Cortisol response in young adults who were aggressive or withdrawn in childhood.

Elizabeth Thomas Austin

A Thesis

in

The Department of

Psychology

Presented in Partial Fulfilment of the Requirements
for the Degree of Master of Arts at
Concordia University
Montréal, Québec, Canada

April 1992

ISBN 0-315-73654-2

Abstract

Cortisol Response in Young Adults Who
Were Aggressive or Withdrawn
in Childhood

Elizabeth Thomas Austin

Recent evidence suggests that stress may be a risk factor in physical and psychosocial pathology and that vulnerability to stress may be modulated by individual differences. The present study examined how childhood social aggression and withdrawal and self-appraised coping efficacy relate to the production of saliva cortisol in adult subjects following exposure to a moderately aversive laboratory stressor.

Eighty two subjects drawn from the population of the Concordia Longitudinal Risk Project participated in the study. These individuals had been classified in childhood using the Peer Evaluation Inventory (Pekarick et al., 1976) as being socially aggressive, withdrawn, aggressive and withdrawn or socially normative. Subjects were also classified as either good or poor copers based on a median split of the score obtained on the Problem Solving Inventory (Heppner & Peterson, 1982), a self rated instrument administered at the time of testing. Subjects were exposed to either predictable-controllable or unpredictable-uncontrollable noise stress in a paradigm adopted from Breier and colleagues (1987).

In response to the unpredictable-uncontrollable stressor condition, poor copers differentiated themselves from good copers with an increase in cortisol production earlier in the course of the trial. Furthermore, young adults who were socially withdrawn in childhood and assessed themselves as good copers produced more cortisol than subjects who were socially aggressive or aggressive and withdrawn in childhood. These results were interpreted in terms of the Gunnar et al., 1990 formulation of stress physiology. Implications for vulnerability to stress and the link between stress and psychopathology are discussed.

Acknowledgements

Many people played an integral role in the conduction and completion of this project. I would like to thank

Dr. Alex Schwartzman for his unfailing support, both academic and otherwise;

Drs. Kevin Austin, Michael Bross and Jane Stewart for assistance with apparatus and computers;

Claude, Linda, Lise and Joseé and the High Risk Project Staff for subject recruitment and data collection;

Dr. Michael Meaney and his staff at the Douglas Hospital for technical assistance with the cortisol assay;

Dr. Bill Bukowski and Jackie Boivin for statistical consultation;

Dr. Lisa Isaac, Brenda Kenyon and Claude Senneville for editorial comments;

and last, but not least, Kevin A., Kevin T., Elinor, Susan, Brenda, Patti, Jasmin et al., for love and laughter.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Cortisol Response in Young Adults Who Were Aggressive or Withdrawn in Childhood

Recent advances in medicine and psychology recognize stress as a potential risk factor in a number of physical disorders through its inhibition of the immune system (Coe & Levine, in press; Weidenfeld, O'Leary, Bandura, Brown, Levine & Raska, 1990) and in the etiology of psychiatric disorders such as depression (Breier, in press; Gold, Goodwin & Chrousos, 1988; Holsboer, 1987; Sapolsky, 1987).

The stress response has been actively studied for over half a century. Beginning with the work of Cannon and Selye in the 20's and 30's, researchers have linked stress with profound behavioral and physiological changes in the organism. Early research examined the general, non-specific arousal elicited by physiological stressors, such as physical restraint, blood loss, and hypo- or hyper-thermia, which Selye termed the General Adaptation Syndrome (Selye, 1950). Further research has refined our knowledge of the stimuli which elicit stress responses and their consequences for the organism.

Stress as a Construct. Stress has been defined in a number of ways, and the ambiguity associated with the term has often led to confusion (Goldstein & Halbreich, 1987). According to Rose (1984), current investigations refer to stress in one of the following ways:

a) a characteristic of the environment such as extreme heat or cold, loud noise, physical restraint, crowding;

cold, loud noise, physical restraint, crowding;

b) the behavioral, cognitive or physiological response of the individual;

c) the interaction of the individual's perception of environmental characteristics and the individual's response to them.

It is this third definition which draws the most consensus among current researchers and is the focus of the present study. The individual's perception of environmental changes or demands and the response to these demands may be shaped by a number of factors including stressor characteristics, physiological sensitivity to stress, learning and social history, and behavioral traits (Breier, Albus, Pickar, Zahn, Wolkowitz & Paul, 1987; Gold et al., 1988; Sapolsky, 1983; Kagan, Reznick and Snidman, 1988).

Physical Stress Response. The index of stress most commonly used in psychological research is glucocorticoid release, specifically cortisol or corticosterone. It has long been understood that stress prompted by any threat to the organism stimulates a rapid increase in the secretion of glucocorticoids. The function of these substances until recently was not entirely clear. Originally, it was thought that glucocorticoids were instrumental in making energy available in the form of glucose so that the organism would be better prepared to counter stressful stimuli. Other manifestations of glucocorticoid action, namely the antinflammatory and immunosuppressive effects, were difficult to interpret strictly in the context of activation theory. Munck, Guyre and Holbrook (1984) recently proposed a more comprehensive theory of glucocorticoid function which integrates these apparently contrasting processes. According to Munck and colleagues, glucocorticoids, in addition to their energy mobilizing function, play a secondary protective role in stress reactions. Through slow acting inhibitory actions on a number of systems via mediators (insulin, endorphins, lymphokines, prostaglandins and vasopressin), glucocorticoids are thought to prevent the body's primary defensive mechanisms from overcompensating and threatening homeostasis (Figure 1). Glucocorticoids are themselves prevented from causing damage to the organism by a negative feedback mechanism. Cortisol production is the end-product of a complex series of events involving hypothalamus, pituitary, and adrenal actions, hence the HPA-axis. The mechanisms involved in this process are described below (see Axelrod and Resine, 1984 for a detailed description). Figure 2 presents a diagram of this sequence.

Figure 1. Illustration of the various primary defense mechanisms affected by glucocorticoid inhibition (After Munck et al., 1984).

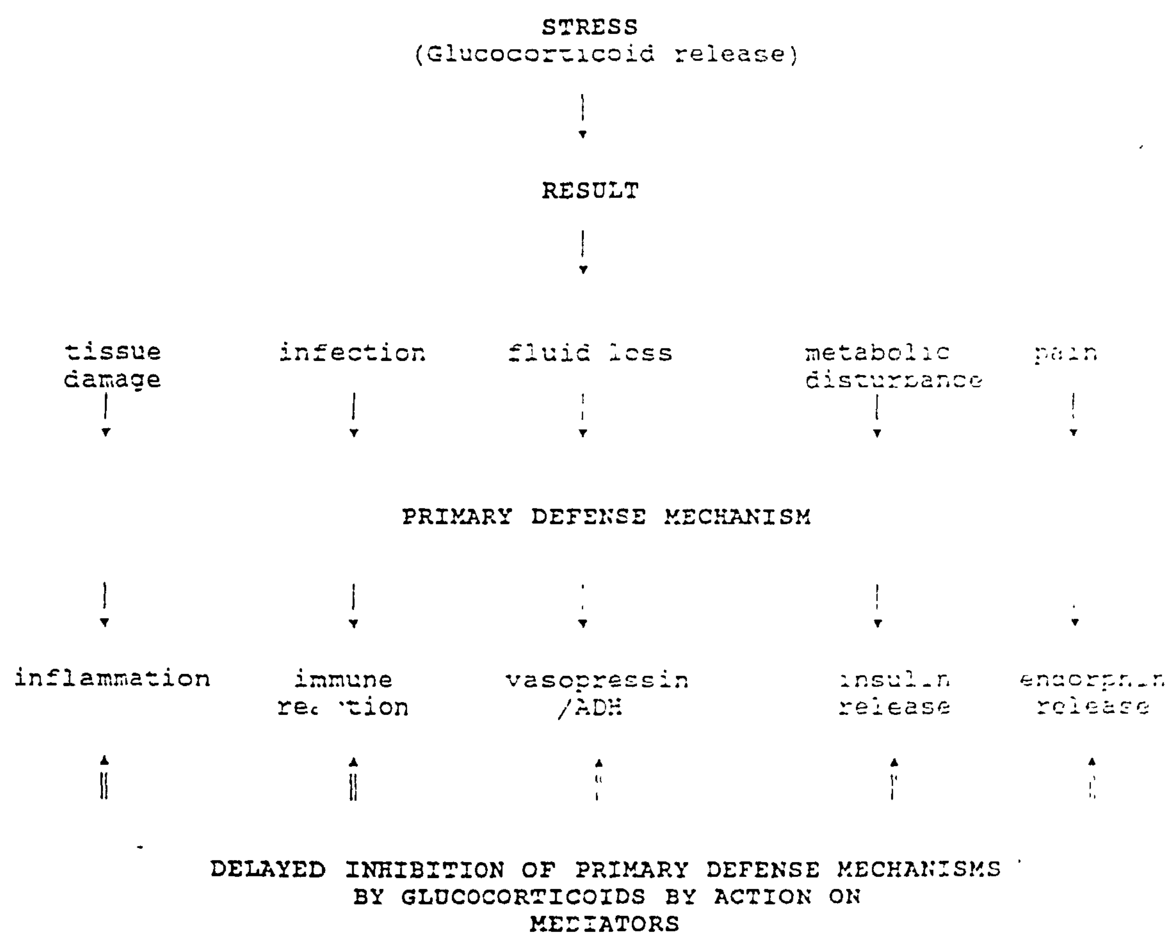
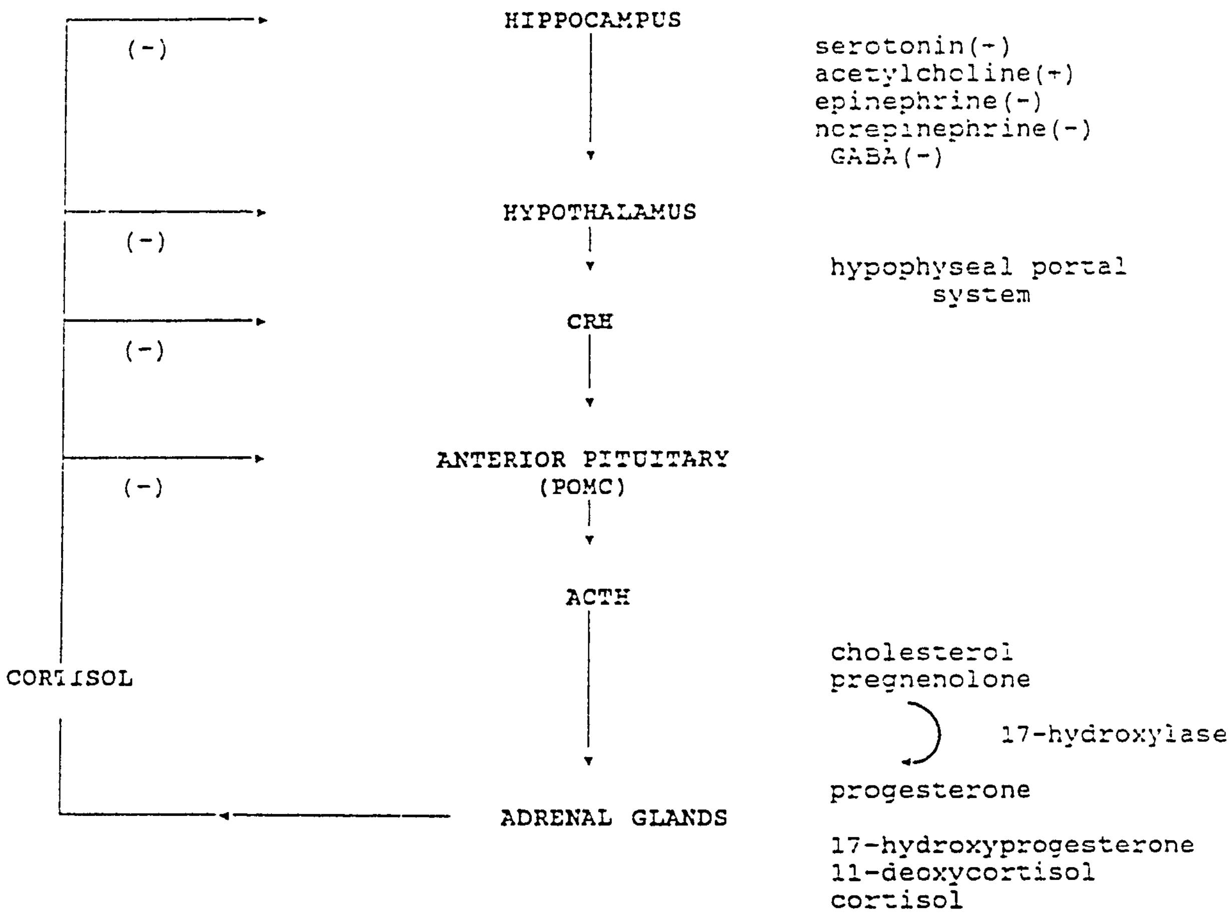


Figure 2. Simplified diagram of HPA-axis function illustrating release and feedback control of cortisol (after Holsboer, 1987).



Key to abbreviations: GABA=gamma amino butyric acid, POMC=proopiomelanocortin, CRH=corticotrophic releasing hormone, ACTH=adrenocorticotropin. "-" designates inhibitory influences, "+" designates excitatory actions.

The process of cortisol release is directly under hypothalamic control. Hypothalamic neurons receive input from a number of neurotransmitter systems which stimulate production of corticotrophic releasing hormone (CRH). CRH is released into the hypophyseal portal system, a capillary bed connecting the hypothalamus and pituitary. CRH receptors in corticotrophic cells of the anterior pituitary bind with CRH and stimulate the proopiomelanocortin (POMC) gene in pituitary corticotrophs to begin production of POMC, which cleaves into adrenocorticotrophin (ACTH). ACTH passes into the bloodstream to the adrenal cortex, which synthesizes corticosteroids, which are in turn released into the circulatory system. Corticosteroids inhibit further production of ACTH release in a classic feedback loop acting at the level of the pituitary by inhibiting further POMC synthesis, and at the hippocampus, a limbic system structure. Projections from hippocampus to hypothalamus inhibit further CRH production (Sapolsky, Krey, & McEwen, 1986). Under normal conditions, cortisol is secreted in a pulsatile fashion which follows a fairly stable circadian pattern. Peak cortisol production occurs in the early morning hours just before awakening. Nearly half of the total cortisol is secreted at this time. The second secretory period occurs midday, and the final in the early evening. It is thought that this pattern may be linked to mealtimes. Typically, cortisol levels are reduced midmorning and midafternoon, with a nadir occurring in the late evening and early hours of the morning (Kreiger, Allen, Rizzo & Kreiger, 1971; Weitzman, Fukushima, Noglire, Roffwang, Gallager & Hellman, 1971).

Stressor Characteristics. Whereas the physiological function of glucocorticoid release is clearly articulated in terms of countering physical damage, it is less clear why certain psychological stimuli are capable of eliciting the same response. A large body of research has evolved in the past 40 years examining the nature of stimuli which activate the HPA-axis. Reviews of this literature by Mason (1968), Goldstein and Halbreich (1987), Hennessey and Levine (1979) and Rose (1980, 1984) have suggested that novelty, uncertainty, unpredictability, and a lack of or loss of control over potentially threatening changes in the environment trigger HPA-axis activity.

Novelty. Novelty has consistently been shown to trigger HPA-axis activation. Early researchers studying stress in animals reported the "first experience effect", which suggested that changes in the environment, such as shifts in light-dark schedule, handling, and changes in housing elicited elevations in plasma corticosteroids. Later studies in humans noted similar effects of novelty as researchers found that hospitalization (Kehlet & Binder,

1973) and relocation (Kral, Grad & Berenson, 1968) were associated with transitory elevations in plasma and urinary corticosteroids. These elevated levels of corticosteroid production returned to normal levels after relatively short periods of time, signalling rapid habituation to novel changes in the environment.

Ursin, Baade and Levine (1978) demonstrated this phenomenon in American soldiers undergoing training for parachute jumping. These authors found that increases in plasma cortisol were greatest on the first day of training, and tapered down to basal levels by between the second and fifth day of training. They interpreted the decrease as an expression of coping, which attenuated HPA-activation with repeated exposure to the stressful stimulus. The uncertainty inherent in initial exposures to the stressor was reduced as these subjects accrued information about the nature of the stressor and the consequences of the stressor. As soldiers made a series of successful jumps from the training tower, they acquired a sense of mastery and control over an increasingly familiar stimulus.

Uncertainty. Another factor which has been shown to be instrumental in eliciting HPA-axis activation is uncertainty. This has frequently been reported in the context of anticipation of life events. Czeisler, Moore and Regestein (1984) found that patients admitted to hospital in anticipation of elective coronary bypass surgery exhibited large increases in plasma cortisol the day before surgery, while undergoing pre-operative procedures. The cortisol levels measured every 20 minutes over a 24 hour period were elevated throughout the day, even into the late evening hours when cortisol secretion is normally very low.

Several studies have shown that anticipation of school examinations produces a rise in cortisol secretion (Mason, 1968). A study by Johansson, Collins and Collins (1983) followed a male doctoral candidate for 16 days prior to and 6 days following the oral defense. Cortisol levels were elevated for several days prior to the defense as compared to post-examination levels, and peaked on the day of the examination. Once mastery of the task was demonstrated in a successful completion of the oral defense, cortisol levels rapidly returned to normal levels.

Control and Predictability. Control over stressors has been shown to reduce the production of corticosteroids in both animal and human populations. In an elegant 1976 study by Hanson, Larson and Snowdon, both the lack of and the loss of control over a stressor were associated with dramatic increases in plasma cortisol. Rhesus monkeys were exposed to loud noise (100dB) for one hour. Three conditions were used in this study: 1) control over noise, 2) no control over noise and 3) no noise. Testing occurred after a seven day habituation period to the apparatus and noise stressor. The levels of plasma cortisol in monkeys with control over noise did not differ from that of monkeys exposed to no noise. In contrast, plasma cortisol levels were elevated in the monkeys in the no control over noise group. In a second phase of this study, monkeys who had previously had control over noise were exposed to noise without control. Plasma cortisol was elevated above that of the group with no control in the initial phase of the study. Thus, lack of control over stressors was demonstrated to be a powerful stimulus of cortisol production, and loss of control appeared to be even more stressful for these monkeys who had had control previously.

In a recent study of normal human subjects, Breier, Albus, Pickar, Zahn, Wolkowitz, and Paul (1987) demonstrated that individuals exposed to uncontrollable laboratory noise stressors produced elevated levels of ACTH in comparison to subjects receiving controllable noise stressors. In another study conducted by the first author, it was demonstrated that plasma cortisol as well as ACTH were elevated following exposure to uncontrollable noise + shock stressors as compared to a controllable stressor (Breier, in press).

Predictability, usually defined as the presence of an event preceding the onset of a stressor, alone or in combination with controllability over a stressor is also a factor in HPA-axis activation. Dess, Linwick, Patterson, Overmeier and Levine (1983) evaluated the immediate and proactive effects of controllability and predictability of shock stressors on plasma cortisol production in dogs. These authors found that control over the stressor attenuated immediate effects of the shock on cortisol production, whereas predictability of the stressor seemed to attenuate cortisol production during repeated trials. In both situations, control over shock and prediction of shock was associated with cortisol production in the basal range in contrast to elevated levels of plasma cortisol associated with an uncontrollable and unpredictable shock stressor.

Control and predictability were also factors in the elevated urinary cortisol levels present in residents of areas adjacent to the Three Mile Island nuclear power plant in the years following the near-meltdown of the reactor. In comparison to control groups comprised of individuals living adjacent to an undamaged nuclear power plant, a coal-fired plant and no power plant, Schaeffer and Baum (1984) found that Three Mile Island residents' urinary cortisol levels were three times higher than those of comparison groups, and were significantly correlated with subjective measures of perceived control. In their interpretation of these findings, the authors emphasized the absence of instrumental control over the power plant accident, repercussions on their physical health, and the lack of prediction associated with technological disasters as factors in the stress these subjects experienced.

The above studies illustrate the type of stressors which trigger HPA-axis activation. Novel situations, uncertainty regarding future outcomes of life events, and unpredictability and uncontrollability of stressors contribute to the perception of alterations in the environment as threatening, the effect of which are to activate systems which function to protect the organism from harm. Early formulations attributed these physiological changes to emotional responses (Mason, 1968) or arousal (Hennessey & Levine, 1979; Levine, 1985) accompanying stress. A recent reformulation of the role of perceived threat in activation of the stress response mechanisms (Gunnar, Marvinney, Isensee & Fisch, 1989) suggests that emotional or physiological arousal triggered by changes in the environment occurs when these changes are perceived as increased demands which surpass an individual's repertoire of coping resources.

These authors state that changes in the environment which require compensatory action outside the organism's behavioral repertoire elicit a state of "coping uncertainty", which initiates a search for effective coping strategies. Rather than a general emotional reaction or arousal in response to stressors, it is this search for new ways of coping which triggers HPA-axis activity. This formulation accounts in part for inter-individual and intra-individual variability reported in the stress literature by defining the role of appraisal processes in the perception of stimuli as "stressful". The following section addresses factors which may influence this process.

Individual Differences. Researchers engaged in studying the stress response have noted significant individual differences in basal levels of adrenal steroid as well as glucocorticoid production following exposure to stressful life events and laboratory stressors. Early attempts to relate these differences to personality variables, such as introversion or extraversion, or coping styles have generally been equivocal. More recent studies evaluating these trait-like characteristics and cognitive variables have been more successful.

Research with primates has provided evidence that trait-like phenomena may be associated with differential patterns of responding to stressful stimuli. Sapolsky (1983) demonstrated that patterns of social dominance and submission in a colony of wild olive baboons predict different patterns of basal cortisol and cortisol production in response to stressors. Dominant males generally have lower basal levels of cortisol under normal conditions, and exhibit a brisk cortisol response to stress. In contrast, subordinate baboons show elevated basal levels of cortisol, and a sluggish response to stressful stimuli. In addition, Suomi (1987) has reported that behavioral responses to maternal separation in rhesus monkeys are associated with differing patterns of cortisol production following stress. The primates in his sample who react to maternal separation with "uptight", anxious and withdrawn behavior exhibit greater cortisol levels following stress than monkeys who are characterized by a more relaxed pattern of behavior.

Aggression and Inhibition. Researchers studying aggression and inhibition in human samples have noted different HPA-axis response patterns following exposure to stress. Anecdotal evidence reported by Woodman, Hinton and O'Neill in 1978 indicated that a small proportion of prisoners admitted to a maximum security hospital prior to court appearances exhibited unusual patterns of urinary cortisol excretion following admission and exposure to a cognitive and intellectual test battery. A proportion of these individuals were noted to have a lack of endocrine response following these procedures. These men were described by hospital personnel as having "psychopathic" behavior patterns. A 1985 report by Virkkunen provided additional evidence that trait aggression may be associated with depressed cortisol activation. The author reported that under non-stressful conditions, individuals with DSM-III diagnoses of antisocial personality disorder with habitually violent tendency produced significantly less urinary cortisol in a 24-hour period than contrast groups comprised of a) habitually violent offenders with intermittent explosive reaction (triggered by alcohol abuse), b) other violent offenders, c) recidivist arsonists, d) men with antisocial personality disorder without aggressive tendency and e) hospital personnel. A retrospective review of school records indicated that habitually violent offenders had elevated rates of truancy, undersocialized aggressive disorder and attentional difficulties in school. The results of these studies support the notion that violent and criminal forms of adult aggression are associated with depressed HPA-axis activity.

In contrast to findings with aggressive samples, Kagan, Reznick, and Snidman (1988) reported different patterns of basal cortisol and cortisol production in response to stressful laboratory procedures in inhibited children. In a longitudinal design, these investigators followed young children over a period of approximately five years. These were children who had been characterized at the initiation of the project as inhibited based on assessment of behavioral reactions to a strange situation at two and three years of age. Inhibition was defined in terms of response to unfamiliar stimuli. Inhibited children were characterized by shy, quiet, and timid patterns of behavior. These patterns consisted of infrequent spontaneous vocalizations, clinging to mother when exposed to unfamiliar adults, and lower rates of spontaneous interaction with unfamiliar peers in a laboratory setting. Observation of these children at three to five years underlined their continuing social isolation. Basal and reactive saliva cortisol levels were found to be significantly elevated in these children, and correlated with inhibition ratings taken at 21 and 31 months.

These results were consistent with the view that timid, withdrawn behavior in early childhood may reflect a low threshold for HPA-axis activation. Heightened sensitivity of the HPA-axis has been proposed by Kagan et al. (1988) and by other authors (Gold et al., 1988; Sapolsky, 1983; Suomi, 1987) as a risk factor for vulnerability to affective disorder. Individuals suffering from Major Depressive Disorder with melancholia often exhibit elevations in glucocorticoid production and disruption of the circadian pattern of cortisol secretion. This deviation from the normative pattern of secretory episodes is thought to be caused by dysfunction of feedback mechanisms regulating glucocorticoid production (Sacher, 1973).

Cognitive Factors. Another body of literature examining variability in cortisol production has suggested that cognitive processes involved in the perception of threat and assessment of personal coping resources are instrumental in determining the magnitude of the stress response. Several reports have linked subjective coping efficacy expectations with HPA-axis activation following stress. In a study examining the dynamic effects of behavioral and cognitive training in a group of snake phobics, Weidenfeld and associates (1990) demonstrated that cortisol activation following exposure to the phobic stimulus decreased over time as self-efficacy expectations increased. These results provide support for Gunnar et al.'s, (1990) hypothesis regarding the relationship between personal coping resources and cortisol release associated with stress. As subjects in this study acquired new and more effective behavioral responses to the stressor, they no longer perceived the stimulus as a demand exceeding their coping resources. This change in perceived coping efficacy was reflected in the reduction of HPA-axis activity.

Indirect evidence for a similar process is reported in a study of college-level tennis players by Booth, Shelley, Mazur, and Tharp (1989). These authors found that cortisol levels prior to and following a tennis match were associated with seed, or ranking. Top seeded players, who would likely have higher efficacy expectations than low seeded players, produced lower levels of saliva cortisol. In addition, saliva cortisol levels decreased as the season progressed. For lower ranking players, it is likely that self-confidence and mastery over the game increased over the course of the season, as self-efficacy expectations increased.

The foregoing evidence suggests that individual differences influence the sensitivity of the HPA-axis to stressful situations. A pattern of frequent aggression has been linked with low cortisol production, and by contrast, a pattern of frequent inhibition has been associated with high cortisol production in the face of stress. In addition, performance expectations or self-efficacy beliefs appear to modulate cortisol secretion through their effects on the appraisal of the gap between available coping resources and those needed to meet environmental demands. The research to date, however, is predicated on the assumption that, whatever their causes, the differences between adults in aggression, inhibition, and self-efficacy beliefs are long-standing. The present research examined this relatively untested premise in a study which examined cortisol response in adults who were identified as aggressive, withdrawn or both aggressive and withdrawn as children, and as adults had developed stable efficacy beliefs.

The Present Study: The purpose of the present study was to determine whether differences exist in the stress response of adults who were aggressive, withdrawn, or both aggressive and withdrawn in childhood. Stress was evaluated as a function of the interaction between stressor condition and self-appraised coping efficacy. The index of stress used in this study was saliva cortisol, a measure of HPA-axis activity. A detailed description of these variables is presented in the following sections.

Childhood Aggression and Withdrawal: Aggression and social withdrawal represent major indicators of maladaptive functioning in childhood (Achenbach & Edelbrock, 1984; Quay, 1986). A third pattern consisting of frequent aggression and frequent withdrawal has been identified as a prominent characteristic of childhood social behavior in young adults with a diagnosis of schizophrenia (Watt, Stolorow, Lubensky & McLennand, 1970).

The Concordia Longitudinal Risk Project focused on these three modes of deviant social interactions in childhood as risk factors for psychiatric disorder in adulthood (Schwartzman, Ledingham & Serbin, 1985). Aggression in this study refers to attention seeking behaviors, acting out, physical aggression, and disruptiveness; withdrawal refers to shyness, oversensitivity, and social isolation. Children were screened for aggression and withdrawal by means of a peer nomination procedure (Peer Evaluation Inventory; Pekarik, Prinz, Liebert, Weintraub and Neale, 1976). Peer assessments have been shown to have predictive validity for maladjustment in adulthood (Cowen, Peterson, Babington, Izzo & Trost, 1973; Smith, 1967). Children who were identified by peers as aggressive, withdrawn, aggressive and withdrawn, or socially normative comprised the project's sample for follow-up study.

Over the past 15 years, the project's findings have provided evidence that aggression and withdrawal are risk factors for negative psychosocial outcome and/or psychiatric disorder in early adulthood (Schwartzman, Moskowitz, Serbin & Ledingham, 1990). In childhood, the aggressive group was characterized by patterns of externalizing and attention seeking behavior (Ledingham, Schwartzman & Serbin, 1984; Lyons, Serbin & Marchessault, 1985; Schwartzman, Ledingham & Serbin, 1985). Aggressive children exhibited poor school competence and school achievement (Ledingham, Schwartzman & Serbin, 1984). In adolescence, aggression was associated with continuation of this pattern as well as frequent medical and psychiatric problems (Moskowitz & Schwartzman, 1989). As young adults, the aggressive children were prone to substance use disorders, antisocial and histrionic personality disorders (Schwartzman & Moskowitz, 1991).

Social withdrawal in childhood was characterized by social isolation from peers (Lyons et al., 1985). Withdrawn children demonstrated a lack of self-confidence and poor social competence. In adolescence, withdrawn children received more medical treatment and non-psychiatric diagnoses than controls (Moskowitz & Schwartzman, 1989). In early adulthood, childhood social withdrawal was associated with elevated rates of phobic disorders (Schwartzman &

Moskowitz, 1991).

Aggressive-withdrawn children presented the most problematic behaviors and outcomes. In childhood, these individuals were rated as immature by parents and teachers and their social, cognitive, and motor skills were below average (Schwartzman et al., 1985). This pattern persisted through adolescence with the aggressive-withdrawn sample showing poor cognitive, motor, social and academic skills as well as frequent contact with social services (Moskowitz & Schwartzman, 1989). Aggressive-withdrawn individuals exhibited the broadest constellation of negative outcomes in young adulthood. Common among males in this group were antisocial personality disorder and substance use disorder. Aggressive-withdrawn females were vulnerable to major depressive, phobic and substance abuse disorders. The poor psychosocial adjustment of the aggressive-withdrawn group was indicated by depressed socioeconomic status, increased stress, attentional deficit and problematic marital relationships (Schwartzman & Moskowitz, 1991).

For the purpose of this study, endocrine response patterns of the aggressive and withdrawn groups were expected to be consistent with the findings of studies reviewed earlier. Individuals who were aggressive in childhood were expected to show a pattern of diminished cortisol activity, although to a less extreme degree than in the Woodman et al. (1978) and Virkkunen (1985) studies in which subjects had histories of violent criminal behavior. Nonetheless, in the Concordia sample aggressiveness was assessed in childhood and this behavioral style has been moderately stable (Moskowitz, Schwartzman & Ledingham, 1985). Thus, it was expected that individuals who had been aggressive in childhood would demonstrate lower levels of cortisol activity than individuals who had been socially normative.

Individuals who were withdrawn in childhood were expected to be physiologically sensitive to stress in a manner similar to that found by the Harvard group in their sample of inhibited children (Kagan et al., 1988). Although inhibition and withdrawal are not necessarily synonymous, there is evidence from the Harvard and Concordia studies which suggests that withdrawal and inhibition are overlapping constructs. Results from observational studies (Lyons et al., 1985; Reznick et al., 1986) indicate that peer interactions are characterized by social isolation in both withdrawn and inhibited children. If, as Kagan (1991) hypothesizes, these behavior patterns are reflections of an underlying physiological sensitivity to novel stimuli, and further, if these physiological properties are potentiated over time (Sapolsky et al., 1986), we could expect that the young adults who were withdrawn in childhood would exhibit greater stress-induced elevations of cortisol than those individuals who had been aggressive or socially normative children.

Whereas the research literature provides grounds for predicting the adult HPA-axis reactivity of withdrawn and aggressive children, there is no comparable evidence available for predicting cortisol production in adults with a childhood history of frequent aggression <u>and</u> frequent withdrawal. Those who were both aggressive and withdrawn in childhood may respond in one of two ways. If aggression and withdrawal act in synergy to elevate the risk of psychopathology, as has been hypothesized in the Concordia Longitudinal Risk Project, we should expect a vulnerability to stress over and above that of the other socially deviant children. Aggressive-withdrawn children should therefore exhibit higher levels of cortisol production as young adults than either aggressive or withdrawn children. Alternatively, if aggression and withdrawal are orthogonal traits which exert opposing influences on HPA-axis physiology, we should expect a pattern of cortisol production which parallels the behavioral dysregulation seen in these individuals as children. Individuals who were both aggressive and withdrawn as children would then be expected to exhibit a labile pattern of cortisol production, consistent with their behavioral lability, reflecting a dysregulation of HPA-axis physiology.

<u>Self-appraised coping efficacy</u>: The third factor

examined in this study dealt with "self appraised coping efficacy". Since the task called for a problem-focused coping strategy (Lazarus and Folkman, 1984) in order to terminate the tone stressor, it was deemed relevant to have an index of problem solving skills serve as the measure of self-appraised coping efficacy. As Gunnar and colleagues (1989) have postulated, the degree of coping uncertainty generated by a shift in environmental demands which trigger HPA-axis activity, may be associated with self-efficacy beliefs (Bandura, 1989). Therefore, individuals who believe they use a wide range of problem-solving behaviors and attitudes which promote the application of these strategies, should find the laboratory task less stressful than those who rate themselves less favourably. Self-rated coping efficacy was expected to enhance differences predicted as a function of stressor condition and childhood social deviance.

Stressor Conditions. In line with the literature reviewed previously, the stressor, a loud pure tone, was selected for its novelty. Subjects in the study were presented with a tone which was either predictable and controllable or unpredictable and uncontrollable. Feedback was provided on the success or failure to acquire the appropriate strategy to terminate the tone. Feedback has been shown to be important in determining the magnitude of endocrine response following controllable stress in laboratory animals (Weiss, 1971).

On the basis of previous reports (Breier et al., 1987; Dess et al., 1983; Hanson et al., 1976) it was expected that the unpredictable and uncontrollable stressor condition would provoke greater cortisol activation than a stressor that was predictable and controllable. Studies evaluating endocrine response to controllable and/or predictable stressors have shown that HPA-axis activity associated with predictability and controllability of the stressor do not differ in magnitude from non-stressors. It was also expected that the stress reaction would be attenuated early in the trial as the behavior necessary to terminate the tone stressor was acquired. In line with the findings of the links between aggression, inhibition, and ccrtisol response reviewed earlier, it was expected that the unpredictable-uncontrollable condition would elicit greater HPA-axis activity in individuals with a childhood history of withdrawal than those with a childhood history of aggression. Cortisol levels in individuals who were both aggressive and withdrawn in childhood in the unpredictable-uncontrollable condition were expected to reflect the HPA-axis dysregulation previously described, and demonstrate a labile pattern of cortisol production. However, since the children who were identified as both aggressive and withdrawn were the least able of the target groups to cope with academic and social demands, and were the most susceptible to the stresses of psychosocial disadvantage as adolescents and young adults (Schwartzman et al., 1991), members of this group were expected to perceive themselves as limited in coping efficacy and could show the highest level of HPA-axis activity in the unpredictable-uncontrollable condition.

Saliva cortisol. The index of stress chosen for this study was cortisol measured in saliva. This relatively new method of assessing HPA-axis function has proven useful (Bassett, Marshall & Spillane, 1987; Gladue, Boechler & McCaul, 1989; Jones, Copolov & Outch, 1986; O'Connor, Morgan, Raglin, Barksdale et al., 1989; Stahl and Dorner, 1982). Assessment of steroids hormones in saliva has been used with increasing frequency since the technique was first described in the early 1980's (Riad-Fahmy, Read, Walker & Griffiths, 1982; Stahl and Dorner, 1982). It has been shown in several studies to have adequate reliability and sensitivity for most applications (Evans, Peters, Walker, Riad-Fahmy & Hall, 1984; Foreman & Goodyear, 1988), and is highly correlated with plasma cortisol measures (Burke, Reichler, Smith, Dugaw, McCauley & Mitchell, 1985; Riad-Fahmy et al., 1982). The measurement of cortisol in saliva has several advantages over assessment techniques using blood plasma or urine samples. First, collection of saliva for steroid hormone assay is a non-invasive and non-disruptive sampling procedure which eliminates the need for venipuncture, thus alleviating the stress associated with the procedure itself. This is especially important in a study which calls for repeated cortisol sampling over a short period of time. Second, saliva measures allow assessment of dynamic change in cortisol levels over time in contrast to urinary measures, which assess total cortisol production over the course of the day. Third, steroids in saliva represent the unbound fraction of cortisol, providing information regarding the biologically active fraction of cortisol present in the system. Finally, saliva samples are easier to handle, and they do not require immediate processing (Hanada, Yamada, Takahashi & Takahashi, 1985, Stahl and Dorner, 1982).

Hypotheses. Evidence documented in the preceding sections suggests that the stress response, defined as elevated levels of cortisol measured in saliva, is a function of at least three factors: childhood behavioral style, stressor condition, and self-appraised coping efficacy. As a response to a moderately aversive physical stressor, it was expected that:

(a) adults who were socially withdrawn in childhood would exhibit elevated levels of saliva cortisol;

adults who were aggressive in childhood would exhibit depressed cortisol levels; adults who were both aggressive and withdrawn in childhood would exhibit either elevated cortisol in saliva, or a labile pattern of cortisol production;

(b) adults who perceived themselves as below average in self-efficacy would produce higher levels of saliva cortisol than adults who perceived themselves as above average in self-efficacy;

(c) a higher level of saliva cortisol would be produced when the stressor was unpredictable and uncontrollable than when the stressor was predictable and controllable;

(d) the most elevated levels of saliva cortisol would be present in adults who perceived themselves as below average in self-efficacy, who were withdrawn or aggressive and withdrawn in childhood, and when exposed to an unpredictable-uncontrollable stressor; the most depressed levels of saliva cortisol would be produced in adults who perceived themselves as above average in self-efficacy, who were aggressive in childhood, and when exposed to a predictable-controllable stressor.

Method

Subjects

The subjects were 82 French-speaking volunteers (43 males and 39 females) who were drawn from the two older age groups of the Concordia Longitudinal Risk Project sample. They were in grades 4 and 7 at the time of initial screening for aggression and withdrawal in 1977-78. Mean age of subjects in the present study was 23 years (SD: 1.68; range: 20-27 years). Table 1 presents the cell size breakdown by classification group and sex. Candidates were screened in a telephone interview for current (within the past month) substance abuse including alcohol and for current prescriptive medication other than contraceptive, as criteria for exclusion. Female subjects who were pregnant or lactating were also excluded.

Classification of subjects. A French translation of the Peer Evaluation Inventory (PEI; Pekarik, Prinz, Liebert, Weintraub & Neale, 1976) was used to screen a large population of French-speaking Montreal school children in grades 1, 4 and 7 for aggression and social withdrawal in 1977-78 (See Appendix A for scale). Children who met the selection criteria outlined below were assigned to one of the four groups of the Concordia project's research sample: Aggressive, Withdrawn, Aggressive-Withdrawn, and Control.

Table 1

Sample Distribution By Sex and Peer-rated Classification Group

	Sex of Subject	
Classification Group	Male	Female
Aggressive	10	10
Withdrawn	10	9
Aggressive/ Withdrawn	10	10
Controls	13	10

The PEI is a factor-analyzed, peer nomination scale which consists of 34 behavior descriptors loading on the factors aggression, withdrawal, and likeability. Children in each classroom were asked to nominate up to four boys and four girls in their class who best fit the description of each behavior item in the questionnaire. Boys and girls were rated separately.

The total number of nominations for each child was tabulated for each of the three factors, subjected to a square root transformation to reduce skewness and then standardized for each sex within each classroom. Thus, scores were age- and sex-appropriate. Only z-scores on the aggression and withdrawal factors were used to identify subjects for the project.

Children were assigned to the aggressive group if their z-scores were at the 95th percentile or above on aggression and below the 75th percentile on withdrawal. The withdrawn group consisted of individuals whose z-scores were at the 95th percentile or above on withdrawal and below the 75th ercentile on aggression. Children whose z-scores were above the 75th percentile on both aggression and withdrawal were assigned to the aggressive-withdrawn group. Control subjects were those whose z-scores were between the 25th and 75th percentiles on both aggression and withdrawal.

Measures

Self-appraised coping efficacy. A French version of the Problem Solving Inventory (PSI; Heppner & Peterson, 1982) was developed to assess self-appraised coping efficacy (See Appendix B for scale). The scale consists of 32 six-point Likert items which describe coping behaviors and attitudes; the higher the rating on the item, the lower the coping efficacy.

Reliability and validity data obtained (Heppner & Peterson, 1982) indicate that the scale has excellent internal consistency ($\alpha=.90$) and test-retest reliability ($r=.89$). The PSI is moderately correlated with the Level of Problem Solving Estimate Form, a simple problem solving rating scale ($r=-.46$). It is not significantly correlated with measures of intelligence, academic achievement, or social desirability. The PSI is moderately correlated with the Personal Control scale of the Rotter Internality-Externality scale ($r=-.34$) (Rotter, 1966), and testing following a problem solving training program indicated that problem solving attitudes and behaviors were significantly improved ($t(16)=1.86$, $p<.05$) (Heppner & Peterson, 1982).

The normalized sum of the self-ratings was the index of self-appraised coping efficacy. Subjects were classified as "good copers" and "poor copers" by median split of the total sample. Table 2 presents coping classification breakdown by peer-rated behavioral classification.

Perceived success (PS). As a manipulation check, ratings of experienced success were taken before and after the stressor presentation phase. The scale consisted of a French version of a "visual-analog" scale (after Breier et al., 1987). Subjects were asked to mark a 100 mm line, with responses ranging from "not at all" (0 mm) to "very much" (100 mm) in response to a statement assessing feelings of success at the Pre-stress and Post-stress sampling times. The pre-post difference in ratings was the index of perceived success. The scale is presented in Appendix C.

Table 2

Sample Distribution by Self-appraised Coping Efficacy and Peer-rated Classification Group

	Self-appraised Coping Efficacy	
Classification Group	Good	Poor
Aggressive	12	7
Withdrawn	6	13
Aggressive/ Withdrawn	7	12
Controls	15	7

Cortisol. The cortisol sampling procedure was an adaptation of that used by Stahl & Dorner (1982). Subjects were asked to hold a strip of filter paper (65mm x 25mm, Watman 1) under their tongue until it was saturated with saliva. Saliva samples were air dried, then frozen at minus 20°C until they were assayed for cortisol. Cortisol levels were determined via competitive protein binding radioimmunoassay, using a radioimmuniassay procedure developed by Krey, Butler, Hotchkill, Piva and Knobil (1975). Cortisol antibody (F3314) was obtained from Endocrine Sciences, CA and [3H]cortisol purchased from New England Nuclear, Boston, MA served as the tracer. The assay procedure is presented in Appendix D.

Apparatus for Tone presentation. Software developed for an IBM PC computer specifically for this project (K.B. Austin, 1989) following the procedure of Breier and colleagues (1987), generated the tones and controlled the frequency and duration of tone presentation for the experimental conditions. The volume and pitch of the tones were calibrated using an audiometer. The tones were presented through headphones.

Tone control and visual feedback. Tone termination was controlled by pressing a silver button on a plexiglass panel. Feedback was provided by two indicators on the panel which were illuminated by red and green lights. The feedback indicators were labelled "subject" and "computer" in French to designate the source of tone termination (See Appendix E for illustration and details).

Experimental stressor conditions. There were two stressor conditions: predictable-controllable (PC) and unpredictable- uncontrollable (UU). Both stressor conditions consisted of 60 presentations of a loud pure tone (90 dB, 3000 Hz). The tone duration ranged from two to five seconds. The intertrial interval, which was under computer control, ranged from 15-35 seconds.

In the PC condition, each stressor tone was preceded by a 0.5 second, 1000 Hz warning tone. The stressor tone followed five seconds later and could be terminated by four button presses. The button had a "stick-down" interval of 0.5 second.; thus, the minimum tone presentation was two seconds. If the tone was successfully terminated by the subject, a green light, labelled "sujet", flashed on the control panel for two seconds. If the tone was terminated by the computer after a maximum duration of five seconds, a red light, labelled "ordinateur", flashed for two seconds.

In the UU condition, subjects did not receive a warning tone, nor were they able to terminate the stressor tone. Therefore, each tone presentation was followed by a red light, signalling their failure to terminate the tone.

Procedure

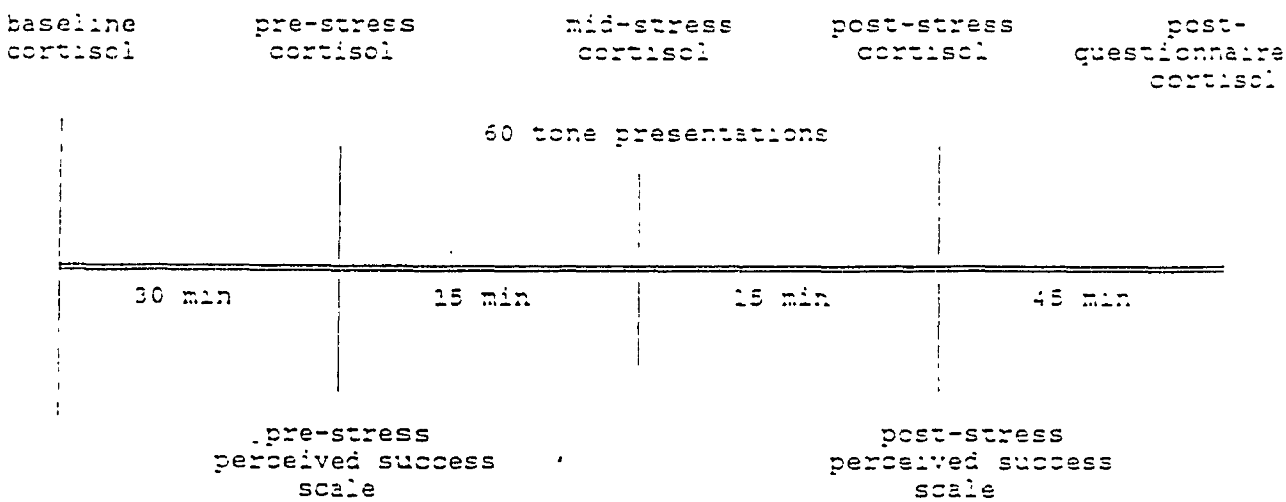
Candidates were contacted and invited to participate. They were informed as to the nature and aims of the study, and the amount of payment to be received for participation. As stated earlier, volunteers were screened in telephone interview for current (within the past month) substance abuse including alcohol, for current prescriptive medication other than contraceptive and for pregnancy as criteria for exclusion. Prospective participants were advised not to eat one hour before arriving at the laboratory. Testing took place between 1.00 P.M. and 4.00 P.M. to take advantage of the mid-afternoon drop in cortisol secretion (Kreiger, Allen Rizzo & Kreiger, 1971; Weitzman, Fukushima, Noglire, Roffwang, Gallager & Hellman, 1971).

On arrival, subjects completed informed consent forms, were assigned to either the PC or UU stressor condition, and had their first saliva sample taken. The PC and UU subjects were "yoked" to receive the same frequency and duration of tone presentation. They were also matched as closely as possible for classification group, age, and sex.

Subjects completed several risk project questionnaires for 45 minutes. At the end of this period, the Baseline measure of perceived success was administered and the Pre-stress saliva sample taken. Instructions were then given regarding the tone presentations. Subjects were told that a loud noise would be presented through the headphones, that there was something that they could do to terminate the tone, and that it would be up to them to figure out how to do it. The function of the feedback indicators was explained as described above. Once the subject indicated full understanding of the instructions, the tone presentations commenced.

The third saliva sample (Mid-stress) was taken after the 30th tone presentation; and the fourth (Post-stress) was taken after the final 60th tone presentation. At this point, the Post-stress measure of perceived success was administered. Following this, subjects completed an additional set of questionnaires, including the PSI. The fifth and final saliva sample was taken 45 minutes after the fourth saliva sample. A schematic of the events in the procedure is presented in Figure 3.

Figure 3. Schematic of experimental procedure.



Results

Statistical treatment of cortisol production was directed at four data points: baseline, pre-stress, mid-stress, and post-stress. The fifth cortisol data point for the recovery phase was excluded because of the confounding effects of questionnaire completion during that period. In addition, three subjects were excluded from the analyses because their cortisol levels were more than three standard deviations from the mean (Tabachnick & Fidell, 1989). Thus, analyses reported below are based on a sample size of 79 subjects.

Manipulation check: To determine whether the stressor conditions were meaningful, pre- and post-stress ratings of success for subjects in the UU condition versus subjects in the PC condition by means of a t-test. Subjects in the PC condition reported a mean increase in subjective success of 9.4 points (SD: 28.3) as compared to a mean loss of 19.8 points (SD:32.6) for subjects in the UU condition. This difference in perceived success between subjects in the PC condition and subjects in the UU condition was significant [$t(77)=4.27$; $p<.001$].

Cortisol Response: Examination of cortisol production prior to data analysis revealed violations of the ANOVA assumptions of normality and homogeneity of variance. Use of log transformations to correct positive skew was considered. However, the difficulties in interpretation following this manipulation outweighed the benefits of a slight reduction of α-inflation (Stevens, 1986). Potential inflation in α-level due to heterogeneity of variance and unequal cell sizes was addressed using the Greenhouse-Geisser correction factor for degrees of freedom as recommended by Tabachnick and Fidell (1989).

The effect of sex of subject on saliva cortisol production was evaluated in each of three ANOVAs with repeated measures for sampling time. The first ANOVA was directed at classification group (aggressive, withdrawn, aggressive-withdrawn, normative controls), the second at self-appraised coping efficacy (good, poor) and the third ANOVA at stressor condition (predictable-controllable, unpredictable-uncontrollable). None of these analyses produced a statistically significant main effect or interaction for sex. Sex was therefore dropped as an independent variable in subsequent analyses.

Effects of age of subject on saliva cortisol production were also evaluated in three separate ANOVAs with repeated measures as described above, with school grade level at initial screening as a measure of age. As with sex, there were no significant main effects or interactions for grade level, and age was also dropped as an independent variable in the following analyses.

Stressor Condition: The influence of stressor condition on saliva cortisol activity was examined in two separate ANOVAs with repeated measures using classification group and coping efficacy as the independent variables.

In the stressor condition by classification group repeated measures ANOVA, stressor condition was found not to be significant as a main effect: [$F(1.86, 142.85)=1.95$; $p=.15$], nor was it significant in its interaction with classification group: [$F(5.53, 130.83)=0.89$; $p=.50$].

In the stressor condition by self-appraised coping efficacy repeated measures ANOVA, the interaction of stressor condition with coping efficacy was significant [$F(1.85, 138.76)=5.51$; $p<.01$]. A simple effects test for sampling time (Tabachnick and Fidell, 1989) indicated that the interaction of stressor condition and coping efficacy was significant at both the Mid-stress [$F(1,75)=8.75$; $p<.005$] and Post-stress [$F(1.75)=4.56$; $p<.05$] sampling times (Figure 4).

Evaluation of mean cortisol production at Mid-stress with a simple groups comparison procedure (Tukey-Kramer) revealed that, in line with our predictions, poor copers produced significantly more cortisol in the unpredictable-uncontrollable condition than did poor copers in the predictable-controllable condition, or good copers in either condition [Q(75)=3.89, p<.01]. Table 3 presents the means and standard deviations for this interaction.

In contrast to the findings at the Mid-stress sampling time, simple comparison tests at the Post-stress sampling time indicated that good copers produced significantly more cortisol in the unpredictable-uncontrollable condition than did good copers in the predictable-controllable condition, or poor copers in either stressor condition [Q(75)=3.66; p<.05]. Means and standard deviations are presented in Table 4.

Figure 4. Mean saliva cortisol production as a function of self-appraised coping efficacy and stressor condition.

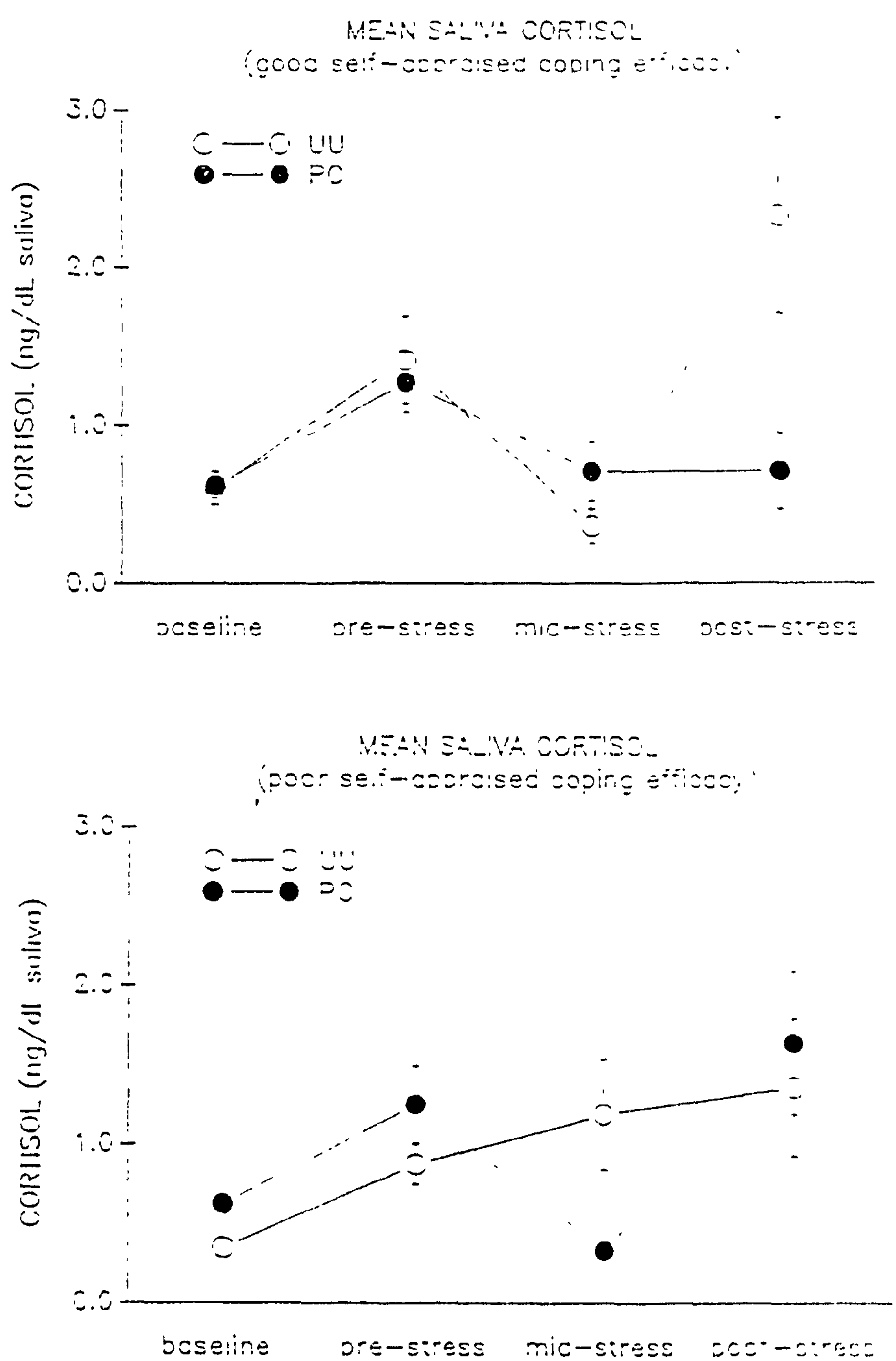


Table 3

Saliva Cortisol Means (Standard deviations) as a function of Self-Appraised Coping Efficacy and Stressor Condition at Mid-Stress Sampling Time

	Stressor Condition	
Coping Efficacy	Predictable Controllable	Unpredictable Uncontrollable
Good	0.711 (0.879)	0.363 (0.466)
Poor	0.333 (0.433)	1.189 (1.479)

Table 4

Saliva Cortisol Means (Standard deviations)as a function of Self-Appraised Coping Efficacy and Stressor Condition at Post-Stress Sampling Time

	Stressor Condition	
Coping Efficacy	Predictable Controllable	Unpredictable Uncontrollable
Good	0.712 (1.143)	2.329 (2.641)
Poor	1.639 (2.072)	1.359 (1.842)

Classification Group and Coping Efficacy: The effect of peer-rated behavioral classification group on saliva cortisol was examined first as a function of stressor condition and then coping efficacy in separate ANOVAs with repeated measures. As noted earlier, the stressor condition by classification group ANOVA did not yield significant results.

The effects of classification group and coping efficacy on cortisol activity was examined in a four by two ANOVA with repeated measures for sampling time. Main effects for coping efficacy [$F(1.89,133.84)=1.03$, $p=.36$] and classification group [$F(5.66,133.84)=2.71$, $p=.09$] were not significant. There was a significant classification group by coping efficacy by sampling time interaction [$F(5.66,133.84)=3.13$, $p<.01$]. A simple effects test for time indicated that this interaction was significant at the Post-stress sampling time. Table 5 presents means and standard deviations for these groups at post-stress.

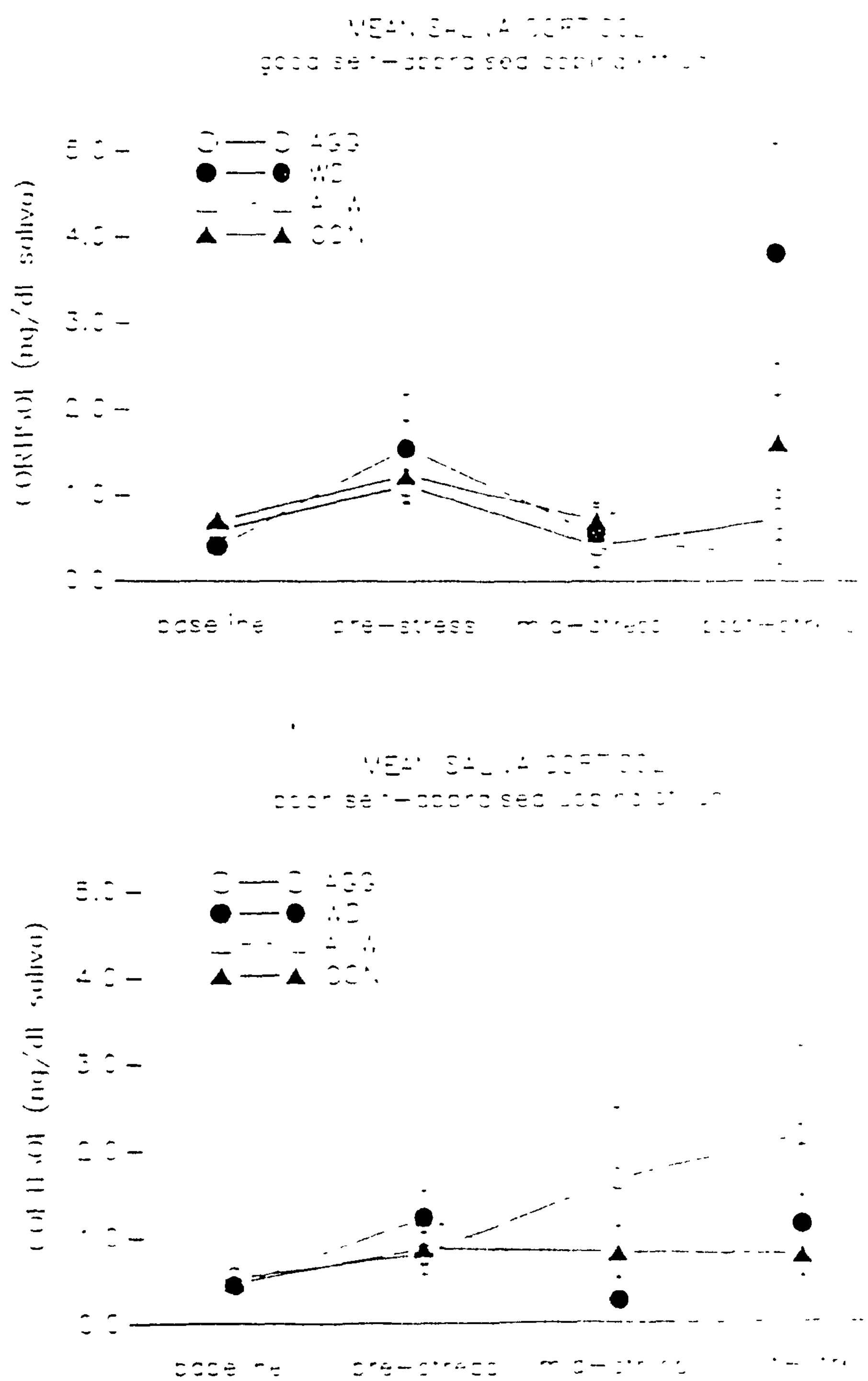
A simple effects test for coping efficacy indicated that this interaction was significant for good copers [$F(3,75)=5.91$; $p<.01$]. The peer-rated classification by coping efficacy interaction was not significant for poor copers [$F(3,75)=1.09$; $p =.25$]. Multiple comparisons between peer-rated classification groups of good copers (Tukey/Tukey-Kramer) indicated that among good copers, withdrawn subjects produced significantly more cortisol than either aggressive subjects [$Q(75)=4.6$; $p<.01$] or aggressive-withdrawn subjects [$Q(75)=4.7$; $p<.01$]. These results are illustrated in Figure 6.

Table 5

Saliva Cortisol Means (Standard deviations) as a function of Self-Appraised Coping Efficacy and Classification Group at Post-Stress Sampling Time

	Self-appraised Coping Efficacy	
Classification Group	Good	Poor
Aggressive	0.719 (0.859)	2.155 (2.708)
Withdrawn	3.803 (3.149)	1.134 (1.171)
Aggressive/ Withdrawn	0.291 (0.251)	1.968 (2.526)
Controls	1.607 (2.145)	0.778 (0.659)

Figure 5. Mean saliva cortisol production as a function of self-appraised coping efficacy and behavioral classification group.



Risk Profiles. One of the goals of the present study was the construction of a risk profile for vulnerability to stress using the independent variables described above. Toward this end, the interaction between stressor condition, childhood social deviance classification and self-appraised problem-solving skills was examined. The cell sizes produced through this three-way ANOVA did not permit statistical testing or this interaction. However, the mean values of cortisol production at the Post-stress sampling point (Table 6) suggest that the individuals who were socially withdrawn in childhood, who evaluated themselves as good copers, and who were exposed to an uncontrollable-unpredictable stressor produced the largest amount of saliva cortisol at Post-stress sampling.

Table 6

Saliva Cortisol Means (Standard deviations) as a function of Self-Appraised Coping Efficacy and Classification Group and Stressor Condition at Post-Stress Sampling Tire

	Stressor Condition			
	PC		UU	
	Self-appraised Coping Efficacy			
Classification Group	Good	Poor	Good	Poor
Aggressive	0.526 (0.311)	2.259 (3.791)	0.990 (0.940)	2.078 (2.251)
Withdrawn	1.788 (2.190)	1.098 (1.196)	4.810 (3.297)	1.213 (1.287)
Aggressive/ Withdrawn	0.152 (0.097)	2.827 (2.775)	0.640 (0.020)	1.354 (2.364)
Controls	0.956 (1.416)	0.904 (0.878)	2.350 (2.682)	0.610 (0.273)

Discussion

The present study was conducted to explore the stress response of individuals with childhood histories of social withdrawal, aggression or both aggression and withdrawal. The stress response, defined as cortisol measured in saliva was examined as a function of coping efficacy, and the controllability and predictability of the stressor. Taken in the context of studies of risk factors for adult psychopathology such as the Concordia Longitudinal Risk Project, it was expected that the study would elucidate the nature of the interplay among biopsychosocial factors in stressful situations which may elevate risk for psychiatric disorders. The major findings of the present study will be reviewed and the implication of these results and directions for future research will be discussed in the following sections.

Our hypothesis that the uncontrollable-unpredictable noise stressor would provoke higher levels of cortisol than the predictable-controllable stressor was not supported. Unlike previous studies which reported increases in cortisol production following exposure to uncontrollable noise stress in monkeys (Hanson, Larson & Snowdon, 1976) and following unpredictable and uncontrollable shock in dogs (Dess et al., 1983), the unpredictable-uncontrollable stressor condition did not in and of itself produce group differences in cortisol secretion over the course of the stressor trials.

This result may be addressed in two ways.

First, the stressor used in this study may not have been sufficiently salient for subjects. Whereas previously discussed studies have examined cortisol response subsequent to life events such as the Three Mile Island nuclear accident (Schaeffer & Baum, 1984), preparation and defense of a doctoral dissertation (Johansson & Collins, 1983) and exposure to novel social situations (Kagan, Reznick & Snidman, 1988), the physical stressor in the present study did not necessarily pose a threat for the participants. The perceived absence of negative consequences resulting from a failure to predict or control the stressor may have attenuated HPA-axis activation during the unpredictable-uncontrollable condition.

Second, the research literature regarding HPA-axis activation following uncontrollable or unpredictable stress is largely composed of studies using animal populations. The question raised by these negative results is whether psychoneuroendocrinology research in analog populations are generalizable to human subjects. Studies of post-stress HPA-axis activation in human populations (Johansson & Collins, 1983; Schaeffer & Baum, 1984) and models of this phenomenon (i.e.: Gunnar et al., 1989) target cognition and affect as modulatory variables in the activity of the HPA-axis, and these higher order processes cannot be directly assessed in animal populations.

A review of the relevant literature (Booth et al., 1989; Weidenfeld et al., 1990) prompted the prediction that subjects with lower perceived coping efficacy would produce higher levels of cortisol. As with effects of stressor condition on saliva cortisol, this prediction was not supported by the results. It should be noted, however, that the cell distribution of our sample was not balanced because of the association of coping efficacy with peer-rated behavioral classification. It will be recalled that classification of subjects as good and poor copers was based on a median split of the total Problem Solving Inventory Score for the entire sample. As can be seen in Table 2 (p. 34), poor coping was more prevalent among members of the aggressive-withdrawn and withdrawn groups. In future studies with this instrument, it will be necessary to balance cell sizes to assure reliable findings.

In examining the effect of perceived coping efficacy on saliva cortisol levels, it was found that both the good copers and the poor copers of the study had elevated levels of cortisol only after unpredictable-uncontrollable stress. Poor copers differentiated themselves from good copers, however, by exhibiting an elevated cortisol response to unpredictable-uncontrollable noise stress earlier than did the good copers. According to Gunnar et al. (1989), cortisol production occurs when the individual has exhausted his or her repertoire of coping responses, and can no longer meet the changing demands of the environment. At this point in time, it is posited that a change in cognitive processing occurs, which directs the individual toward a search for new ways of coping. Given that both the good and poor copers in the present study were exposed to equivalent environmental demands, it is possible that the earlier peak in cortisol production in the poor copers and the later peak in cortisol production in the good copers reflects the difference in time required for these two groups to exhaust their problem solving resources, and to reach the state of coping uncertainty which is hypothesized to activate the HPA-axis.

It is to be noted that the amount of cortisol produced at peak was greater for good copers than for poor copers (see Figure 4, p. 44). This result contrasts with previous studies described earlier (Weidenfeld et al., 1991) which associated elevated cortisol production was with poor coping efficacy. The role of novelty may be relevant in interpreting this discrepant finding. As discussed earlier, novelty is a powerful trigger for HPA-axis activity. In the case of good copers who encounter an unpredictable-uncontrollable stressor, it may be that relative to poor copers the experience of failure to cope successfully with the task is novel. If we assume that participants in the present study evaluated their problem-solving skills realistically, then we may further assume that the good copers encountered failure far less often than did the poor copers. Thus, the experience of failure induced by the unpredictable-uncontrollable stressor condition in the present study was a relatively unusual event for the good copers. The novelty of this experience for them was reflected by the larger increase in cortisol at the post-stress sampling time than that seen in the poor copers.

Differences in cortisol production between poor and good copers may also have stemmed from the length of time these individuals expended effort in trying to solve the problem presented by the task. Frankenhauser (1983) found that effort is related to elevations in catecholamine levels and active suppression of the HPA-axis, whereas distress is associated with elevated glucocorticoid production. Good copers may have expended effort throughout the trial sequence in attempting to solve the problem. As can be seen from Figure 4 (p. 44), cortisol production of the good copers was low relative to the poor copers until the termination point of the unpredictable-uncontrollable stressor trial sequence when the distress associated with failure may have triggered the large increase in cortisol. On the other hand, poor copers may have expended less effort throughout the entire course of the trial if they expected to fail the task. They may have become mildly distressed earlier in the trial sequence as reflected in the earlier increase in cortisol seen at mid-stress, and then "given-up" shortly thereafter. Thus, unlike the good copers, the suppression of cortisol production associated with continued effort is presumed not to have occurred.

The final hypothesis concerned the role of childhood behavioral deviance in the stress response of the adult. The cortisol response of individuals who were classified as aggressive and withdrawn in childhood was not consistent with our expectations. We had hypothesized that this group would respond to the stressor with either more pronounced HPA-axis activity than the aggressive or withdrawn groups or with a labile pattern of cortisol activity reflecting HPA-axis dysregulation. Results from the Concordia Longitudinal Risk Project had suggested that as a group, aggressive-withdrawn individuals were the least able to cope with academic and social demands and demonstrated a host of negative outcomes in late adolescence (Schwartzman et al., 1991). In the present study, the post-stress cortisol response of these individuals mirrored that of the aggressive subjects, suggesting that physiological activity in the aggressive-withdrawn group is associated more closely with childhood aggression rather than with withdrawal.

While deviance classification itself was not directly associated with differences in cortisol production, the interaction of childhood social deviance and self-appraised coping efficacy was significant. Within the sample of good copers, the withdrawn group produced significantly more cortisol than the aggressive group. This finding is consistent with results of the Harvard study, which indicated that inhibited children produced more salivary cortisol in response to laboratory stressors (Kagan, Reznick & Snidman, 1988). Moreover, the depressed cortisol response observed in the good coper-aggressive group is consistent with findings reported by Virkkunen (1985) and Woodman et al. (1978), linking aggression in violent offenders with low cortisol levels.

Poor copers, unlike the good copers in our sample did not differ in cortisol production as a function of peer classification group. As noted earlier, this result was not consistent with our hypothesis. We have suggested that poor copers are more likely to be familiar with and therefore more likely to expect problem solving failures than good copers. With this "mind set", poor copers regardless of their childhood behavioral style, feel less incentive to seek new problem solving and coping strategies. The low cortisol activity in the poor copers of the present study may therefore reflect low motivation.

Although attempts to examine the interactions between childhood behavioral classification, perceived coping self-efficacy and stressor condition were limited by sample size constraints, preliminary results offer several leads for future research. These results suggest that adults who were socially withdrawn in childhood and who evaluate themselves as good copers have difficulty coping with failure when exposed to unpredictable and uncontrollable stress. Results of the Concordia Risk Project indicate that individuals who were withdrawn in childhood underestimate their competencies (Schwartzman et al., 1985) in a manner which suggested fragile self-esteem. This pattern may continue into adulthood. A relatively large proportion of the withdrawn group in the present study evaluated themselves as poor copers (see Table 2, p. 34). Therefore, those of the withdrawn group who did rate themselves as good copers are unusual by virtue of the relatively high level of confidence they expressed in their ability to problem-solve. When these expectancies were challenged, as they were in the unpredictable-uncontrollable stressor condition, a pronounced HPA-axis activation ensued.

We interpret these findings as follows: Individuals with a childhood background of withdrawal have difficulty coping appropriately with negative life events. They react strongly to failure thereby increasing the risk for anxiety-related disorders (Schwartzman et al., 1991). It should prove useful in future research to examine the coping styles of these individuals as they face a range of life situations whose characteristics pose demands beyond their perceived coping repertoire, in order to target specific maladaptive attitudes and behaviors for purposes of intervention.

Cortisol levels were not elevated in the aggressive and aggressive-withdrawn groups. Such individuals appear to employ different coping strategies when encountering changes in environmental demands in comparison with individuals who were socially withdrawn as children. Aggression or co-occurring aggression and withdrawal in childhood may be associated with a narrow coping repertoire, a history of failure, and a lack of interest, motivation or effort expended in solving problems. This apparent dissociation from the demands of the task may have its origins in the learning histories of these individuals. Results from early phases of the Concordia Longitudinal Risk Project have indicated that childhood aggression and aggression-withdrawal are associated with low academic competence (Schwartzman et al., 1985). If these individuals as children developed relatively high expectancies of failure, coping strategies which serve to distance them from the affective consequences of failure would be adaptive. This pattern of adjustment is consistent with the elevated incidence of antisocial personality disorder and substance use disorder found in the aggressive and aggressive-withdrawn males of the Concordia project sample (Schwartzman et al., 1991). Further, as noted earlier, the depressed cortisol production in members of the aggressive and aggressive-withdrawn groups was consistent with the levels reported by Virkkunen (1983) and Woodman and colleagues (1978) in male prison inmates with antisocial and psychopathic personality disorders.

Aggressive females in the Concordia project sample showed different patterns of maladaptive behavior in adulthood (Schwartzman et al., 1991). Future studies employing a sample larger than that presently described should address the question of sex differences in cortisol response following stressor tasks. In addition, it should be useful to examine the relation between coping strategies and response patterns, not only in laboratory settings but also across a range of social and work situations. Studies of this kind are of theoretical and practical interest.

Summary and Conclusions: The present study examined the cortisol response of individuals identified in childhood as aggressive, withdrawn, aggressive and withdrawn or socially normative as a function of coping efficacy and the predictability and controllability of the stressor. The results of this study indicate that 1) low self-efficacy is associated with a rapid increase in saliva cortisol in the face of unpredictable-uncontrollable stress; 2) individuals who were withdrawn in childhood and perceive themselves as good copers are particularly sensitive to unpredictable and uncontrollable stress and 3) childhood patterns of aggression and aggression/withdrawal are associated with depressed HPA-axis activation in response to stress. The study underscores the need for further research on variables which emphasize individual differences in vulnerability to stress and its biopsychosocial effects. Finally, there is a need for studies which use classes of stressors that are personally meaningful to the individual as a further means of articulating the particular susceptibilities to stress common among those who share particular sociodemographic attributes such as social class or ethnic culture.

References

Achenbach, T. M., & Edelbrock, C. (1983). Manual for the Child Behavior Checklist and Revised Child Behavior Profile. Burlington, VT: Department of Psychiatry, University of Vermont.

Axelrod, J., & Resine, T. D. (1984). Stress hormones: their interaction and regulation. Science, 224, 452-459.

Bandura, A. (1989). Human agency in social cognitive theory. American Psychologist, 44(9), 1175-1184.

Bassett, J. R., Marshall, P. M., & Spillane, R. (1987). The physiological measurement of acute stress (public speaking) in bank employees. International Journal of Psychophysiology, 5(4), 265-273.

Booth, A., Shelley, G., Mazur, A., & Tharp, G. (1989). Testosterone, and winning and losing in human competition. Hormones and Behavior, 23(4), 556-571.

Breier, A., Albus, M., Pickar, D., Zahn, T. P., Wolkowitz, O. M., & Paul, S. M. (1987). Controllable and uncontrollable stress in humans: Alterations in mood and neuroendocrine and psychophysiological function. American Journal of Psychiatry, 144(11), 1419-1425.

Breier, A. (in press). Experimental approaches to human stress research: assessment of neurobiologic mechanisms of stress in volunteers and psychiatric patients. Biological Psychiatry.

Burke, P. M., Reichler, R. J., Smith, E., Dugaw, K., McCauley, E. Mitchell, J. (1985). Correlation between serum and salivary cortisol levels in depressed and nondepressed children and adolescents. American Journal of Psychiatry, 142(9), 1065-1067.

Coe, C. L., & Levine, S. (in press). Psychoimmunology: An old idea whose time has come. In P. R. Barchas (Ed.), Social Physiology of social relations. Oxford, England: Oxford University Press.

Cowen, E. L., Peterson, A., Babington, H., Izzo, L. D., & Trost, M. A. (1973). Long-term follow-up of early detected vulnerable children. Journal of Consulting and Clinical Psychology, 41, 438-446.

Czeisler, C. A., Moore, E., & Regestein, Q. R. (1976). Episodic 24-hour cortisol secretory patterns in patients awaiting elective cardiac surgery. Journal of Clinical Endocrinology and Metabolism, 42, 273-283.

Dess, N. K., Linwick, D., Patterson, J., & Levine, S. (1983). Immediate and proactive effects of controllability and predictability on plasma cortisol responses to shocks in dogs. Behavioral Neuroscience, 97(6), 1005-1016.

Evans, P. J., Peters, J. R., Walker, R. F., Riad-Fahmy, D., & Hall, R. (1984). Salivary cortisol levels in true and apparent hypercortisolism. Clinical Endocrinology, 20, 709-715.

Foreman, D. M., & Goodyear, J. M. (1988). Salivary cortisol hypersecretion in juvenile depression. Journal of Child Psychology and Psychiatry, 29(3), 311-320.

Frankenhaeuser, M. (1983). The sympathetic-adrenal and pituitary response to challenge: Comparison between the sexes. In T.M. Dembroski, T. H. Schmidt and G. Blumchen (Eds.), Biobehavioral Basis of Coronary Artery Disease (pp 91-105). New York: Karger.

Gladue, B. A., Boechler, M., & McCaul, K. D. (1989). Hormonal response to competition in human males. Aggressive Behavior, 15(6), 409-422.

Gold, P. W., Goodwin, F. K., & Chrou sos, G. P. (1988). Clinical and biochemical manifestation ot depression: Relation to the neurobiology of stress (part 1). New England Journal of Medicine, 319(6), 348-353.

Gold, P. W., Goodwin, F. K., & Churosos, G. P. (1988). Clinical and biochemical manifestation of depression: Relation to the neurobiology of stress (part 2). New England Journal of Medicine, 319(7), 413-420.

Goldstein, S., & Halbreich, U. (1987). Hormones and Stress. In C.B. Nemeroff & P. T. Loosen (Eds.), Handbook of Clinical Psychoneuroendocrinology (pp 460-469). New York: Guilford.

Gunnar, M., Marvinney, D., Isensee, J., & Fisch, R. O. (1989). Coping with uncertainty: New models of the relations between hormonal, behavioral, and cognitive processes. In D. S. Palermo (Ed.), Coping with uncertainty: Behavioral and developmental perspectives (pp 101-129). Hillsdale, NJ: Lawrence Erlbaum Associates.

Hanada, K., Yamada, N., Takahashi, K., & Takahashi, S. (1985). Direct radioimmunoassay of cortisol in saliva and its application to the dexamethasone suppression test in affective disorders. Psychoneuroendocrinology, 1(2), 193-201.

Hanson, J. D., Larson, M. E., & Snowdon, C. T. (1976). The effects of control over high intensity noise on plasma cortisol levels in rhesus monkeys. Behavioral Biology, 16, 333-340.

Hennessy, J. W., & Levine, S. (1979). Stress, arousal and the pituitary-adrenal system: A psychoendocrine hypothesis. Progress in Psychobiology and Physiological Psychology, 8, 133-178.

Heppner, P. P., & Petersen, C. H. (1982). The development and implications of a personal problem-solving inventory. Journal of Counselling Psychology, 29(1), 66-75.

Holsboer, F (1987). Implication of altered limbic-hypothalamic-pituitary-adrenocortical (LHPA)-function for neurobiology of depression. Acta Psychiatrica Scandinavica (Supplement), 72-109.

Johansson, G., Collins, S., & Collins, A. (1983). Male and female psychoneuroendocrine response to examination stress: A case report. Motivation and Emotion, 7(1), 1-9.

Jones, K. J., Copolov, D. L., & Outch, K. H. (1986). Type A, test performance and salivary cortisol. Journal of Psychosomatic Research, 30, 699-707.

Kagan, J. E., Reznick, J. S., & Snidman, N. (1988). Biological bases of childhood shyness. Science, 240, 167-171.

Kehlet, H., Binder, C. (1973). Journal of Clinical Endocrinology and Metabolism, 36(2), 330-333.

Kraemer, H. C., & Thiemann, S. (1987). How Many Subjects? Statistical Power Analysis in Research. London: Sage Publications.

Kral, V. A., Grad, B., & Berenson, J. (1968). Canadian Psychiatric Association, 13(3), 201-209.

Krey, Butler, Hotchkill, Piva and Knobil (1975). Endocrinology, 96, 1088-1093.

Kreiger, D. T., Allen, W., Rizzo, F., & Kreiger, H. P. (1971). Characterization of the normal temporal pattern of plasma corticosteroid levels. Journal of Clinical Endocrinology, 32, 266-284.

Ledingham, J. E. (1981). Developmental patterns of aggressive and withdrawn behavior in childhood: a possible method for identifying preschizophrenics. Journal of Abnormal Child Psychology, 9, 1-22.

Ledingham, J. E., & Schwartzman, A. E. (1984). A 3-year follow-up of aggressive and withdrawn behavior in childhood: preliminary findings. Journal of Abnormal Child Psychology, 12(1), 157-168.

Levine, S. (1985). A definition of stress? In G. P. Molberg (Ed.), Animal Stress (pp 51-69). Bethesda, MD: American Physiological Society.

Lyons, J., Serbin, L. A., & Marchessault, K. (1988). The social behavior of Peer-identified aggressive, withdrawn, and aggressive/withdrawn children. Journal of Abnormal Child Psychology, 16(5), 539-552.

Mason, J. W. (1968). A review of psychoendocrine research on the pituitary-adrenal cortical system. Psychosomatic Medicine, 30(5), 576-607.

Moskowitz, D. S., Schwartzman, A. E., & Ledingham, J. E. (1985). Stability and change in aggression and withdrawal in middle childhood and early adolescence. Journal of Abnormal Psychology, 1, 30-41.

Moskowitz, D. S., & Schwartzman, A. E. (1988). Life Paths of aggressive and withdrawn children. In D. M. Buss & N. Cantor (Eds.), Personality Psychology: Recent Trends and Emerging Directions (pp. 99-114). New York: Springer Verlag.

Moskowitz, D. S., & Schwartzman, A. E. (1989). Painting group portraits: Studying the life outcomes for aggressive and withdrawn children. Journal of

Personality, 57, 723-746.

Munck, A., Guyre, P. M., & Holbrook, N. J. (1984). Pphysiological function of glucocorticoids in stress and their relation to pharmacological actions. Endocrine Reviews, 5(1), 25-44.

Pekarik, E. G., Prinz, R. J., Liebert, D. E., Weintraub, S., & Neale, J. M. (1976). The pupil evaluation inventory: A sociometric technique for assessing children's social behavior. Journal of Abnormal Child Psychology, 4(1), 83-97.

Quay, H.C. (1986). Classification. In H.C. Quay and S. S. Werry (Eds.), Psychological Disorders of Childhood (pp 1-34). New York: John Wiley & Sons.

Reznick, J. S., Kagan, J., Snidman, N., Gersten, M., Baak, K., & Tosenberg, A. (1986). Inhibited and uninhibited behavior: A follow-up study. Child Development, 51, 660-680.

Riad-Fahmy, D., Read, G. F., Walker, R. F., & Griffiths, K. (1982). Steriods in saliva for assessing endocrine functions. Endocrine Reviews, 3(4), 367-396.

Rose, R. M (1980). Endocrine responses to stressful psychological events. Psychiatric Clinics of North America, 3(2), 251-276.

Rose, R. M. (1984). Overview of endocrinology of stress. In G. M. Brown (Ed.), Neuroendicrinology and Psychiatric Disorder (pp 95-122), New York: Raven

Press.

Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, 80 (1, whole No. 609).

Sachar, E. J., Hellman, L., & Roffwarg, H. P. (1973). Disrupted 24-hour patterns of cortisol secretion in psychotic depression. Archives of General Psychiatry, 28, 19-24.

Sapolsky, R. M. (1983). Individual differences in cortisol secretory patterns in the wild baboon: Role of negative feedback sensitivity. Endocrinology, 1131, 2263-2268.

Sapolksy, R. M. (1987). Stress, social status and treptductive physiology in free-living baboons. In D. Crews (Ed.), Psychobiology of Reproductive Behavior: An Evolutionary Perspective. Englewood Cliffs, NJ: Prentice Hall.

Sapolsky, R. M., Krey, L. C., McEwen, B. S. (1986). The neuroendocrinology of stress and aging: the glucocorticoid cascade hypothesis. Endocrine Reviews, 7, 284-301.

Schaeffer, M., & Baum, A. (1984). Adrenal Cortical response to stress at Three Mile Island. Pssychosomatic Medicine, 46(3), 227-237.

Schwartzman, A. E., Ledingham, J. E., & Serbin, L. A. (1985). Identification of children at risk for adult schizophrenia: a longitudinal study. International Review of Applied Psychology, 34, 363-380.

Schwartzman, A. E., Moskowitz, D. S., Serbin, L. A., Ledingham, J. E. (1991). Les comportements agressifs et renfermes de l'enfance comme facteurs de resque: les sequelles psychosociales a l'age adulte. Montreal: Concordia University, Department of Psychology.

Smith, G.H. (1967). Usefulness of peer ratings of personality in educational research. Educational and Psychological Measurement, 24, 967-984.

Stahl, F., & Dorner, G. (1982). Responses of salivary cortisol levels to stress situations. Endokrinologie, 80(2), 158-162.

Stevens, J. (1986). Applied Multivariate Statistics for the Social Sciences. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Suomi, S. (1987). Perinatal development: A psychobiological perspective. In N. A. Krasnegor, E. M. Blass, M. A. Hoffer, & W. P. Smotherman (Eds.),(pp 397-420). New York, Academic Press.

Tabachnick, B.G., & Fidell, L.S. (1989). Using Multivariate Statistics. New York: Harper & Row.

Ursin, H., Baade, E., & Levine, S. (1978). Psychobiology of Stress: A Study of Coping Men. New York: Academic Press.

Virkkunen, M. (1985). Urinary free cortisol secretion in habitually violent offenders. Acta Psychiatrica Scandinavica, 72, 40-44.

Watt, N.F., Stolorow, R.D., Lubensky, A.W., & McClelland, D.C. (1970). School adjustment and behavior of children hospitalized for schizophrenia as adults. American Journal of Orthopsychiatry, 40, 637-57.

Weiss, J. M. (1971). Effects of coping behavior in different warning signal conditions on stress pathology in rats. Journal of Comparative and Physiological Psychology, 77, 1-13.

Weitzman, E.D., Fukushima, D., Nogeire, C., Roffwarg, H., Laggagher, T. F., & Hellman, L. (1971). Twenty-four hour pattern of the episodic secretion of cortisol in normal subjects.

Wiedenfeld, S. A., O'Leary, A., Bandura, A., Brown, S., Levine, S., Raska, K. (1990). Impact of Perceived Self-efficacy in coping with stressors on components of the immune system. Journal of Personality and Social Psychology, 59(5), 1082-1094.

Woodman, D. D., Hinton, J. W., & O'Neill, M. T. (1978). Cortisol secretion and stress in maximum security hospital patients. Journal of Psychomatic Research, 22, 133-136.

Appendix A

Pupil Evaluation Inventory

EVALUATION PAR LES PAIRS - garcons

Voici la liste des items presentes aux enfants et le facteur correspondant a chaque item

A - Agressivite
I - Isolement
P - Popularite

Les items precedes de - - correspondent a la version presentee en premiere annee

A remarquer que l'item # 1 ne se rattache a aucun facteur et ne sert que d'item de pratique.

La liste concernant les filles est identique a celle redigee ci-dessous

- -	1	Ceux qui sont plus grands que les autres.
	P 2	Ceux qui aident les autres
	A 3	Ceux qui ne sont pas capables de rester assis tranquilles
	A 4	Ceux qui essaient de mettre les autres dans le trouble
- -	I 5	Ceux qui sont trop timides pour se faire des amis facilement.
- -	I 6	Ceux qui se sentent trop facilement blesses
	A 7	Ceux qui prennent des airs superieurs et qui pensent qu'ils valent mieux que tout le monde
	A 8	Ceux qui font les clowns et qui font rire les autres.
- -	A 9	Ceux qui commencent la chicane a propos de rien
	I 10	Ceux qui ne semblent jamais s'amuser
	I 11	Ceux qui sont bouleverses quand ils ont a repondre aux questions en classe
	A 12	Ceux qui disent aux autres enfants quoi faire
	I 13	Ceux qui sont d'habitude les derniers choisis pour participer a des activites de groupe
- -	P 14	Ceux que tout le monde aime

A 15 Ceux qui s'entêtent tout le temps et se mettent en difficulté

-- A 16 Ceux qui rient des gens

-- I 17 Ceux qui ont très peu d'amitié

A 18 Ceux qui font des choses bizarres

P 19 Ceux qui sont les meilleurs amis

-- A 20 Ceux qui ennuient les gens qui essaient de travailler

A 21 Ceux qui se mettent en colère quand ça ne marche pas comme ils le veulent

-- A 22 Ceux qui ne portent pas attention au professeur

A 23 Ceux qui sont impolis avec le professeur

-- I 24 Ceux qui sont malheureux ou tristes

P 25 Ceux qui sont particulièrement gentils

-- A 26 Ceux qui se comportent comme des bébés

A 27 Ceux qui sont méchants et cruels avec les autres enfants

-- I 28 Ceux qui ne veulent pas jouer

A 29 Ceux qui vous regardent de travers

A 30. Ceux qui veulent faire les fins devant la classe

-- A 31. Ceux qui disent qu'ils peuvent battre tout le monde

-- I 32 Ceux que l'on ne remarque pas beaucoup

-- A 33 Ceux qui exagèrent et racontent des histoires

-- A 34 Ceux qui se plaignent toujours et qui ne sont jamais contents

-- P 35. Ceux qui semblent toujours comprendre ce qui se passe

EVALUATION PAR LES PAIRS - Filles

Voici la liste des items présentés aux enfants et le facteur correspondant à chaque item

A - Agressivité
I - Isolement
P - Popularité

Les items précédés de « - - » correspondent à la version présentée en première année

À remarquer que l'item # 1 ne se rattache à aucun facteur et ne sert que d'item de pratique

La liste concernant les garçons est identique à celle rédigée ci-dessous

- -	1	Celles qui sont plus grandes que les autres
	P 2	Celles qui aident les autres
	A 3	Celles qui ne sont pas capables de rester assises tranquilles.
	A 4	Celles qui essaient de mettre les autres dans le trouble
- -	I 5	Celles qui sont trop timides pour se faire des amies facilement
- -	I 6	Celles qui se sentent trop facilement blessées
	A 7	Celles qui se donnent des airs supérieurs et qui pensent qu'elles valent mieux que tout le monde
	A 8	Celles qui font les clowns et qui font rire les autres
- -	A 9	Celles qui commencent la chicane à propos de rien
	I 10	Celles qui ne semblent jamais s'amuser
	I 11	Celles qui sont bouleversées quand elles ont à répondre aux questions en classe.
	A 12	Celles qui disent aux autres enfants quoi faire.
	I 13	Celles qui sont d'habitude les dernières choisies pour participer à des activités de groupe.
- -	P 14	Celles que tout le monde aime

A 15. Celles qui s'emportent tout le temps et se mettent en difficulté

-- A 16. Celles qui rient des gens

-- I 17. Celles qui ont très peu d'amies

A 18. Celles qui font des choses bizarres

P 19. Celles qui sont les meilleures amies

-- A 20. Celles qui ennuient les gens qui essaient de travailler

A 21. Celles qui se mettent en colère quand ça ne marche pas comme elles le veulent

-- A 22. Celles qui ne portent pas attention au professeur

A 23. Celles qui sont impolies avec le professeur

-- I 24. Celles qui sont malheureuses ou timides

P 25. Celles qui sont particulièrement gentilles

-- A 26. Celles qui se comportent comme des bébés

A 27. Celles qui sont méchantes et cruelles avec les autres enfants

-- I 28. Celles qui ne veulent pas jouer

A 29. Celles qui vous regardent de travers

A 30. Celles qui veulent faire les fines devant la classe

-- A 31. Celles qui disent qu'elles peuvent battre tout le monde

-- I 32. Celles que l'on ne remarque pas beaucoup

-- A 33. Celles qui exagèrent et racontent des histoires

-- A 34. Celles qui se plaignent toujours et qui ne sont jamais contentes

-- P 35. Celles qui semblent toujours comprendre ce qui se passe

Appendix B

Problem Solving Inventory

No d'identification ____________________

Lis chaque enonce et indique à quel point tu es en accord ou en desaccord avec chaque idee en utilisant une des reponses suivantes :

1. Tres d'accord
2. Moderement d'accord
3. Un peu d'accord
4. Un peu en desaccord
5. Moderement en desaccord
6. Tres en desaccord

1.	Quand une solution à un probleme n'a pas reussi, je ne cherche pas à savoir pourquoi.	1	2	3	4	5	6
2.	Quand je fais face à un probleme complexe, je ne me donne pas la peine de developper une strategie pour accumuler de l'information dans le but de definir le probleme de façon plus precise.	1	2	3	4	5	6
3.	Quand mes premiers efforts ne reussissent pas à regler un probleme, je me sens moins capable de maitriser la situation.	1	2	3	4	5	6
4.	Apres avoir regle un probleme, je n'analyse pas ce qui a bien ete et ce qui a mal ete.	1	2	3	4	5	6
5.	Habituellement, je suis capable de trouver des alternatives creatrices et efficaces pour regler un probleme.	1	2	3	4	5	6
6.	Apres avoir essaye une certaine approche pour resoudre un probleme, je prends le temps de comparer le resultat avec ce que je pensais qui aurait dû arriver.	1	2	3	4	5	6
7.	Quand j'ai un probleme, j'essaie de trouver le plus de solutions que je peux, jusqu'à ce que je n'aie plus d'idees.	1	2	3	4	5	6
8.	Quand je suis aux prises avec un probleme, j'examine constamment comment je me sens de façon à trouver ce qui se passe.	1	2	3	4	5	6
9.	Je suis capable de regler la plupart des problemes, meme si à prime abord il ne semble pas y avoir de solutions.	1	2	3	4	5	6
10.	Plusieurs problemes auxquels je fais face sont trop complexes pour que je puisse les resoudre.	1	2	3	4	5	6

1	tres d accord
2	moderement d accord
3	un peu d'accord
4	un peu en desaccord
5	moderement en desaccord
6	tres en desaccord

11. Je prends des decisions et je ne les regrette pas plus tard.	1	2	3	4	5	6
12. Quand je suis confronte(e) a un probleme, j'ai tendance a suivre la premiere chose qui me vient a l'idee pour le resoudre.	1	2	3	4	5	6
13. Parfois je ne prends pas le temps m arreter pour resoudre mes problemes et j'y vais comme ça vient.	1	2	3	4	5	6
14. Quand je decide que l'idee ou que la solution choisie pour regler un probleme, je ne prends pas le temps de considerer les chances de reussite de chaque alternative.	1	2	3	4	5	6
15. Quand j'ai un probleme, je m arrete et j y reflechis avant de decider de l'etape suivante.	1	2	3	4	5	6
16. Habituellement, j adopte la premiere bonne idee qui me vient a l esprit.	1	2	3	4	5	6
17. Quand je prends une decision, je pese les consequences de chaque alternative et je les compare les unes aux autres.	1	2	3	4	5	6
18. Quand je planifie un plan d action pour resoudre un probleme, je suis presque certain que je vais le reussir.	1	2	3	4	5	6
19. J'essaie de predire le resultat global d'un plan d action en particulier.	1	2	3	4	5	6
20. Quand j essaie de trouver des solutions possibles a un probleme, je n en trouve pas tant que ça.	1	2	3	4	5	6
21. Si j ai suffisamment de temps et si je m'y donne vraiment la peine, je crois que je peux resoudre la plupart des problemes que je rencontre.	1	2	3	4	5	6
22. Quand je fais face a une nouvelle situation, je suis convaincu(e) que je peux resoudre les problemes qui peuvent arriver.	1	2	3	4	5	6

1. tres d'accord
2. moderement d'accord
3. un peu d'accord
4. un peu en desaccord
5. moderement en desaccord
6. tres en desaccord

23.	Meme si je travaille sur un probleme, j'ai parfois l'impression de patiner ou de chercher aveuglement et de ne pas m'adresser à la base du probleme.	1	2	3	4	5	6
24.	Je fais des jugements hatifs et je les regrette plus tard.	1	2	3	4	5	6
25.	Je crois etre capable de resoudre des problemes nouveaux et complexes.	1	2	3	4	5	6
26.	J'ai une methode systematique pour comparer les alternatives et prendre des decisions	1	2	3	4	5	6
27.	Quand je fais face a un probleme, habituellement, je n'essaie pas d'examiner s'il y a des facteurs externes dans mon environnement qui contribuent a mon probleme.	1	2	3	4	5	6
28.	Quand je suis confronte(e) a un probleme, une des premieres choses que je fais est d'evaluer la situation et de considerer toute information pertinente.	1	2	3	4	5	6
29.	Quelquefois, je suis tellement affecte(e) emotivement que je suis incapable de considerer plusieurs alternatives pour regler mon probleme	1	2	3	4	5	6
30.	Apres avoir pris une decision, le resultat auquel je m'attends concorde habituellement avec ce qui se produit en realite.	1	2	3	4	5	6
31.	Quand je fais face à un probleme, je ne suis pas certain(e) d'etre capable de le resoudre.	1	2	3	4	5	6
32.	Des que je constate qu'il y a un probleme, la premiere chose que je fais est d'essayer de definir exactement la nature du probleme.	1	2	3	4	5	6

Appendix C

Visual Analog Scale

No d'identification ______________________

Pour chacun des énoncés suivants, indiquez avec un crochet à quel point il vous décrit bien MAINTENANT

Je me sens que j'ai du succès.

____

pas du tout | énormément

Je me sens triste.

____

pas du tout | énormément

Je me sens tendu(e) ou crispé(e)

____

pas du tout | énormément

Je me sens sans recours

____

pas du tout | énormément

Je me sens heureux(se)

____

pas du tout | énormément

Je me sens stressé(e)

____

pas du tout | énormément

Appendix D

Radioimmunoassay Procedure

Radioimmunoassay Procedure

The procedure outline below was adapted from Krey et al., 1975. Filter paper strips were removed from the freezer and a uniform section (25mm2) cut from the end of the strip. These sections were placed in borosilicate tubes, and cortisol extracted with 1ml ethanol (ETOH). Tubes were vortexed and spun, and 200 l ETOH transferred to another set of tubes. At this time, standards with known quantities of cortisol (0, 10, 20, 50, 100, 200, 500, 1000, 2000) were prepared with ETOH and 200ul of these solutions transferred to tubes. Ethanol was dried from tubes. The tracer was prepared with PBS gel, antibody and tracer and 200ul added to cortisol residue. Tubes were sealed and incubated in a cold room for 24 hours.

The following day, 1ml dextran-coated charcoal solution was added to the tubes which had been placed in an ice bath. After 15 minutes, the tubes were centrifuged for 10 minutes at 3000rpm at 0oC. The supernatant was decanted to scintillation vials, 4.5ml scintillation cocktail added, and samples counted.

Standard curves were constructed according to the procedure of Krey et al., 1975, and cortisol concentrations determined by a standard comparison procedure. Cortisol values were adjusted for the volume of saliva actually analyzed, which had been determined prior to the assay.

Appendix E

Illustration and Description of Apparatus

Figure F-1. Illustration of apparatus used in the study to terminate the tone stressor and provide visual feedback to subjects regarding their performance. The panel was constructed from opaque white plexiglass mounted on a plywood frame. Block **A** flashed green if the tone was terminated by the subject with the correct number of button presses in the predictable-controllable condition. Block **B** flashed red if the tone was discontinued by the computer. The silver button, **C**, had a stick-down interval of 0.5 seconds, which resulted in a minimum tone duration of 2 seconds in each trial.