respiration. Wenger has similarly advocated the use of several physiological variables in his investigations of "autonomic balance" in children (Wenger & Ellington, 1943) and in adults (Wenger, 1942). Unfortunately, investigations such as these involve very complicated and lengthy analyses. Perhaps because of this, the majority of recent studies appearing in the literature tend to use only a few physiological measures. Two which have figured prominently in the literature are heart rate and skin conductance (Lacey et al., 1963; Lacey, 1967; Elliott, Bankart & Light, 1970). Theories proposed have suggested that heart rate and skin conductance respond independently of one another and may reflect different types of response to the stimulus situation. In many cases, however, only one measure of heart rate or skin conductance has been taken. Furthermore, different methods have been used to measure these responses, thus making comparison across studies difficult and leading to confusion in interpretation. In the present study several measures of heart rate and skin conductance were taken with the aim that they would reflect different aspects of tonic and phasic response to stimulation.

Lacey's theory of directional "fractionation" states that under certain conditions heart rate and skin conductance respond in different directions: in arousing states when the organism attempts to "reject" the environment both heart rate and skin conductance increase, whereas in a situation requiring "taking in" of the environment heart rate decelerates while skin conductance increases. Many studies support this finding (Adamowicz & Gibson, 1970; Blaylock, 1972; Tursky, Schwarz & Crider, 1970). In the present experiment, beat-by-beat deceleration was observed for each presentation of the shock threat signal, together with increased skin conductance response to each presentation of the film. The inference from Lacey's theory could be that the child was "taking in" the environment. Yet if peak heart rate scores are considered, they suggest that this situation was very arousing for the child. Referring to Figures 12 and 13 it can be seen that even at the point of greatest deceleration, heart rate was still higher during the shock threat condition than during vicarious threat. Hence it would seem that both tonic and phasic measures of heart rate are necessary to assess fully the impact of this condition on the child. Increased peak rate values, or beat-by-beat acceleration may well be a component of the arousal or anxiety response, while short latency deceleration may reflect the extent of attention to stimuli.

Another theory dealing with heart rate and skin conductance is that proposed by Elliott and his colleagues (Elliott, 1969; Elliott, et al., 1970). They have suggested that these two measures differ in their motivational significance: heart rate should increase in response to the "action-instigating" properties of events, whereas skin conductance should increase to arousing or "collative" properties. The term "action-instigating" refers to situations in which responses have to be initiated, or where incentive is present; "collative" properties involve such factors as surprise, complexity, novelty and uncertainty, which it is assumed lead to greater arousal. Their hypothesis asserts quite strongly that "tonic heart rate will not accelerate <u>unless</u> there are responses available, responses instigated and initiated, and response-consequences of importance" (Elliott, 1969, p. 222). In all of their experiments the average of beats during one minute intervals were taken to reflect tonic heart rate. In the present experiment peak rate measures were used over 40-second intervals. When these measures were compared for the vicarious and shock threat conditions it was evident that the latter produced significant heart rate acceleration. Thus heart rate acceleration did occur under conditions where no responses were required. With respect to skin conductance, Elliott's only measure consisted of average tonic readings during the various task intervals. Results led to the hypothesis that skin conductance should increase during arousing situations in which surprise, novelty, complexity or uncertainty play a part. Again in the present experiment we see that tonic skin conductance decreased significantly during the uncertain shock threat condition (Fig. 5). Furthermore, the significant deceleration of heart rate on all trials suggests that heart rate OR is more sensitive to uncertainty than skin conductance, which showed rapid habituation over trials (Fig. 1). With respect to the vicarious threat condition, it may be assumed that the first presentation of vicarious harm involved greater surprise value than succeeding presentations. Figure 1 illustrates that OR was less on this trial than on trials 2 and 3. Moreover, skin conductance increase (MTI) was less on trial 1 than on any of the succeeding trials (Fig. 2). Thus skin conductance in this case did not respond to "surprise." It may be that further refinement is called for in Elliott's theory. This could probably be achieved by using other measures of skin conductance and heart rate as well as tonic levels.

Some investigators have recognized different components of the electrodermal response (Bernstein, 1969; Darrow, 1933; Edelberg & Wright, 1964; Katkin, 1965; Kilpatrick, 1972; Miller & Shmavonian, 1965). Katkin (1965), for example, has drawn attention to differences between phasic and tonic activity, stating that phasic changes reflect emotional responses to experimental conditions while changes in tonic skin conductance reflect cognitive responses to stimulation. Katkin used spontaneous galvanic skin responses as a measure of phasic activity, and Deviation Ratios of skin resistance readings as an index of tonic activity. This latter, in effect, measures proportional change from one reading to another and is comparable to change in skin conductance. (In the present study change in skin conductance was computed for tonic level (CTL), peak skin conductance level (CML), and maximum increase during each trial (MTI). In a series of studies using the same measures as Katkin, Miller et al. (1965) and Kilpatrick (1972) came to similar conclusions: they found that tonic activity increased greatly during both simple and complex cognitive tasks but was minimally responsive to psychological stress, and that phasic activity reflected psychological stress but not cognitive activity. The results of the present experiment similarly suggest that spontaneous activity differentiates between stress and non-stress conditions. On the other hand, this measure was not a sensitive indicator of the quality of stress. While all other measures of heart rate and skin conductance reflected differences between vicarious and shock threat, number of spontaneous responses did not differ significantly for the two conditions. The present findings for tonic level, however, differ from those of Katkin, Miller et al. and Kilpatrick, who found that tonic activity appeared to change mainly as a function of cognitive activity. In the present experiment, shock threat produced much higher tonic levels than vicarious threat. In addition, tonic level was shown to increase from trial 2 to trial 5 of the vicarious threat condition (Fig. 5). It would seem that Katkin's one measure of "tonic" activity, based on changes in skin resistance, is again not sufficient. The present experiment would suggest greater information may be obtained by measuring several changes in skin conductance and attempting to specify the response to which each refers. The following possibilities may merit further study:

1. Tonic level may reflect the 'state' or receptiveness of the individual, and changes in its pattern over time may well reflect homeostatic mechanisms. To illustrate, the first presentation of the neutral film followed by the vicarious threat film produced a significant decrease in tonic level. Since there was no reason to anticipate threat on this first trial (although threat did occur finally), it may be that up until the time of the unpleasant incident Ss were as relaxed as they had been during the rest period, when tonic levels also decreased. Over trials, however, a 'toning up' to a level slightly above that of resting level was achieved. In contrast, in the shock threat situation the original warning that shock would be given produced a large increase in this measure. Evidence of a

homeostatic decline from this ceiling then became evident.

2. Phasic responses, or skin conductance change during periods when the stimulus is presented, appear to be most sensitive to emotional components of the situation: number of spontaneous responses appear to reflect whether or not a situation is stressful, whereas amount of skin conductance change over given periods of time seems to be more sensitive to the qualitative aspects of the situation. As the anticipated threat is presented repeatedly, there is less of an increase on each trial. Conversely, as each shock threat trial is presented, and the likelihood of shock presumably increases, greater increases in skin conductance are observed.

3. The OR appears to be responsive to the stimulus configuration itself. The fact that both films were repeated several times permitted an accurate timing of all parameters of the stimulus array so that a 'neuronal' model could be formed. For shock threat, habituation occurred following trial 1. In the case of vicarious threat, however, it appeared that anticipated threat on trial 2 produced a "defensive" reflex, which then habituated following this trial. Finally, it would appear that the skin conductance OR may be reflecting only one aspect of 'attention.' In an emotionally-arousing situation where alerting for meaningful cues is implied by 'attention' the skin conductance OR does not tap this as efficiently as heart rate deceleration.

Application to Behaviour Therapy

The observation of lowered physiological arousal with repeated film presentations of vicarious threat suggests the possibility of applying this technique to behaviour therapy. Desensitization, based on the premise that progressive relaxation is an important factor in controlling or counteracting autonomic tension (Jacobson, 1938), introduces gradual presentations of the feared stimuli on a hierarchy of least to most frightening. Implosive therapy (Stampfel & Levis, 1968) proceeds from the other direction, using repeated bombardment of emotional stimuli to bring about extinction. The use of vicarious threat films would appear to be a valuable technique for both forms of therapy.

The present results are limited in that they deal only with children and use a very mild form of threat. Nevertheless, these findings do receive support from some of the literature involving the imagined visualizations of anxiety-producing scenes by adults. Grossberg and Wilson (1968), for example, found that successive visualizations of such scenes led to decreases in physiological arousal. In their case also, anxiety-provoking situations were interspersed with neutral scenes. More recently, Edelman (1971) reported habituation in skin conductance as a function of 5 vicarious presentations of anxiety-provoking scenes. There were no intervening neutral sequences but he did provide a 2-minute period free from stimulation to permit the stabilization of physiological measures. An interesting feature of his study was that a high and a low fear group did not differ significantly: when half the *S*s were required to imagine fear scenes which were highest on their hierarchy of fears, and the other half were given fear scenes which were lowest, both groups showed a significant decrease in skin conductance. This is contrary to an earlier prediction by Wolpe (1962) that heightened arousal would follow from repeated presentations of stimuli with high arousal potential. However, it is consistent with more recent findings that autonomic reactions do not decondition faster to weak stimuli than to strong. The results of Van Egeren, Feather and Hein (1971) established that number of skin conductance responses extinguished in direct proportion to the threat value of the stimulus.

Consideration should be given, therefore, to a greater use of film in behaviour therapy treatment. Particularly in research, it would present a much more objective tool than the presently-used and less tangible method of imagined scenes.

EXPERIMENT 2

Physiological Concomitants of Coping and Cognitive Styles

Method

Subjects

The sample consisted of the same 39 Ss that were used in the first experiment. I.Q. ranged from 95 to 136, with a mean of 113.

Coping and Cognitive Style Test Battery

All tests were administered during the summer, five months prior to the administration of the films and recording of physiological data discussed in Experiment 1.

Coping style. The story completion technique has frequently been used to measure children's coping style. A potentially frustrating situation featuring a hero of the same age as the S is presented to the child and he is asked to predict the outcome. Previous research using this test revealed that when children were required to make up their own endings they tended to give responses which reflected optimism, compromise, or pessimism: optimism involves happy endings which ignore or deny painful facts in the frustrating situation; compromise involves themes of partial gratification or delay prior to reaching the goal; and pessimism involves an expectation that the worst possible events actually happen. Subsequently, a multiple choice version of the test was developed which contained these three categories of response. Research using both the free-ending and the multiple choice versions, and involving several different groups of children, has shown that there are developmental changes in response to frustration (Coleman, 1961, 1962; Douglas, 1958, 1965). As children mature, they are more able to cope realistically with frustration: the ability to compromise increases with age, whereas the tendency to deny decreases. The relationships between pessimism and age have been less clear. Furthermore, significant correlations have been found between children's responses and mothers' predictions as to how their children would behave in these situations (Bildfell & Douglas, 1965), and between the responses and popularity ratings given by peers (Douglas, 1958). There would appear, therefore, to be some degree of construct validity to this technique.

In the present study a multiple choice version of the story completion technique was used (Marton & Douglas, unpublished manuscript). It consisted of 14 tape-recorded stories. Each of the stories depicted a situation in which the possibility of attaining a rewarding goal was threatened by an act on the part of a peer. For example, in one case a boy carefully builds a model of the city for a contest. Just prior to the contest, and after several people have commented on how good the model is, another boy passes by and accidentally brushes the model with his sleeve; the model falls to the floor. The child's reaction to frustration was then assessed by requiring him to choose one of three possible endings, featuring compromise, denial or pessimism. In the compromise ending the model was broken just a little and it was possible to mend it sufficiently to enter it in the contest. In the denial ending there was not even a scratch on it, and it even won first prize. Finally, the pessimistic ending suggested that the model broke into little pieces and there was no time to make another before the contest.

Scores for each type of response were totalled. Hence the test produced scores on 3 scales. The present experiment used two of these scales: compromise and denial. One aim of the experiment was to assess whether the physiological responses of the reality-oriented child to a life-like vicarious frustration differed from those of a child who characteristically denied reality. A high score on compromise reflected the extent to which the child was reality oriented; similarly, a high score on denial reflected the degree to which the child denied reality. Since the pessimistic scale has appeared in other studies to be tapping a qualitatively different type of response, it was decided to exclude these responses from the analysis.

Cognitive styles. Field dependence-independence: The Children's Embedded Figures Test (CEFT) (Karp et al., 1963) was used to measure field dependence-independence. Two series of simple figures embedded in complex designs are presented to the child. In the first "tent" series he is required to identify a triangle of specific dimensions which is embedded in each of

11 coloured designs of varying complexity. The second series uses a house-shaped figure and consists of 14 designs. Only one trial per item is allowed and there is no time limit. The score is the total number of figures located correctly. Maximum score possible is 25. A prior demonstration of the embedding process was given to the child. Testing was discontinued after five consecutive failures.

Split-half reliabilities for the CEFT are high: correlations of .83 to .90 have been reported (Karp et al., 1963). The children's version of the test has also been compared in a sample of older children with the adult version: correlations of .70 to .86 have been reported (Karp et al., 1963). The stability of this style is also impressive. In a long term study measuring field dependence, boys were followed from the age of 10 to 24. Correlations as high as .66 were reported over this 14-year period (Witkin et al., 1967).

Reflection-impulsivity: The Matching Familiar Figures Test (MFF) (Kagan et al., 1964) was used to measure reflection-impulsivity. It consists of 14 sets of pictures of familiar objects and animals. Of these the first two are practice sets. In each case the child is shown a standard picture together with six very similar ones. He is required to choose from the six stimuli the one which is identical to the standard. If an incorrect response is given, the child is asked to look again. A maximum of six trials per set of pictures is allowed. Latency to the first response and number of errors is scored. Mean latency and mean number of errors for the 12 test items were the two scores used in the analysis.

Test-retest correlations of .25 to .50 have been reported for this test using primary grade children over a period of one year (Kagan, 1965). Measures of reflection-impulsivity have also been related to performance in a variety of tasks, including reading (Kagan, 1965), serial learning tasks (Kagan, 1966), tests of inductive reasoning (Kagan et al., 1966 [a]) and tests of visual analysis (Kagan et al., 1964).

Intelligence: The Wechsler Intelligence Scale for Children (WISC) was used to estimate intelligence. Three subtests were administered according to standard instructions (Wechsler, 1949). Two verbal subtests, vocabulary and comprehension, and one performance subtest, picture completion, were pro-rated to give a rough measure of intelligence.

Procedure

The intelligence, coping and cognitive style tests used in this experiment were administered over a period of three weeks. They were part of a more extensive battery of psychological tests which formed the basis of a correlational study (Marton & Douglas, unpublished manuscript). The films and physiological measures described in Experiment 1 were administered 5 months later, during the winter, since investigators have commented on the inadvisability of conducting physiological experiments during the hot, humid summer months (Wenger, 1962).

Physiological Recording Apparatus and Testing Procedure, Stimulus Presentation, and Treatment of Physiological Data

The physiological data taken during the presentation of the films, and reported in the first experiment, were used in this study. Hence all previous descriptions regarding apparatus, stimulus presentation, testing procedure and treatment of physiological data apply also to this experiment

Statistical Treatment of the Data

Bivariate correlations were used to correlate coping and cognitive styles with resting levels of heart rate and skin conductance and number of spontaneous galvanic skin responses during the vicarious and shock threat conditions. For further analysis of the skin conductance data the main statistical technique used was multiple regression. For each S physiological responses for the 5 trials of each of the measures derived (orienting response [OR], maximum trial increase [MTI], change in tonic level [CTL], and change in maximum skin conductance level [CML] were used as predictors of scores on the individual coping and cognitive style tests. In this way it is possible to assess the relationship of scores on each of the tests to the various physiological measures over all trials in the vicarious and shock threat conditions.

Results

Coping and Cognitive Style Measures

Table 2 presents means, standard deviations and ranges for scores on the two coping style measures. Table 3 presents analogous data for the two cognitive style tests.

The group as a whole was predominently compromising, reflective and field independent. Plotted distributions of these test scores indicated a tendency toward skewed distributions with a few Ss scoring on the denial, MFF error and field dependent extremes (c.f. Appendices 20 and 21).

Physiological Data

Resting levels of heart rate and skin conductance. Bivariate correlations were performed between skin conductance and heart rate resting levels and scores on each of the coping and cognitive style tests. Table 4 presents the data for skin conductance and heart rate.

The CEFT was the only test which correlated significantly with resting skin conductance and heart rate measures: .34 ($p < .03$) with skin conductance, and .37 ($p < .01$) with heart rate. This indicated that Ss scoring high on field independence tended to have higher skin conductance and heart rate resting levels than field dependent Ss.

Heart rate and coping and cognitive styles. For the most part, the heart rate analysis failed to yield consistent or meaningful correlations between coping and cognitive styles and

Table 2

Means and Standard Deviations of Coping Style Responses

Coping Style	Mean	Standard Deviation	Standard Error	Maximum	Minimum
<u>Compromise</u>					
No. of Compromise Responses	8.122	2.704	0.422	12	1
<u>Denial</u>					
No. of Denial Responses	2.641	2.158	0.346	10	0

Table 3

Means and Standard Deviations of Scores on the Cognitive Style Tests

Cognitive Style	Mean	Standard Deviation	Standard Error	Maximum	Minimum
<u>Reflection-Impulsivity</u>					
Mean Latency (in seconds)	18.225	11.973	1.917	52.29	3.96
Mean No. of Errors	0.617	0.438	0.068	1.83	0
<u>Field Dependence-Independence</u>					
No. of Correct Responses	19.659	3.752	0.586	25	9

Table 4

Bivariate Correlations Between Resting Skin Conductance and Heart Rate Levels and Scores on the Coping and Cognitive Style Measures

	Coping Style		Cognitive Styles		
	Compromise No. of C. Resp.	Denial No. of D. Resp.	Reflection-Impulsivity $\bar{X}$ Latency	$\bar{X}$ No. of Errors	Field of Dep.-Indep. No. of Correct Resp.
Skin Conductance Resting Level (in umhos)	0.0699	0.0091	-0.0186	0.0655	0.3498*
Heart Rate Resting Level (in b/p/m)	-0.0051	-0.0659	-0.0070	0.0934	0.3771**

*$p < .05$
**$p < .01$

measures of heart rate acceleration and deceleration. These data will therefore not be reported.

Skin Conductance

Spontaneous responses. Bivariate correlations were used to assess the extent to which scores on each of the coping and cognitive style measures were related to number of spontaneous GSR's emitted during the vicarious and shock threat films. Table 5 presents the correlation coefficients for both films.

For the vicarious threat condition the following relationships were found. Compromise yielded a significant correlation with number of GSR's ($r = -.37$, $p < .02$). This indicated that Ss who gave more realistic or compromise solutions to the frustrating situations on the story completion test showed less spontaneous activity during threat. Both measures of the Kagan test of reflection-impulsivity were related to number of GSR's; MFF errors correlated .33 ($p < .04$) and latency -.29 ($p < .07$). Thus, children who characteristically commit more errors as well as those who respond more hastily on the MFF tend to show greater spontaneous activity than the slower, more accurate child.

For the shock threat condition only one significant correlation was found: compromise yielded a significant correlation of -.31 ($p < .05$) with number of spontaneous responses. A high score on compromise is therefore related to less spontaneous activity during this type of stress.

Table 5

Bivariate Correlations Between Scores on Each of the Coping And Cognitive Style Measures and Number of Spontaneous GSR's During the Vicarious and Shock Threat Conditions

	Coping Style		Cognitive Styles		
	Compromise No. of C. Resp.	Denial No. of D. Resp.	Reflection-Impulsivity $\bar{X}$ Latency	Reflection-Impulsivity $\bar{X}$ No. of Errors	Field Dep-Indep. No. of Correct Resp.
Vicarious Threat Condition					
Total No. of GSR's (pro-rated)	-0.3715**	0.1475	-0.2961*	0.3395**	-0.1619
Shock Threat Condition					
Total No. of GSR's	-0.3151**	0.0140	-0.1538	0.1940	-0.2372

* $p < .10$

** $p < .05$

Orienting response. Table 6 presents results of the multiple regression of the OR with coping and cognitive style tests for the vicarious threat condition. Data for shock threat appear in Table 7. A significant multiple correlation coefficient reflects the relationship between the physiological responses over the 5 trials and scores on the coping and cognitive style tests. The individual regression coefficients for each trial can be compared to a correlational analysis. They reflect the 'weight' or contribution of each trial to this overall relationship. Hence a significant positive regression coefficient would indicate that on that specific trial, Ss scoring high on the test tended to respond with greater magnitude than Ss scoring low on the test.

For the vicarious threat condition the OR response over trials yielded a significant multiple correlation coefficient with compromise ($R = .54$, $p < .05$). The individual regression coefficients indicate that on 4 of the 5 trials Ss scoring high on compromise show orienting responses of less amplitude than Ss scoring low on this scale. Only one of these regression coefficients, however, is significant, and the one trial which shows a positive relationship with compromise is also significant. Since the denial and compromise scales are interrelated, it is not surprising to find a significant multiple correlation coefficient for denial also ($R = .53$, $p < .05$). Here the regression coefficients for each trial indicate that on 4 of the 5 trials tendency to deny reality is positively related to the

Table 6

Multiple Regression of Vicarious Threat Orienting

Response with Coping and Cognitive Style Measures

Tests	Multiple Correlation Coefficient	Standardized Regression Coefficients Trials 1	2	3	4	5
Coping Style						
Compromise	0.54927*	-0.25789	-0.27063*	0.43613***	-0.27622	-0.14681
Denial	0.53430*	0.16508	0.21772	-0.28543	0.43525***	0.11205
Cognitive Styles						
MFF Errors	0.26749	0.08194	0.15539	-0.11378	0.20374	-0.01256
MFF Latency	0.27833	-0.22787	-0.01284	-0.00867	-0.12359	0.04270
Field Dep.-Indep.	0.39233	0.03654	-0.31340*	0.22359	-0.27451	-0.07124

* $p < .05$

** $p < .02$

*** $p < .01$

Table 7

Multiple Regression of Shock Threat Orienting

Response with Coping and Cognitive Style Measures

Tests	Multiple Correlation Coefficient	Standardized Regression Coefficients				
		Trials				
		1	2	3	4	5
Coping Style						
Compromise	0.35305	-0.39285	-0.11868	0.20259	-0.12162	0.22109
Denial	0.31784	0.38435	0.18828	-0.22665	0.03207	-0.31510
Cognitive Styles						
MFF Errors	0.08268	-0.04255	-0.09427	0.08503	-0.02894	0.03257
MFF Latency	0.40609	0.12704	-0.01433	-0.18651	-0.19516	0.46715***
Field Dep.-Indep.	0.50694	-0.30192	0.62814**	-0.26792	-0.50573***	0.04199

*p< .05
**p< .02
***p< .01

amplitude of skin conductance OR. Once again, however, only one of these regression coefficients is significant (trial 4). The OR response is frequently used to reflect degree of habituation to signal stimuli. Regression analysis, however, does not indicate habituating trends: it provides information on the relative magnitude of response of Ss scoring high or low on the test. To give a rough estimate of whether habituation may have been occurring in this condition, a graph of Ss scoring above and below the mean on compromise and denial was plotted. Appendices 22 and 23 present these data. With respect to the distribution of compromise responses, it can be seen that after Trial 2 (the trial in which anticipation of vicarious threat was introduced) habituation over trials appears to be occurring most clearly for the Ss scoring high on compromise. When the group is divided according to scores on the denial scale, however, the habituation curves of high and low scorers do not appear to differ greatly.

Cognitive styles show no significant relationship to orienting responses during vicarious threat. Similarly, for shock threat there were no significant relationships between the OR response and coping and cognitive styles.

Maximum increase in skin conductance during each trial (MTI). Tables 8 and 9 present the multiple regression data for MTI responses during the vicarious and shock threat conditions respectively.

Table 8

Multiple Regression of Vicarious Threat MTI

With Coping and Cognitive Style Measures

Tests	Multiple Correlation Coefficient	Standardized Regression Coefficients Trials 1	2	3	4	5
Coping Style						
Compromise	0.41953	-0.22661	0.04086	-0.34046*	-0.01247	-0.03652
Denial	0.55729*	0.11196	-0.17344	0.51119****	0.18025	0.12263
Cognitive Styles						
MFF Errors	0.43589	-0.00870	-0.28171	0.47498***	-0.09457	0.08307
MFF Latency	0.38237	-0.28870*	0.04301	-0.27610	0.04854	0.20760
Field Dep.-Indep.	0.42461	0.09444	0.42182*	-0.36381***	-0.41227**	-0.07153

*p< .05

**p< .025

***p< .01

****p< .001

Table 9

Multiple Regression of Shock Threat MTI

With Coping and Cognitive Style Measures

Tests	Multiple Correlation Coefficient	Standardized Regression Coefficients Trials				
		1	2	3	4	5
Coping Style						
Compromise	0.22965	0.09335	-0.14472	0.03379	-0.21926	0.01271
Denial	0.34122	-0.22250	0.21967	-0.18110	0.44522	-0.13653
Cognitive Styles						
MFF Errors	0.10916	-0.16718	0.09711	-0.01924	0.09474	0.02645
MFF Latency	0.34105	0.32637	0.11636	-0.21969	-0.27611	0.06176
Field Dep.-Indep.	0.54629*	0.14200	0.56162***	-0.10795	-0.40002***	-0.49503***

*$p < .05$

***$p < .01$

Once again, physiological response to vicarious threat shows a relationship to coping style: the denial scale yields a multiple correlation coefficient of .55 ($p < .05$). Four of the five trials are positively related to the denial scale, although only one of these is significant. This indicates the tendency for high deniers to react with greater electrodermal response to stress than low deniers.

In the shock threat condition, MTI shows no significant relationship with coping styles. With respect to cognitive styles, the CEFT yields a significant multiple correlation coefficient ($R = .54$, $p < .05$). The individual regression coefficients indicate a positive relationship on the first two trials. Of these only trial 2 is significant. Trials 3, 4 and 5 show negative relationships, and of these two are significant. Thus field independent Ss react with greater skin conductance increase than field dependent Ss on the early trials, but on trials 3, 4 and 5 this relationship is reversed: relative to field dependent Ss, field independent Ss appear to react with lesser increases in skin conductance as continued experience with shock threat continues. Since this pattern implied that either increasing arousal or habituation might be occurring in one of the groups, a further analysis was conducted. Two groups were formed by taking those Ss who scored above or below the mean on the field dependence-independence distribution. Appendix 24 illustrates the responses over trials for these two groups. It can be seen that on trials 2 to 5 field dependent

Ss respond with greater increases in skin conductance, and thus show a trend for increased arousal over later trials. Field independent Ss, however, show little change in response from trials 2 to 5.

Change in tonic level over trial presentations (CTL). This measure reflects the degree to which tonic level at the beginning of each trial changes with respect to initial resting level. Tables 10 and 11 present the multiple regression data for the vicarious and shock threat films.

For the vicarious threat condition both the CEFT and the error scale of the MFF yield significant multiple correlation coefficients. For the latter, however, ($R = .61$, $p < .01$) the individual regression coefficients reflect no consistent pattern of responses over trials. The pattern for field dependence-independence is also rather unclear. All that may be said is that initially on trial 1, prior to the introduction of vicarious threat, and later on trials 4 and 5, field independent Ss show less change above resting tonic level than their field dependent counterparts. The relationship only reaches significance, however, on the first trial.

For shock threat, CEFT yields a significant multiple correlation coefficient ($R = .59$, $p < .025$). Individual regression coefficients, however, do not suggest any consistent pattern of response from trial 1 to trial 5.

Change in maximum skin conductance level over trials (CML). Tables 12 and 13 give the multiple regression data for change

Table 10

Multiple Regression of Vicarious Threat CTL

With Coping and Cognitive Style Measures

Tests	Multiple Correlation Coefficient	Standardized Regression Coefficients Trials 1	2	3	4	5
<u>Coping Style</u>						
Compromise	0.40308	0.01068	-0.22811	0.56509*	-0.39928	-0.39141
Denial	0.32451	0.09842	-0.07098	-0.63637*	0.33663	0.28856
<u>Cognitive Styles</u>						
MFF Errors	0.61445***	0.03863	0.04123	-0.84124***	1.25781****	-0.15225
MFF Latency	0.45057	0.10609	-0.30196	0.31034	-0.52436	-0.11649
Field Dep.-Indep.	0.55560*	-0.37900**	0.20555	0.24766	-0.21260	-0.42073

*p< .05

**p< .025

***p< .01

****p< .001

Table 11

Multiple Regression of Shock Threat CTL

With Coping and Cognitive Style Measures

Tests	Multiple Correlation Coefficient	Standardized Regression Coefficients Trials 1	2	3	4	5
<u>Coping Style</u>						
Compromise	0.49432	-0.35973	1.69919	0.45161	-0.02115	-2.09965***
Denial	0.49918	-0.13615	-0.90615	0.01773	-1.51186	2.70420****
<u>Cognitive Styles</u>						
MFF Errors	0.12380	-0.31695	0.04160	-0.30374	0.51720	0.13948
MFF Latency	0.44474	0.85249	-1.35189	2.62902***	-0.98820	-1.21172
Field Dep.-Indep.	0.59530**	-0.50407	0.00482	1.45041*	0.47384	-1.91057***

*p< .05
**p< .025
***p< .01
****p< .001

in maximum skin conductance level (CML). This measure reflects the difference between resting tonic level and the ceiling reached during each trial presentation.

For the vicarious threat film CEFT shows a significant relationship to CML: R = .61, ($p < .01$). On four of the five trials, negative regression coefficients indicate that field independent Ss respond to vicarious threat with less increase in skin conductance than field dependent Ss. Only one of these regression coefficients, however, is significant. Furthermore, the one trial to show a positive relationship to CEFT was also significant. On the first trial, before threat is introduced, and on the last 3 trials, field independent Ss show less increase than field dependent Ss. However, on trial 2 when threat is first introduced this relationship is reversed.

In the shock threat condition the same cognitive style shows a relationship with CML: CEFT R = .69 ($p < .001$). Once again, relative to field dependent Ss, field independent Ss show a tendency to react with less increase in skin conductance on trial 1 and on trials 4 and 5. Two of these regression coefficients are significant. Trial 2, however, which shows a positive relationship with CEFT, is also significant.

Since the relationship between CEFT and CML responses yielded multiple correlation coefficients which were significant at the .01 and .001 level in the two stressful conditions, graphs were again plotted for Ss scoring high and low on this test. Appendices 25 and 26 present this data. Once more it

Table 12

Multiple Regression of Vicarious Threat CML

With Coping and Cognitive Style Measures

Tests	Multiple Correlation Coefficient	Standardized Regression Coefficients Trials 1	2	3	4	5
Coping Style						
Compromise	0.39873	-0.13449	-0.17774	-0.34902	0.11394	0.06957
Denial	0.32761	0.05318	0.19957	0.54070	-0.40165	-0.04213
Cognitive Styles						
MFF Errors	0.32882	0.16102	-0.25421	0.08824	0.28681	-0.04783
MFF Latency	0.38398	-0.16316	-0.02431	-0.27409	-0.04643	0.14382
Field Dep.-Indep.	0.61262**	-0.59013***	0.64285***	-0.17023	-0.42957	-0.18821

**p< .01

***p< .001

Table 13

Multiple Regression of Shock Threat CML

With Coping and Cognitive Style Measures

Tests	Multiple Correlation Coefficient	Standardized Regression Coefficients				
		Trials				
		1	2	3	4	5
Coping Style						
Compromise	0.39943	-0.16750	0.72484	0.48555	-0.44034	-0.94453
Denial	0.33954	-0.70475	-0.43684	-0.46319	0.98087	0.79457
Cognitive Styles						
MFF Errors	0.17170	-0.71110	0.47972	-0.23811	0.65644	-0.10948
MFF Latency	0.36479	1.08002	-0.55399	1.13727	-2.05792***	0.32537
Field Dep.-Indep.	0.69191***	-1.17237*	2.25741**	1.05494	-0.83362	-1.81169***

*$p < .05$
**$p < .01$
***$p < .001$

can be seen that field dependent Ss respond with greater increases in skin conductance than field independent Ss under both stressful conditions. There also appears to be some tendency for the differences between the two groups to increase on later trials.

Summary

I. Resting Levels of Heart Rate and Skin Conductance

1. The CEFT was the only test to correlate significantly with resting skin conductance and heart rate measures. Field independent *S*s tend to have higher resting levels of skin conductance and heart rate than field dependent *S*s.

II. Physiological Response to the Vicarious Threat Condition

1. Number of spontaneous galvanic skin responses was related to one coping and one cognitive style test. A significant negative correlation with compromise indicated the tendency for those high on compromise to react with fewer spontaneous responses than those low on compromise. A significant negative correlation with MFF errors indicates that the reflective child shows less spontaneous activity than the impulsive child.

2. Orienting response was related to the compromise and denial scales of the coping style test. On four of the five trials greater amplitude of response on later trials was related to the tendency to deny reality; conversely, lesser amplitude was related to the tendency to compromise.

3. Increase in skin conductance during each trial presentation showed a significant relationship with denial: those high on denial tended to respond with greater increases than those low on denial.

4. Change in tonic level over trials was related to two cognitive style tests: MFF errors and CEFT. For MFF errors no

consistent pattern could be detected over trials. For CEFT there was a tendency for field independent Ss to show less change in tonic level than field dependent Ss on trials 1, 4 and 5.

5. Change in maximum skin conductance level was related only to CEFT. On 4 of the 5 trials, field independent Ss showed less tendency than field dependent Ss to increase skin conductance levels.

III. Physiological Response to Shock Threat

1. There was a negative relationship between compromise and number of spontaneous responses, with Ss scoring high on this scale showing fewer responses than Ss who scored low.

2. Orienting response showed no relationship to any of the coping or cognitive style tests.

3. Maximum increase in skin conductance to each trial presentation was related only to CEFT. Relative to field independent Ss, field dependent Ss showed less increase in skin conductance on trials 1 and 2, but greater increases in response over trials 3, 4 and 5. A graph indicating the response for high and low scorers on this test reflected a tendency toward increasing arousal over trials in this latter group.

4. Change in tonic level was also related to CEFT, but individual regression coefficients did not reveal any consistent pattern over trials.

5. There was also a significant relationship between CEFT

and change in maximum skin conductance level. On 3 of the 5 trials, field independent Ss showed less increase in maximum skin conductance level than field dependent Ss.

Discussion

The foregoing results indicate that there are some relationships between an individual's typical coping and cognitive styles and his psychophysiological response to stress.

Coping Styles

Whether a child has a tendency to compromise or deny in the face of frustration appears to have no relationship to autonomic heart rate and skin conductance measures during rest. The physiological differences appear only when the environment becomes stressful.

Considering first the simplest measure of skin conductance and the one which has been used most consistently as an indicator of stress, it will be recalled from Experiment 1 that non-specific GSR's did not differentiate between vicarious and shock threat conditions. It appeared that this measure reflected whether or not the condition was stressful, regardless of the type of stress. Other investigators have also found that this measure does not distinguish between different forms of stress (Bowers, 1971 [b]). For the vicarious and shock threat conditions, compromise correlated negatively with total number of GSR's. The child who is more able to cope with frustration is thus less affected by both kinds of stress than the less realistic child. An experiment by Thiesen and Meister (1949) is relevant to this finding. They also reported skin conductance lability to be greater in children judged to be more disturbed by a frustrating situation. In their case, however, behavioural measures of disturbance were rated by observers during the course of the experiment.

Another physiological measure which seems to be related to coping style is increase in skin conductance during each presentation of the vicarious threat film (MTI). This response, together with spontaneous activity, appeared in Experiment 1 to be reflecting specific or immediate reactions to the stressful situation. In this experiment the regression analysis revealed increase in trial response (MTI) to be significantly and positively related to denial. Although the relationship was not significant for compromise responses, a multiple correlation coefficient of .42 ($p < .25$), together with negative regression coefficients on 4 of the 5 trials, indicates a tendency for the reverse of the relationship with denial. These results suggest, therefore, that when the child who does not cope realistically with frustration is faced with threat of a vicarious nature he is more likely to show increases in skin conductance than the reality-oriented child.

Two theoretical hypotheses may be advanced in interpreting this relationship. One concentrates on the physiological reactions themselves and the other on the meaning the child attributes to the threat, as well as the impact of the threat on him. In the first case it may be that children who are able to face up to reality have higher physiological thresholds to withstand stress: threat of a greater intensity may be required to elicit reactions in these children than in children who typically shun reality. Consequently, in any given stressful situation they may be able to cope more effectively because threat has less of a physiological impact on them. This causal relationship can be compared to the James-Lange (1922) theory of emotion, which considered physiological changes in the body to trigger or cause emotional reactions. Thus the child who is physiologically vulnerable is frequently forced to use defence mechanisms which remove him from the threatening situation.

The second alternative hypothesizes that the cause and effect relationship works in the opposite way: first the individual makes a subjective evaluation, and this in turn influences autonomic responses. A considerable body of literature dealing with threat supports this possibility (Appley & Trumbull, 1967; Janis, 1958; Lazarus, 1966). Justification for adopting this view may also be found in the present study when the differences which distinguish vicarious from shock threat are considered. In the vicarious threat condition threat was at first unexpected but then it was experienced several times. Shock threat involved anticipation of a threat which was both temporally uncertain and never experienced. Subjective evaluation of the stressful situation is thus more likely to be effective in the vicarious threat condition than in the shock threat condition, since it may be argued that in order to "appraise" threat and to come to terms with it, it is necessary that the individual have a clear idea of what is involved. In the present study, this condition prevails only for vicarious threat. On five successive trials the child is presented with the same vicarious harm. Consequently, decreases in skin conductance were observed from trial 2 to trial 5. This, however, did not occur in the shock threat condition, where a significant increase was observed from trial 1 to trial 5. It has been suggested, also, that repeated exposures to disturbing events may result in a reduction of the painful reactions associated with them: in commenting on the repetition dreams of the neurotic, Fenichel (1945) has suggested that control is gained when the individual experiences again and again in his dream what once had to be gone through in the trauma. In the present study, in the vicarious threat condition, repeated presentations of the harmful experience did result in reduced physiological responses.

Time is another factor which may have been influencing differences in reactions to vicarious threat between high and low deniers. Reference has already been made to the research of Folkins (1970) and Lazarus (Lazarus et al., 1966). Their findings indicated that longer periods of time permitted an evaluation, or appraisal of threat which led to the lowering of its impact physiologically. In Lazarus' experiment, when a defence-oriented commentary preceded the film, lower physiological responses were recorded than in the case where the same commentary accompanied the film. Folkins' study indicated a warning period of one minute was much more stressful than a period of 3 or 5 minutes, during which time S could prepare for the impact of shock. The inference for the present study would be that after two presentations of the film the child who can cope realistically with unpleasantness more readily appraises the vicarious threat as less threatening than it at first appeared. This process seems to be closely related to what the coping style test is attempting to tap: the ability to come to terms with frustration, to assess its consequences and to find realistic ways in which to overcome it.

One other skin conductance measure which reflected a correspondence between coping style and physiological reactions to vicarious threat was the orienting response. The significant relationship which occurred between OR and two of the coping style measures lends some support to the foregoing interpretation. Both compromise and denial were significantly related to the pattern of OR response: on 4 of the 5 trials, compromise was related negatively whereas denial was related positively to amplitude of response. It has been suggested that habituation of the OR reflects the speed with which a 'neuronal' model of the stimulus configuration is formed (Sokolov, 1963). If we consider amplitude of response to the threatening stimulus as an orienting response during the vicarious threat film, habituation of this response over trials would reflect the rate at which this 'neuronal' model is being formed. When the group was divided according to the mean it was observed on the compromise distribution (Appendix 22) that a curve suggesting habituation occurred only for those scoring high on compromise.

It may be inferred, therefore, that the reality-oriented child more quickly formed a 'neuronal' model, or more quickly assimilated all parameters of the threatening stimulus than the less realistic child.

An alternative interpretation, however, is also possible. It may be that the increased intensity of response which was observed on the second trial in Experiment 1 would warrant considering it as a defensive reflex (Lynn, 1966; Sokolov, 1963) rather than an OR. If this interpretation is adopted, then the negative regression coefficients for high compromisers and low deniers, as well as the graphs presented in Appendices 22 and 23, would suggest that the reality-oriented child shows less of a defensive reflex than the child who typically denies reality. The latter in effect is more "defensive" physiologically.

The two remaining skin conductance measures were both derived by comparison with resting level: they measure change in tonic level and change in maximum skin conductance level during each trial presentation. It will be remembered that analysis of these measures in Experiment 1 did not reveal any significant group trends for arousal or habituation in the vicarious threat condition. Furthermore, it was suggested that they reflected changes in emotional state as opposed to immediate response to stimulation. In the regression analysis neither of these measures was related to compromise or denial. There were, however, significant relationships between coping style and measures which reflected a specific response to each trial: for example, orienting response, maximum increase during each vicarious threat trial, and number of spontaneous responses. It would seem, therefore, that coping is related to those measures which reflect a response to threat at the time it is being experienced. It is not related to measures reflecting changes in general tonic level or emotional state.

In the shock threat condition compromise and denial were related only to number of spontaneous responses. None of the other physiological measures showed any relationship to these two scales. Thus in a shock threat situation, which, according to Experiment 1, was more arousing for this group of children, coping styles appear to have been no longer effective in modifying physiological responses. Thus, a child's propensity to compromise or deny when faced with frustration appears to be irrelevant when the transition is made from a mildly threatening situation to a more stressful one. It is interesting that previous studies using shock threat have so far failed to find a relationship between an individual's coping style and his physiological response during this type of stress (Folkins, 1970).

Another important factor which may contribute to this lack of correspondence between the coping measures and reaction to shock threat is the child's relative helplessness in this situation. In the present experiment he had no control over whether or not he received shock; furthermore, he had no way of even knowing when this might occur. There has been much discussion in the literature on this topic of control. It would seem that in cases where an S is led to believe he can control the timing or intensity of an aversive stimulus, decreased measures of physiological reactions are observed (Champion, 1950; Corah & Boffa, 1970). This has been found even in the case where the belief was incorrect (Geer, et al., 1970). In the present experiment this lack of control concerning the administration of shock may have affected the child's ability to cope. It seems likely that the uncertainty inherent in this condition precluded any cognitive preparation for the impact.

Cognitive Styles

Reflection-Impulsivity. Number of nonspecific GSR's elicited during vicarious threat appears to be related to reflection-impulsivity. Both scales of the MFF yield significant correlations: number of errors correlates positively and latency to first response correlates negatively. Since taken together these scales define reflection-impulsivity, we may infer that the impulsive, error-prone child is more labile autonomically than the reflective, accurate child. Relevant to this are numerous references in the literature concerning physiological attributes of individuals who respond impulsively. Luria (1932), for example, speaks of the relatively labile individual who cannot inhibit responses, and Lacey et al. (1958) found those who were more labile on skin conductance and heart rate measures committed more errors in discrimination on reaction time tasks. Other researchers have similarly linked spontaneous activity with motor impulsivity (Boyle, Dykman & Ackerman, 1965; Kagan et al., 1963).

Together with reflection impulsivity the compromise scale of the coping style test also correlated significantly with number of GSR's. Since several investigators have used this measure of skin conductance as an index of emotional arousal in an experimental situation (Bowers, 1971 [b]; Kaiser et al., 1970), it may be said that the vicarious threat condition provoked increased emotional arousal in children classified as impulsive as well as in those who appeared to be ineffective in dealing with reality. This relationship between reflection-impulsivity and coping styles is reflected in recent findings pointing to the inability of the impulsive child to deal effectively with frustrating situations (Campbell, 1969; Douglas, in press). Since the impulsive child appeared more vulnerable physiologically than the reflective child when confronted with a mildly threatening situation, this would appear to give physiological support to these previous studies.

Multiple regression provided a more detailed analysis of patterns of physiological response over all five trials of the vicarious and shock threat conditions. In this analysis only one skin conductance measure yielded a significant relationship with this test: change in tonic level (CTL) for the vicarious threat condition revealed a significant multiple correlation coefficient with MFF errors ($p < .01$). The meaning of this relationship, however, was not clear from observation of the individual regression coefficients for each trial. An explanation which may partially account for these confusing results is offered as follows. Ordinarily reflection-impulsivity is defined by both errors and latency (Kagan et al., 1964). Thus, those scoring above the mean or median in latency and below the mean or median in number of errors would be classified as reflective. Conversely, to be considered impulsive a child must be both fast and inaccurate. In the present study a plot of scores for both these scales was made for the whole group (Appendix 27). The 12 Ss who were fast yet accurate would normally have been excluded from an analysis using group divisions. The multiple regression analysis, however, necessitated the inclusion of all Ss. Furthermore, since this analysis also involved the use of the two scales individually, it may be that we were tapping only an error or a speed dimension, rather than reflection-impulsivity per se.

Field dependence-independence. One of the most interesting results concerning the CEFT, and one which presents some difficulties in interpreting physiological responses of children scoring high and low on this test, is the finding that it is correlated with both heart rate and skin conductance resting levels. Since field independence is related to higher resting tonic levels on both of these physiological measures, this raises the question of the Law of Initial Values (LIV). As mentioned in the methods section, this law states that the magnitude of response is related to the prestimulus level: the lower the prestimulus level the greater will be the magnitude of response to stimulation. In the present study all skin conductance measures were converted to log values to take account of this law. Nevertheless, in view of the basic physiological differences between field dependent and independent Ss in resting level, reservation may be warranted in interpreting these results. It is interesting, for example, that the physiological measures which were consistently related to scores on this cognitive style test were those which were derived by comparing tonic and peak values with resting tonic level (CTL and CML). In the vicarious as well as the shock threat condition both these measures were related to field dependence-independence. With respect to CML, the trial regression coefficients, together with the graphs (Appendices 25 and 26), revealed that field dependent Ss responded with greater increases in skin conductance than field independent Ss. The same pattern of response was observed for increase in skin conductance during each presentation of the shock threat film (MTI) (Table 9 and Appendix 24), which was the one remaining measure to be related to CEFT.

These results may take on more significance if they are considered in conjunction with the growing body of literature on cognitive style. There are several indirect kinds of evidence which suggest that some sort of basic physiological differences may exist between field dependent and independent Ss. This evidence comes from such disparate areas of research as the study of: pathologic groups; differential effects of drugs;

cognitive style differences in the sexes; and differential effects of stress.

With respect to pathologic groups, field dependence has been found to be characteristic of schizophrenics (Weckowicz, 1960), those suffering brain damage (Canter, 1963, 1966) and mental retardates (Witkin, Faterson, Goodenough & Birnbaum, 1966). Closely related to this is the proposal made by Witkin (1965), that the inability to separate item from field may be due to an inadequate formation of the nervous system which may be genetically determined. The implication may be, therefore, that the inability of the field dependent individual to screen out irrelevant data is due to faulty attentional mechanisms.

Another area of research to offer indirect evidence for physiological differences between field dependent-independent Ss is that dealing with the differential effect of drugs. Reckless et al. (1962), and Cohen et al. (1962) used placebo, sedative or stimulant drugs, which have been shown to have different effects on the excitatory levels of central nervous system (CNS) functioning. In both these studies extreme groups of field dependent-independent Ss were used. It was found that sensory deprivation following administration of these drugs had different effects on the two groups. For field dependent Ss both stimulant and sedative drugs resulted in a decrease in CNS activity. This was reflected in a decrease in beta EEG and skin conductance, and an increase in alpha EEG. The field dependent Ss were also reported to be in a more relaxed psychological state. Field independent Ss, in contrast, showed increased CNS activity with the stimulant, but mixed responses to the sedative. Further studies (Cohen, 1967) agree with these findings. Doses of amphetamine, for example, resulted in decreased CNS activity for field dependent Ss and the reverse for field independent Ss. The fact that drugs appear to have a differential effect on field dependent and field independent Ss would again suggest that there are basic physiological differences between these two types.

Another area of research emphasizes the sex-related differences in field dependence-independence (Broverman, Klaiber, Kobayashi & Vogel, 1968). It has been suggested by these investigators that the ability to separate a stimulus from an embedded field is more characteristic of males than females. They hypothesize that physiological differences caused by hormonally-influenced adrenergic activating and cholinergic inhibitor processes account for these cognitive style differences.

Finally, a series of isolation studies carried out at Duke University (Cohen et al., 1962; Silverman et al., 1959; Silverman et al., 1961) led again to the hypothesis that differences in CNS functioning might be related to different modes of processing perceptual information. In some of these studies, measures such as skin conductance and EEG activity indicated that a higher level of CNS alerting was characteristic of the field dependent Ss following a period of sensory isolation. Relevant also to the present experiment was a study in which uncertainty was manipulated (Culver, et al., 1964). The findings there were that uncertainty led to higher arousal in the field dependent group. In the present experiment, it was the shock threat condition, which presented maximum uncertainty, which resulted in greater increases in skin conductance for the field dependent group.

These latter studies used adults and involved the use of the Rod and Frame Test to assess field dependence-independence. A further difference between these studies and the present experiment is the fact that they emphasize differences following stress but do not discuss physiological differences in resting level prior to the experimental manipulations. In the present study these differences were apparent. There is considerable evidence to show that field dependent-independent adults differ physiologically under stress. The results of the present study would suggest, however, that basic physiological differences are present in childhood and can be detected even before experimental manipulation.

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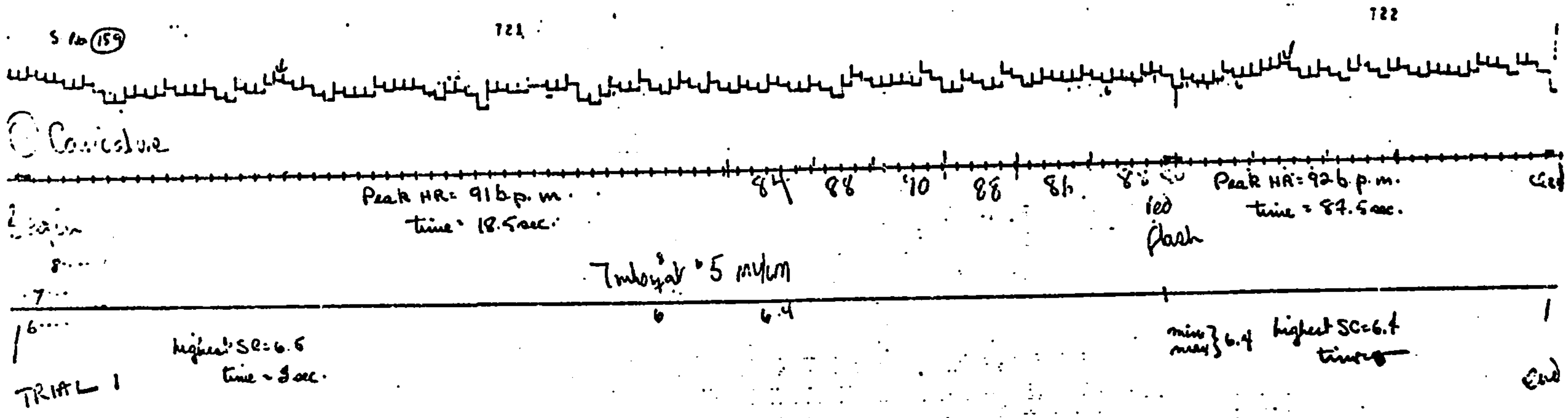
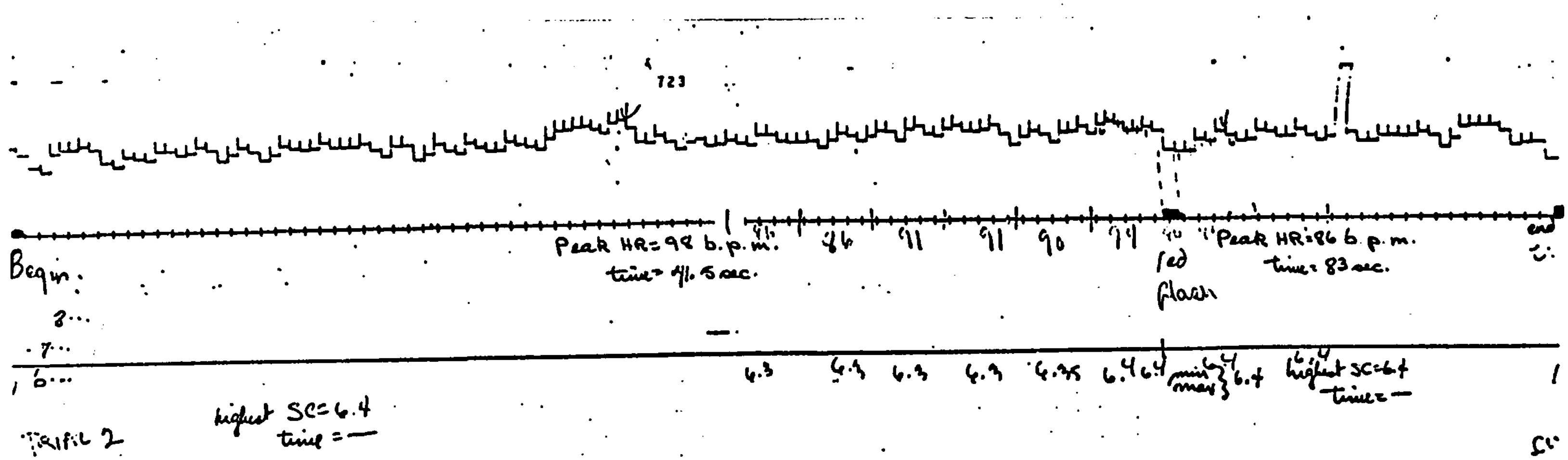
APPENDIX 1



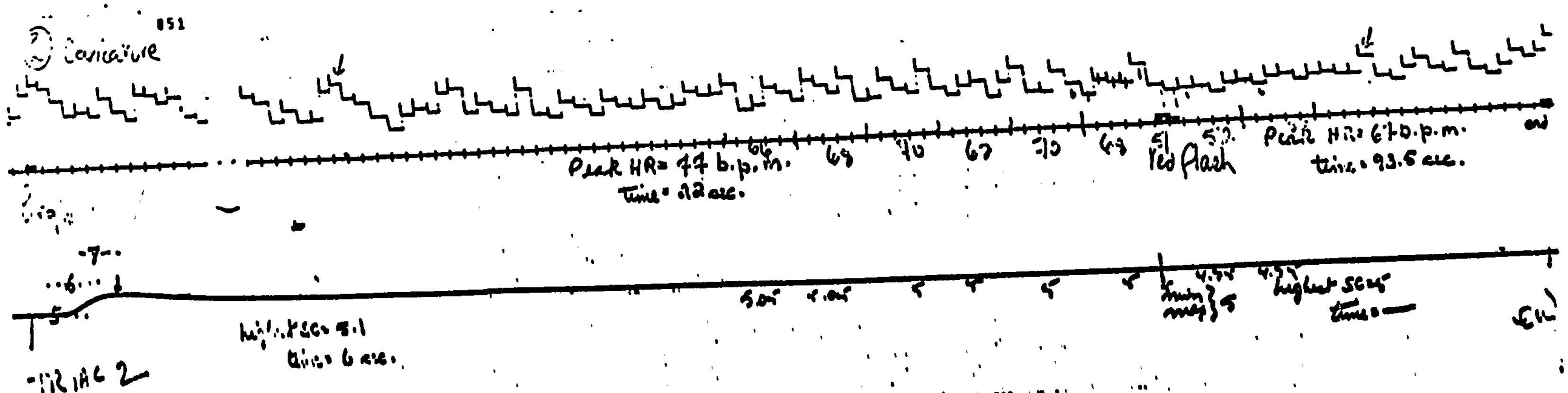
Sample polygraph record, reduced in size, showing skin conductance and heart rate response to the "Caricature" film used in a pilot study. This film was then chosen as a stimulus over which to superimpose the cue for potential shock in the present study.

APPENDIX 2



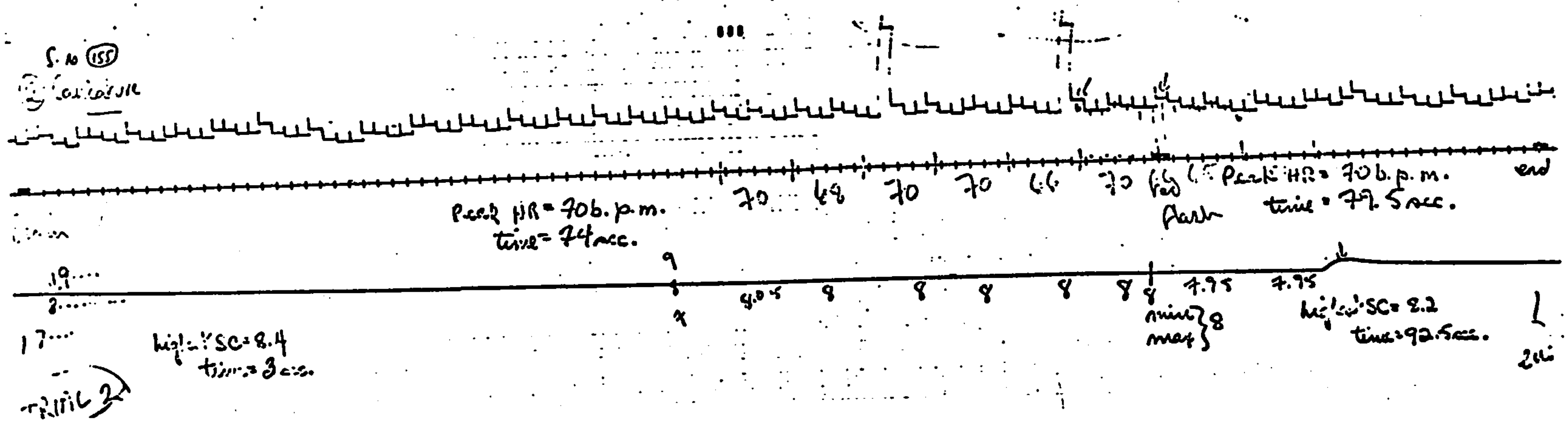
Sample polygraph record, reduced in size, showing skin conductance and heart rate response to the "Caricature" film used in a pilot study. This film was then chosen as a stimulus over which to superimpose the cue for potential shock in the present study.

APPENDIX 3



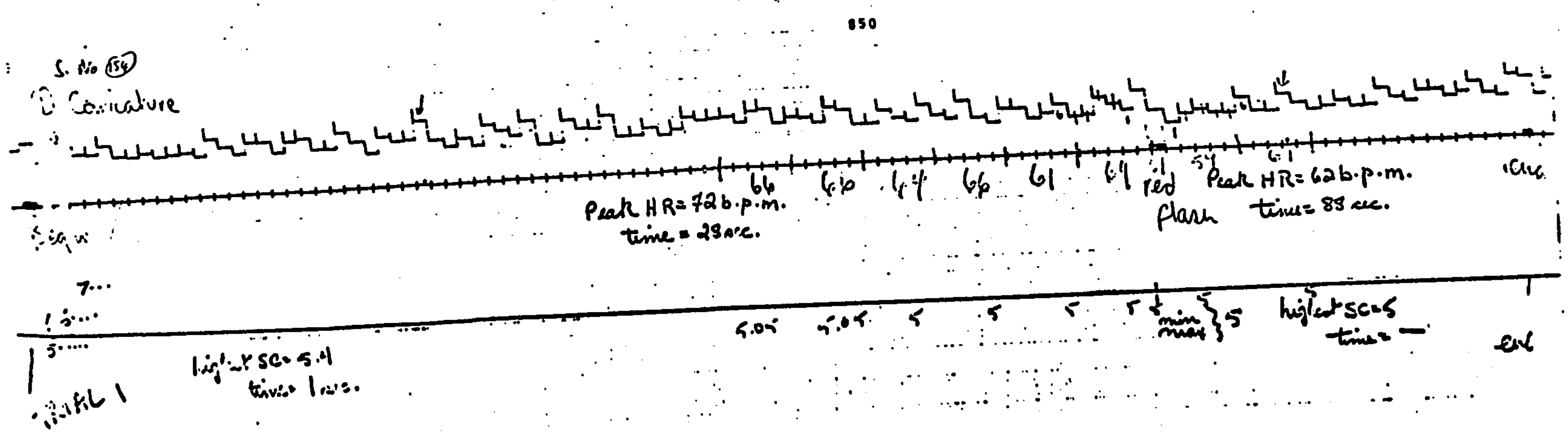
Sample polygraph record, reduced in size, showing skin conductance and heart rate response to the "Caricature" film used in a pilot study. This film was then chosen as a stimulus over which to superimpose the cue for potential shock in the present study.

APPENDIX 4



Sample polygraph record, reduced in size, showing skin conductance and heart rate response to the "Caricature" film used in a pilot study. This film was then chosen as a stimulus over which to superimpose the cue for potential shock in the present study.

APPENDIX 5



Sample polygraph record, reduced in size, showing skin conductance and heart rate response to the "Caricature" film used in a pilot study. This film was then chosen as a stimulus over which to superimpose the cue for potential shock in the present study.

APPENDIX 6

One Way Analysis of Variance of Number of Spontaneous GSR's During Neutral, Vicarious and Shock Threat Conditions

Source	df	MS	F
Conditions	2	1903.7	29.7614***
Conditions x Subjects	76	63.965	

***$p < .001$

APPENDIX 7

One Way Analysis of Variance of the Effect of 5 Presentations of Vicarious Threat on MTI Skin Conductance Response

Source	df	MS	F
Trials	4	.09142	5.6185***
Trials x Subjects	152	.01627	

***$p < .001$

APPENDIX 8

One Way Analysis of Variance of the
Effect of 5 Presentations of Shock Threat
On the MTI Skin Conductance Response

Source	df	MS	F
Trials	4	.02464	8.2039***
Trials x Subjects	152	.00300	

***$p < .001$

APPENDIX 9

Two-way Analysis of Variance of the
Effect of 5 Presentations of Vicarious Threat
on OR and MTI Skin Conductance Responses

Source	df	MS	F
Responses	1	.50977	46.415***
Trials	4	.06740	5.8159***
Subjects	38	.05240	
Responses x Trials	4	.03346	3.8851**
Responses x Subjects	38	.01098	
Trials x Subjects	152	.01158	
Responses x Trials x Subjects	152	.00861	

**$p < .01$

***$p < .001$

APPENDIX 10

Two-way Analysis of Variance of the Effect of 5 Presentations of Shock Threat on OR and MTI Skin Conductance Responses

Source	df	MS	F
Responses	1	.12055	34.678***
Trials	4	.00605	2.4240
Subjects	38	.03426	
Responses x Trials	4	.02150	10.647***
Responses x Subjects	38	.00347	
Trials x Subjects	152	.00249	
Responses x Trials x Subjects	152	.00201	

***$p < .001$

APPENDIX 11

One-way Analysis of Variance of the Effect of 5 Presentations of Vicarious Threat on Change in Tonic Level of Skin Conductance

Source	df	MS	F
Trials	4	.08501	2.8806*
Trials x Subjects	152	.02951	

*$p < .05$

APPENDIX 12

One-way Analysis of Variance of the Effect of 5 Presentations of Shock Threat on Change in Tonic Level of Skin Conductance

Source	df	MS	F
Trials	4	.05866	21.946***
Trials x Subjects	152	.00267	

***$p < .001$

APPENDIX 13

Two-way Analysis of Variance of the Effect of Vicarious and Shock Threat Conditions on Change in Tonic Level of Skin Conductance for Each Presentation of the Films

Source	df	MS	F
Conditions	1	2.1876	14.532***
Trials	4	.06245	3.8866**
Subjects	38	.47506	
Conditions x Trials	4	.08122	5.0372***
Conditions x Subjects	38	.15053	
Trials x Subjects	152	.01606	
Conditions x Trials x Subjects	152	.01612	

$^{**}p < .01$

$^{***}p < .001$

APPENDIX 14

Two-way Analysis of Variance of the Effect of Vicarious and Shock Threat Conditions on the Maximum Change in Skin Conductance Level During Each Presentation of the Films

Source	df	MS	F
Conditions	1	.94795	6.5211*
Trials	4	.01076	0.5904
Subjects	38	.65067	
Conditions x Trials	4	.05134	3.0631*
Conditions x Subjects	38	.14537	
Trials x Subjects	152	.01823	
Conditions x Trials x Subjects	152	.01676	

*$p < .025$

APPENDIX 15

Three-way Analysis of Variance of the Effect of Vicarious and Shock Threat Conditions on Beat-by-beat Cardiac Response to 5 Presentations of the Threatening Stimuli

Source	df	MS	F
Conditions	1	52380.6	14.612***
Trials	4	11194.6	4.8892**
Beats	12	1600.3	21.677***
Subjects	35	14113.6	
Conditions x Trials	4	533.05	2.7075*
Conditions x Beats	12	482.84	6.9499***
Conditions x Subjects	35	3584.6	
Trials x Beats	48	73.295	1.6178**
Trials x Subjects	140	244.34	
Beats x Subjects	420	73.823	
Conditions x Trials x Beats	48	31.571	0.6956
Conditions x Trials x Subjects	140	196.88	
Conditions x Beats x Subjects	420	69.475	
Trials x Beats x Subjects	1680	45.304	
Conditions x Trials x Beats x Subjects	1680	45.388	

*$p < .05$
**$p < .01$
***$p < .001$

APPENDIX 16

Two-way Analysis of Variance of the Effect of First and Second Presentations of Vicarious Threat on Beat-by-Beat Cardiac Response

Source	df	MS	F
Trials	1	122.77	1.5289
Beats	12	138.61	2.8140**
Subjects	35	1749.8	
Trials x Beats	12	73.542	2.0671*
Trials x Subjects	35	80.304	
Beats x Subjects	420	49.258	
Trials x Beats x Subjects	420	35.577	

*$p < .025$

**$p < .005$

APPENDIX 17

Two-way Analysis of Variance of the Effect of First and Second Presentations of Shock Threat on Beat-by-Beat Cardiac Response

Source	df	MS	F
Trials	1	6.0096	0.0195
Beats	12	888.98	13.758***
Subjects	35	6071.8	
Trials x Beats	12	14.852	0.2877
Trials x Subjects	35	308.19	
Beats x Subjects	420	64.613	
Trials x Beats x Subjects	420	51.631	

***$p < .001$

APPENDIX 18

Three-way Analysis of Variance of the Effect of Vicarious and Shock Threat Conditions on Cardiac Acceleration or Deceleration in Response to 5 Presentations of the Threatening Stimuli

Source	df	MS	F
Conditions	1	6149.7	16.010***
Trials	4	295.93	1.0734
Beats	8	1105.8	14.024***
Subjects	35	319.52	
Conditions x Trials	4	120.06	0.4214
Conditions x Beats	8	477.92	7.2338***
Conditions x Subjects	35	384.11	
Trials x Beats	32	76.727	1.8320**
Trials x Subjects	140	275.70	
Beats x Subjects	280	78.852	
Conditions x Trials x Beats	32	32.364	0.7774
Conditions x Trials x Subjects	140	284.90	
Conditions x Beats x Subjects	280	66.068	
Trials x Beats x Subjects	1120	41.881	
Conditions x Trials x Beats x Subjects	1120	41.630	

**$p < .005$

***$p < .001$

APPENDIX 19

Three-way Analysis of Variance of the Effect of Vicarious and Shock Threat on Peak Heart Rate During 5 Presentations of the Films

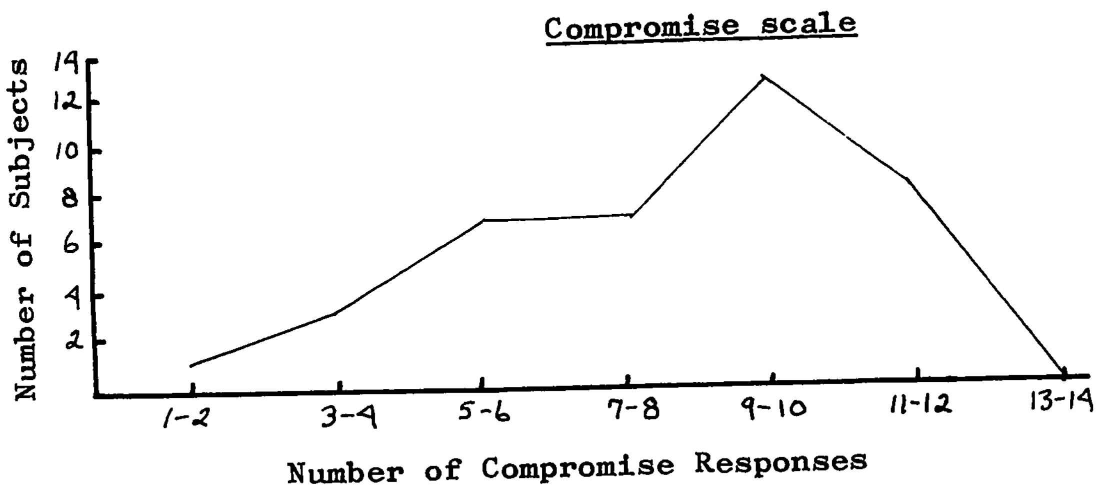
Source	df	MS	F
Conditions	1	37846.8	19.7330***
Trials	4	642.47	6.1521***
Peak Rate	8	3943.4	62.143***
Subjects	37	9320.6	
Conditions x Trials	4	97.472	0.8969
Conditions x Peak Rate	8	320.67	6.0852***
Conditions x Subjects	37	1917.9	
Trials x Peak Rate	32	49.481	1.0473
Trials x Subjects	148	104.43	
Peak Rate x Subjects	296	63.457	
Conditions x Trials x Peak Rate	32	70.690	1.5150*
Conditions x Trials x Subjects	148	108.67	
Conditions x Peak Rate x Subjects	296	52.697	
Trials x Peak Rate x Subjects	1184	47.245	
Conditions x Trials x Peak Rate x Subjects	1184	46.659	

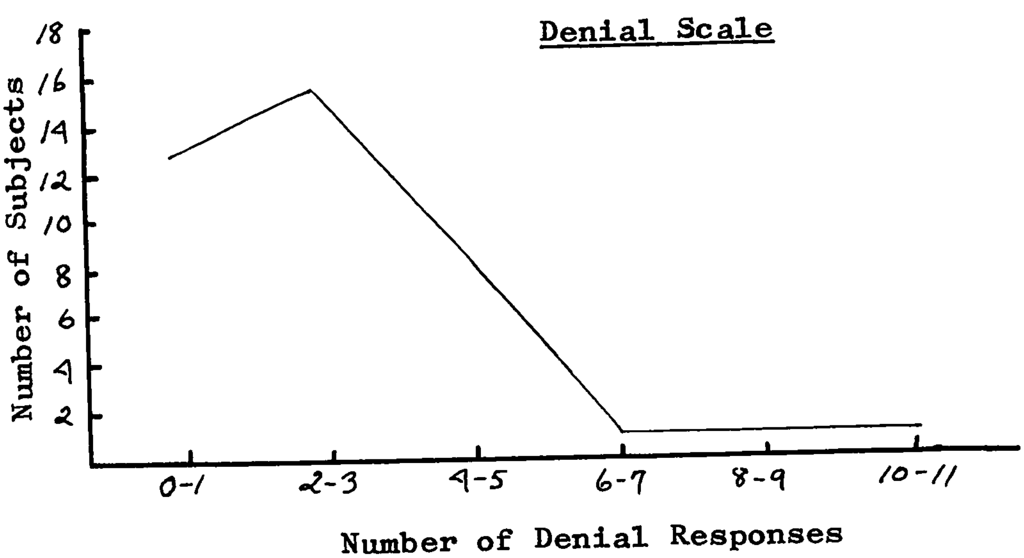
*$p < .05$

***$p < .001$

APPENDIX 20

Distribution of Scores on the Coping Style Test

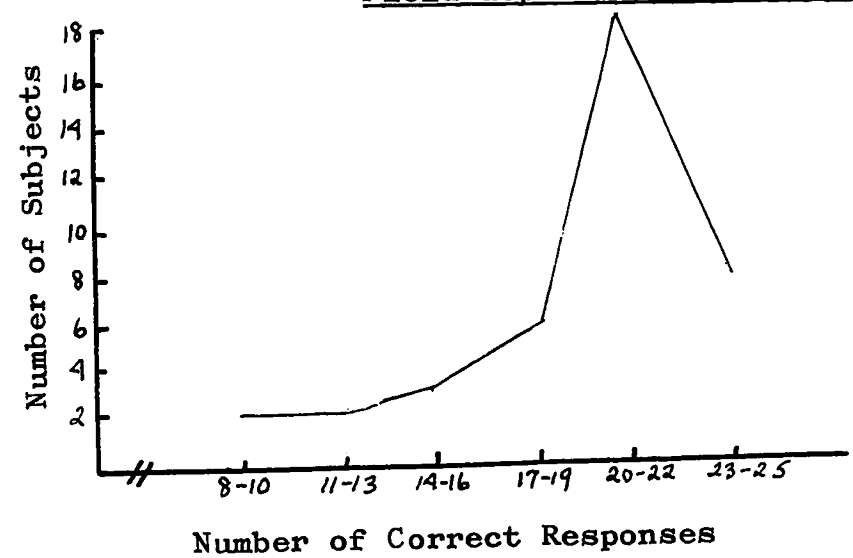




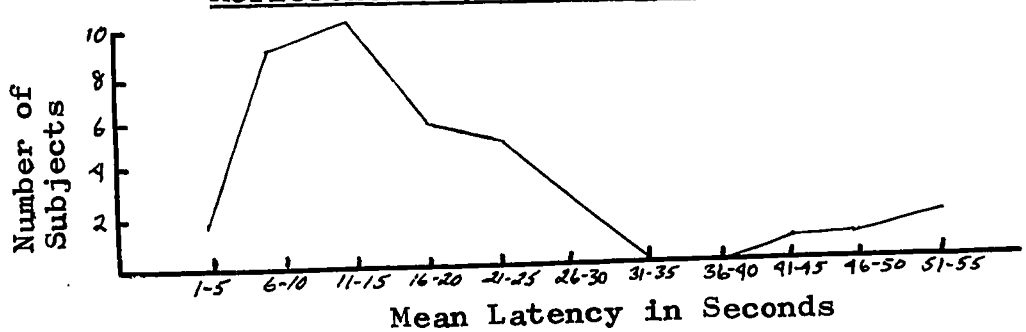
APPENDIX 21

Distribution of Scores on the Cognitive Style Tests

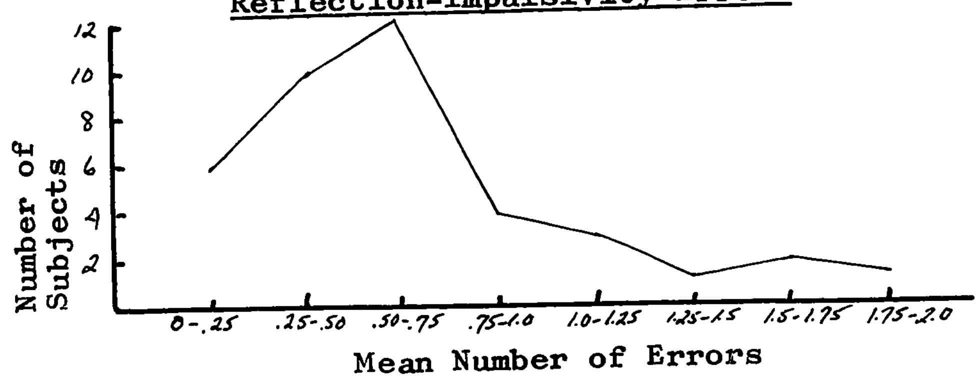
Field dependence-independence



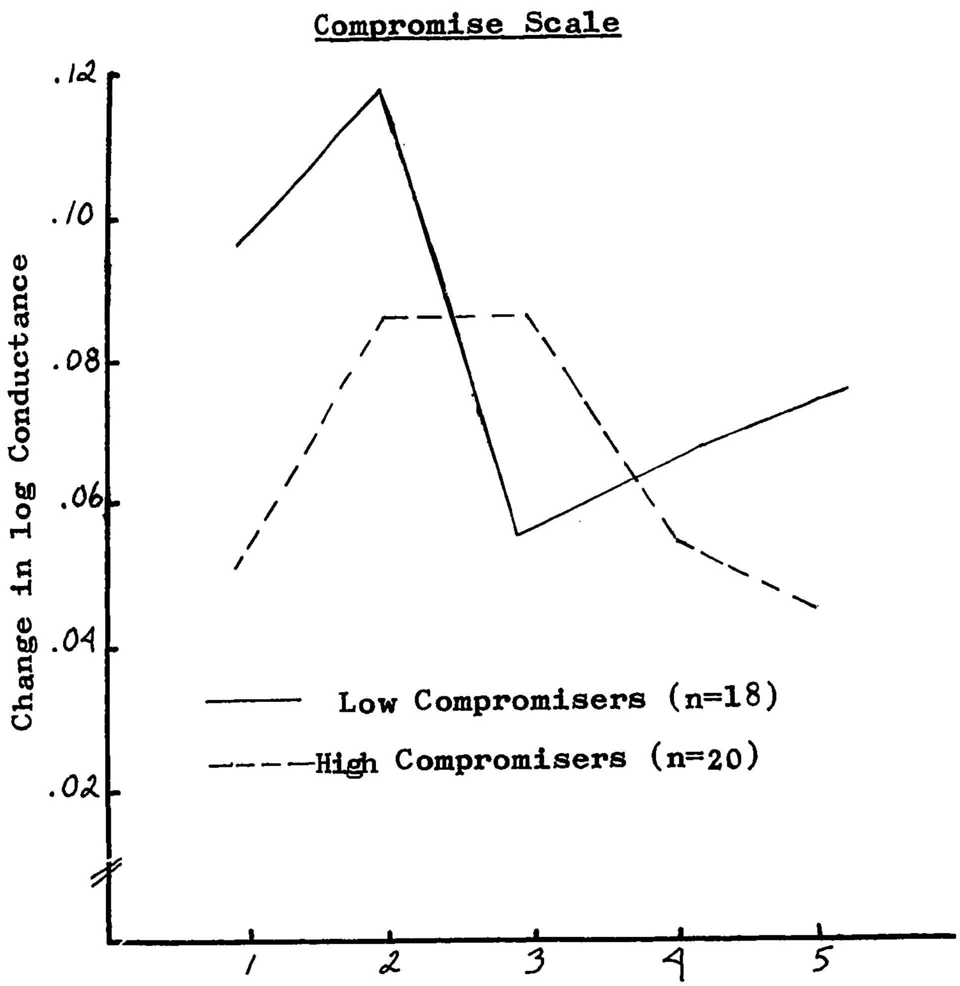
Reflection-Impulsivity Latency



Reflection-Impulsivity Errors

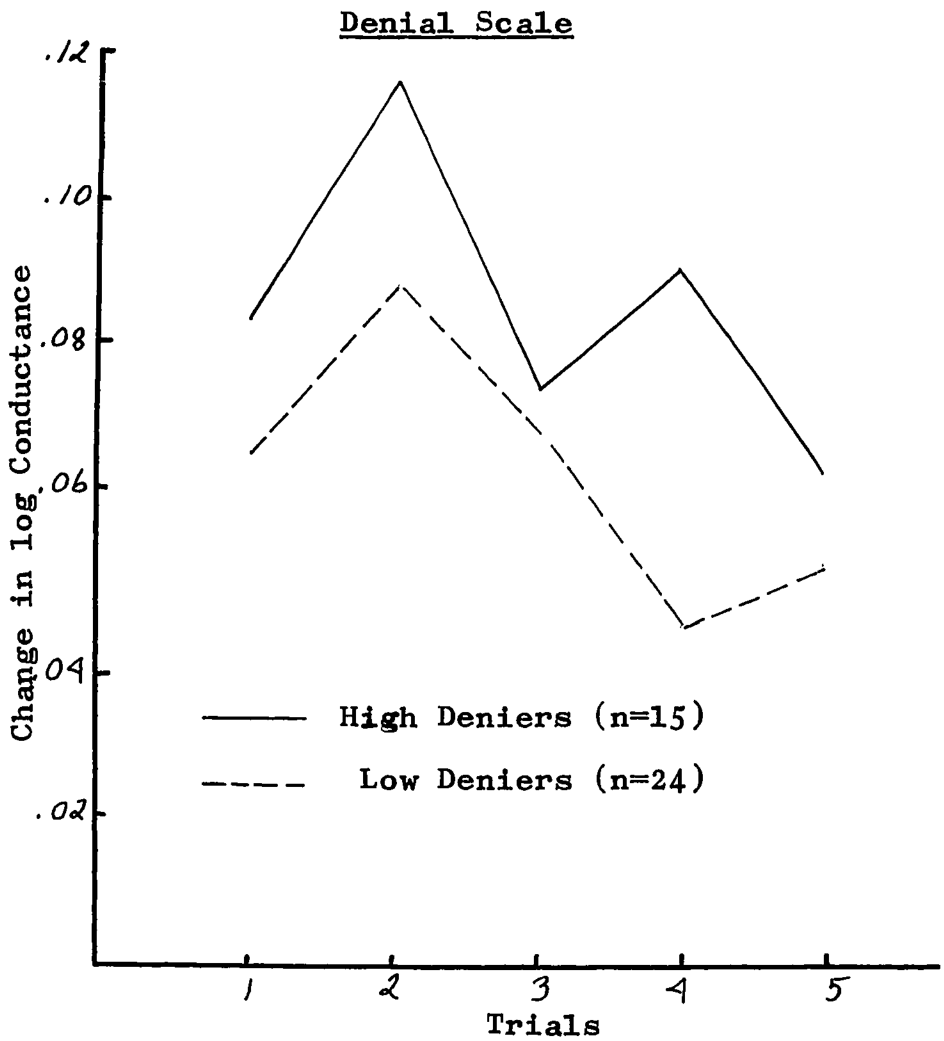


APPENDIX 22



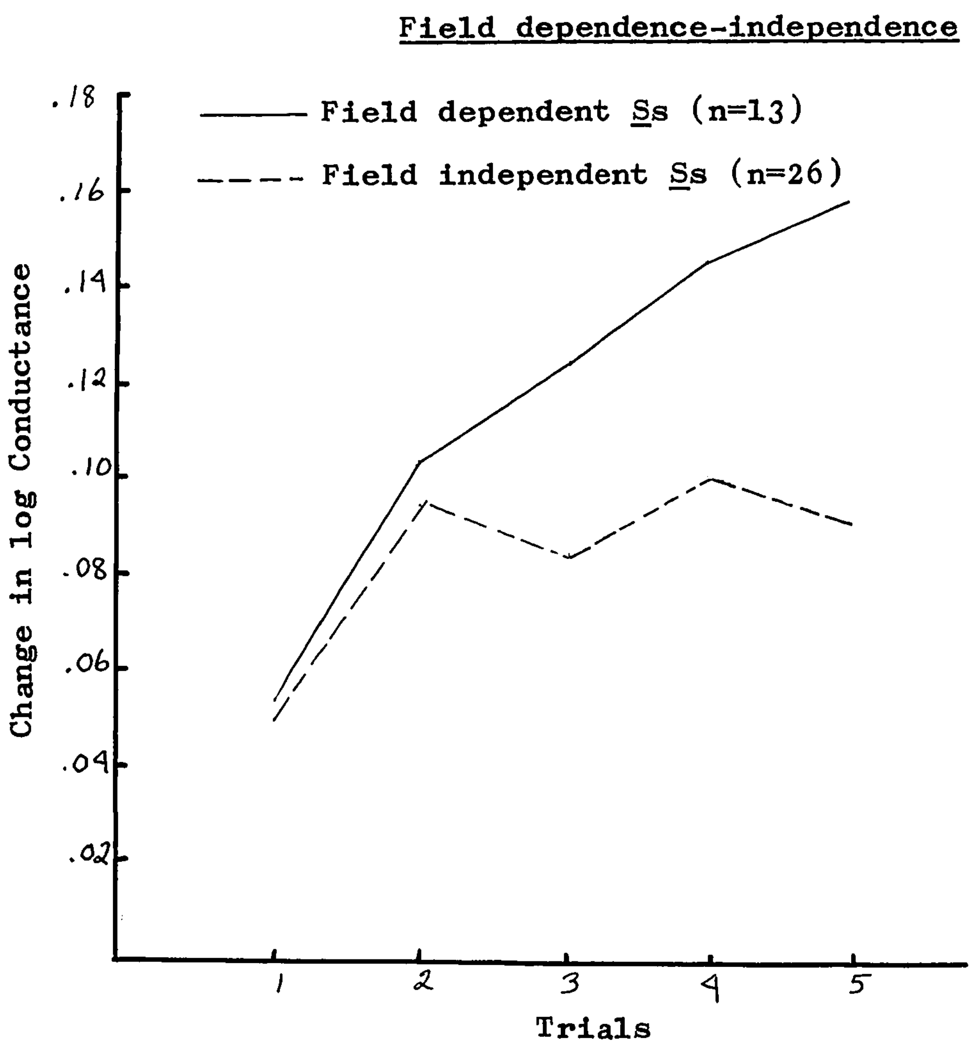
Amplitude of orienting response (OR) during each presentation of the vicarious threat film for Ss scoring above and below the mean on the compromise scale of the coping style test.

APPENDIX 23



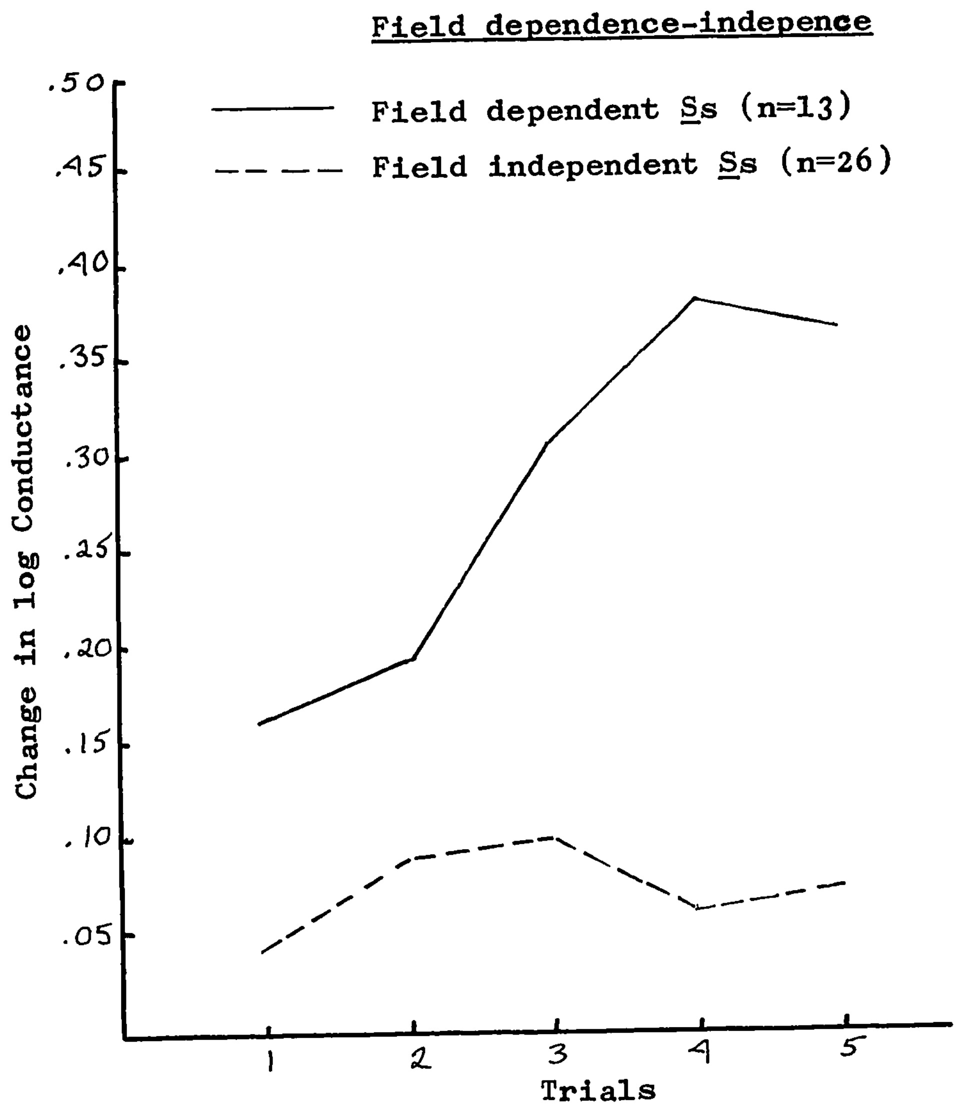
Amplitude of orienting response (OR) during each presentation of the vicarious threat film for Ss scoring above and below the mean on the denial scale of the coping style test

APPENDIX 24



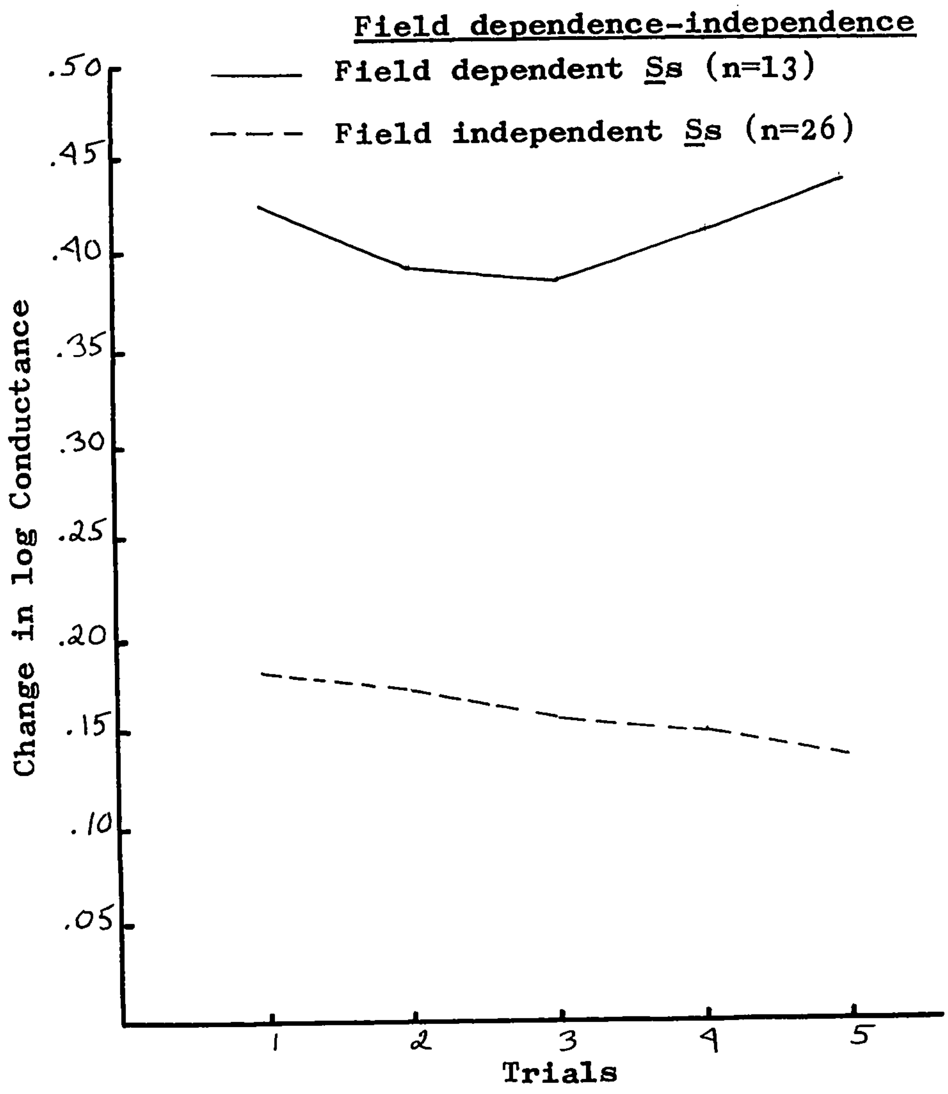
Increase in skin conductance (MTI) during each presentation of the shock threat film for Ss scoring above or below the mean on field dependence-independence.

APPENDIX 25



Change in maximum level of skin conductance (CML) for each presentation of the vicarious threat film for Ss scoring above or below the mean on field dependence-independence.

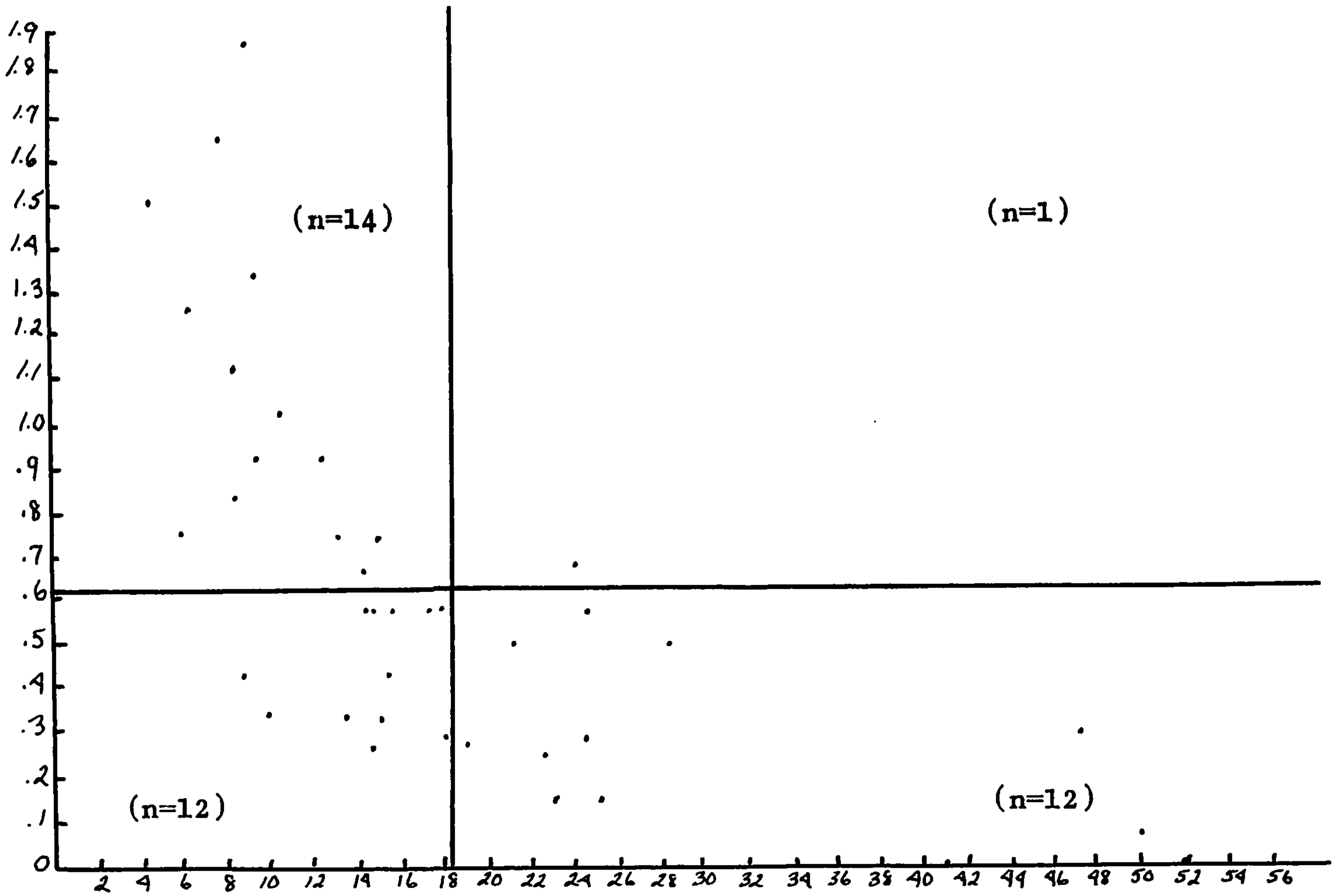
APPENDIX 26



Change in maximum level of skin conductance (CML) for each presentation of the shock threat film for Ss scoring above or below the mean on field dependence-independence.

APPENDIX 27

Distribution of Errors-vs-Latency on the Matching Familiar Figures Test



Latency: Mean = 18.23