SEX DIFFERENCES IN THE STRESS RESPONSES OF CHILDREN AFFECTED BY HURRICANE KATRINA

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SEX DIFFERENCES IN THE STRESS RESPONSES OF CHILDREN AFFECTED BY HURRICANE KATRINA

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ABSTRACT

Children and young adults between the ages of 11-21 years that were displaced by Hurricane Katrina and currently living in a large relocation camp (n = 68) were compared to a sample of demographically matched controls (n = 63) on two measures of physiological distress (salivary cortisol and alpha-amylase, AA), and self-reported symptoms of distress, depression, anxiety, aggression, self-evaluations, self-esteem, and life-satisfaction. The Katrina sample reported lower anxiety and showed lower cortisol levels than the controls. Similarly, females reported lower anxiety and showed lower cortisol levels than males. Multivariate regressions showed that hurricane experience and sex moderated the relations between cortisol and AA and many internalizing and externalizing behaviors, including aggression and symptoms of depression and distress. In general, salivary cortisol and AA were differentially related to distress behaviors in males and females, suggesting a dynamic interplay between normative sex differences in multiple components of psycho-physiological arousal and behavioral manifestation of internalizing and externalizing behaviors. The findings are interpreted from a broad socio-relational framework of social behavior, which suggests that the human stress response system may have evolved, in part, to modulate the formation and maintenance of different types of social relationships. If so, then phenotypic variation in the expression of distress behaviors such as aggression and depression may change with changes in

condition of the individual, including recent life-experiences and sex-typical social interaction styles.

CHAPTER 1: INTRODUCTION

Exposure (e.g., physical proximity, material losses) to events such as natural disasters is associated with increased prevalence of severe psychological distress across all cultures in which it has been studied (Chae, Kim, Rhee, Henderson, 2005; Najarian, Goenjian, Pelcovitz, Mandel, & Najarian, 1996; Weinstein, Lyon, Rothman, & Cuite, 2000). The corresponding short-term, physiological responses include: a) activation of the limbic hypothalamic pituitary-adrenal (HPA) axis and regulation of glucocorticoids such as cortisol; and b) activation of the sympathetic nervous system and release of catecholamines (e.g., norepinephrine) into the bloodstream (Chrousos & Gold, 1992). Activation of these systems is associated with a host of alterations in metabolic, cardiovascular, and immune functioning, such as increased glucose metabolism and cardiovascular reactivity, and down regulation of some aspects of the immune system (Misra et al., 2006; Uchino et al., 1996). HPA and sympathetic responses are also associated with psychological experiences, and especially uncontrollable events (e.g., hospitalization) and experiences that place the individual at increased risk for social evaluation and rejection (e.g. competitive games, public speaking; Dickerson & Kemeny, 2004; Flinn, 2006; Gordis, Granger, Susman, & Trickett, 2006; Lewis, & Ramsay, 2002; Knight et al., 1979; Kurzban & Leary, 2001).

Longer-term, behavioral and psychological responses are often manifested through symptoms of post-traumatic stress disorder, PTSD (e.g., anxiety, disassociation, emotional numbness, intrusive and distressful thoughts), and major depression disorder, MDD (e.g., feelings of hopelessness, negative self-evaluations, lethargy; McDermott,

Duffy, & McGuinness, 2004; North, Kawasaki, Spitznagel, & Hong, 2004). In addition, post-disaster distress is associated with higher morbidity, including lower immune-functioning and onset of cardiovascular disease (Rotton & Dubitsky, 2002; Uchino, Cacioppo, & Kiecolt-Glaser, 1996), and long-lasting changes in expressed and felt mood (Sales, Fivush, Parker, & Bahrick, 2005). At the population level, exposure to large-scale disasters has also been linked to increased rates of divorce (Cohan & Cole, 2002), child abuse (Keenan, Marshall, Nocera, & Runyan, 2004), chemical dependence (e.g., Vlahov et al., 2002), and socio-economic distress (e.g., job loss, academic failure; Alexander, 1993; Giaconia et al., 1995).

Some research suggests that exposure to traumatic events during childhood may contribute to permanent alterations in some aspects of the stress response system (e.g., changes in HPA reactivity), which may place children at particular risk for long-term mental and physical impairment due to changes in sensitivity to stressors later in life (Brotman, Gouley, Klein, Castellanos, & Pine, 2003; Meaney, 2001). The potential for long-lasting effects from experienced trauma has led to a recent surge of interest in the developmental correlates of stress exposure during childhood, such as the role of individual experiences and children's sex on the manifestation of distress behaviors. At present, research on the mechanisms linking individual differences and normal stress responses is still in its early stages. This is due, in part, to the current lack of a strong meta-theoretical framework that can help integrate more specialized models of distress behaviors, such as models that focus on the influence of early life experiences (Ellis, Jackson, & Boyce, 2006; Flinn, 2006). Equally important is the need to study the stress responses of children exposed to severe trauma under naturalistic conditions; that is,

witnessing events or experiences perceived to present a threat to life or wellbeing of self, family members, or close friendships.

The present research is part of a larger study designed to assess the stress responses of families affected by Hurricane Katrina who lost their homes and are currently living in a large, semi-permanent, government-provided relocation camp. This population presents a unique opportunity to investigate behavioral distress among individuals who experienced several forms of severe trauma. In addition to experiencing specific events (e.g., witnessing dead bodies; personal correspondence with hurricane survivors, 2005) and loss of property that resulted from the actual hurricane and flooding in New Orleans, itself, they also endured the hardship and uncertainty associated with relocating to an unfamiliar community and living under post-disaster conditions that present a unique set of ongoing stressors (e.g., inadequate housing facilities) and vulnerability (e.g. isolation from friends and family) onto themselves. Previous research has shown that post-traumatic events and circumstances (e.g., relocation conditions and demographic characteristics such as economic status) can exacerbate the ill-effects caused by the original event (Adams, Boscarino, & Galea, 2006; Cohen, Doyle, & Baum, 2006; McFarlane, 1990; Najarian, Goenjian, Pelcovitz, Mandel, & Najarian, 2001; Pérez-Sales, Cervellón, Vázquez, Vidales, Gaborit, 2005). These findings suggest that the Hurricane Katrina survivors living in relocation camps may be among the most at-risk populations in the United States today.

I begin this chapter with a broad discussion of contrasting theoretical perspectives on the role of functionalism – the belief that normative behavioral patterns are specialized and adaptive – for the study of distress behaviors. I then introduce a framework on

potential social properties and adaptive trade-offs that may be associated with common behavioral responses to life-events. I go on to review recent theoretical models on the ultimate (i.e., evolutionary) origin of sex differences in stress responses, and propose ways in which the present framework may be used to help integrate these specialized models.

In the second chapter, I use the framework to generate several predictions regarding potential hurricane- and sex-related differences in two salivary biomarkers of stress response (cortisol and alpha-amylase, AA) and psychological functioning of children and young adults affected by the hurricane and relocation experience when compared to a sample of demographically matched youth that did not experience these events. Short-term increases in cortisol are associated with acute psychosocial stressors, whereas low or blunted cortisol levels (e.g., evidencing a flat diurnal pattern) are associated with chronic and repeated stress exposure (Miller, Chen, Zhou, 2007). The enzyme alpha-amylase was selected, because it appears to be a readily assayed and reliable surrogate of sympathoadrenal activation (e.g., norepinephrine) in response to acute stressors and because it is uncorrelated with salivary cortisol (Granger et al., 2006; Rohleder, Nater, Wolf, Ehlert, & Kirschbaum, 2004). The assumption is that the inclusion of both basal alpha-amylase and cortisol levels provides non redundant information (e.g., short-term vs. long-term regulation, respectively) and thus a more comprehensive assessment of stress response than either bio-marker alone (Granger et al., 2006; Nater et al., 2006). I focus particular attention on hypotheses related to the moderating role of hurricane experience and sex on the arousal and expressive components of common distress behaviors.

In the third chapter, I describe the participants and the relocation camp and measures and procedures used in the investigation. In the fourth chapter, I report the results of the study. In the fifth and final chapter, I discuss the present findings and outline potential directions for future research on variation in distress behaviors.

Developmental Correlates of Psychological Distress Behaviors

Individual characteristics such as sex and age covary with the frequency and magnitude of expression of common distress behaviors, such as crying and physical violence (Becht & Vingerhoets, 2002; Giblin, 1981; Heuveline, 2002; Holinger, 1980; Lombardo, Cretser, & Roesch, 2001; Wrangham & Peterson, 1996). Typical sex differences in affective response have been implicated in the etiology of extreme forms of problem behaviors, such as low-mood in adolescent girls and women, and conduct and autistic spectrum disorders among males (e.g., Baron-Cohen, Knickmeyer, & Belmonte, 2005; Garber, 2000; Holden, 2005; Rutter, Caspi, & Moffitt, 2003). Although males and females experience these conditions through overlapping dimensions of affect (e.g., sadness; Bogner & Gallo, 2004), they often manifest their symptoms differently; through so-called externalizing behaviors or behaviors that act on the external environment (e.g., physical aggression, psychomotor agitation, risk-taking), and internalizing behaviors that are focused on the individual (e.g., worrying, sadness, self-blame), respectively (Crick & Zahn-Waxler, 2003; Khan, Gardner, Prescott, & Kendler, 2002; Salokangas, Vaahtera, Pacriev, Sohlman, & Lehtinen, 2002).

Emerging research suggests that sex-typed distress responses (e.g., affective disorders in women and antisocial disorders in men) may reflect an extreme form of normal sex differences in neuroendocrine functioning (e.g., HPA reactivity), and

perceptual and expressive biases in healthy men and women (Holden, 2005; Pohjalainen, Rinne, Nagren, Syvalahti, & Hietala, 1998). Several experimental studies have shown that males produce greater HPA and sympathetic activation than women in anticipation of and immediately following exposure to psychosocial stressors, such as public speaking tasks (Kajantie & Philips, 2005; Kudielka et al., 1998; Uhart, Chong, Oswald, Lin, & Wand, 2006). Interestingly, this pattern does not appear to hold for non-social stressors, such that relative hypercorticol responses in males is not observed in response to physical exertion activities, in the absence of a (perceived) social context (Kirschbaum, Wüst, & Hellhammer, 1992).

Other research suggests that sex differences in physiological responses may be associated with differential concordance/risk for psychological distress behaviors. One study with preschoolers found that higher basal cortisol levels were associated with increased internalizing behaviors a year and a half later, and that this relation was stronger for girls. In contrast, lower basal cortisol were associated with more frequent externalizing behaviors, and especially so for boys (Smider et al., 2002). This research suggests that the link between physiological responses and manifestation of distress behaviors may be different for males and females. Another study found that cortisol spikes immediately following a traumatic experience (e.g., measurements taken at hospital admission centers) are more predictive of boys' rather than girls' subsequent risk for developing PTSD (Delahanty, Nugent, & Christopher, Walsh, 2005).

Greater concordance (sensitivity) between HPA activity and behavioral distress in males is paradoxical when one considers the fact that females tend to report greater anxiety and depressive symptoms in the aftermath of experienced trauma (e.g., Marttunen

et al., 1995; Parslow, Jorm, Christensen, 2006; Solomon, Gelkopf, & Bleich, 2005). Tolin and Foa (2006) recently reviewed the literature on sex differences in stress exposure and symptoms of PTSD that shed light on these findings. Although males are far more likely to experience traumatic events in their lifetime, including accidents, physical assault, illness, and witnessing death (the notable exception being higher rates of experienced sexual assault among females), females are twice as likely to develop symptoms of PTSD following a traumatic experience, and especially the types of trauma that are experienced more frequently by males. Thus, it appears that sex-typed distress responses reflect somewhat distinct reactive and expressive biases; specifically, greater reactivity to psychosocial stressors in males and more exaggerated symptoms of distress in females. These consistent sex differences call for research focused on a better understanding of the ultimate (i.e., evolutionary) and proximate (e.g., endocrine) mechanisms that underlie differential stress response and behavioral manifestation in males and females (Klein & Corwin, 2002).

Disease-Centered Models of Distress Behaviors

The mechanisms contributing to sex differences in stress response have been approached from two main perspectives: 1) disease-centered models that consider "problem" behaviors (e.g., sadness and aggression) to be consequences or outcomes of maladaptive responses to trauma or other stressors; and, 2) non-disease models that approach distress behaviors from a functional perspective. The latter include conceptualizing these responses in a socio-biological context, for instance, viewing distress behaviors in relation to changes in circumstances and social status and the

development of interpersonal behavioral strategies that may help to enhance the individual's wellbeing given these changes (e.g., Allen & Badcock, 2003; Hagen, 2003).

The theoretical implications of these perspectives are quite distinct. For instance, whereas disease-centered models seldom make specific predictions in terms of group differences in distress behaviors, the non-disease perspective opens up the theoretical potential to integrate variation in response to trauma along a continuum ranging from more typical responses to situational events and individual differences, such as the child's sex, to extreme responses. Such patterns of responses may reflect behavioral biases that are adaptive in some contexts or during our evolutionary history (e.g., Ellis et al., 2006; Flinn, 2006).

Disease-centered perspectives on sex differences in distress behaviors often interpret these patterns in one of two ways. First, one sex or the other is considered to be at a *disadvantage*. An example is provided by Hankin and Abramson's (2001) "cognitive vulnerability" model of female-depression, in which the authors attribute higher rates of sadness in girls to greater exposure to stressful events, in comparison to males. As noted earlier, however, overall exposure to trauma is usually higher in males (Tolin & Foa, 2006). Second, one sex or the other is considered to be relatively *deficient* in the types of characteristics that would enable the expression of more "positive" behaviors. An example is Bennett, Farrington, and Huesmann's (2005) "cognitive inferiority" model of male risk-taking behavior in which higher rates of male aggression are attributed a lack of problem solving and inhibitory control in males, relative to females.

A recent variation of the disease-centered perspective incorporates the role of social behaviors; for instance, by noting the consistency between female-typical

internalizing patterns (e.g., low mood, negative self-evaluations) and emerging evidence of sex differences in the social styles of males and females. Particularly during adolescence, girls tend to engage in higher rates of self-disclosure and intimate discussion and rehashing of personal problems with their same-sex peers (sometimes referred to as co-rumination), in comparison to same-age boys (Geary, Byrd-Craven, Hoard, Vigil, & Numtee, 2003; Rose, 2002; Rose & Rudolph, 2006). This association has led to the hypothesis that the greater tendency for females to effectively recall and rehearse their personal problems with other females is associated with costs and benefits. Although intimate discussion may be beneficial in most relationships, extreme expression of co-ruminative behaviors may also precipitate or reactivate higher levels of depressive symptoms in girls and women than are typically reported among males (Rose, 2002; Rudolph & Conley, 2005; see also Kendler, Myers, & Prescott, 2005). The consideration of cost and benefits in a social context adds important depth to traditional disease-centered models.

Still, there are several drawbacks to trying to explain universal group differences, such as sex-typed distress behaviors from a disease-centered or maladaptive perspective. For one, these models seldom address the adaptive nature of internalizing and externalizing behaviors, themselves, as well as the fitness advantages that should, in theory, be associated with differential manifestation of these behaviors in each sex (Daly & Wilson, 1985). Emerging research has documented sex differences in affective behaviors (e.g., crying patterns and ability to self-sooth), behavioral sensitivities (e.g., frequency of eye-contact, facial expressiveness), and implicit perceptual biases (e.g., facial expression processing) as early as infancy and sometimes at birth (e.g., Camras et

al., 1998; Fuller, 2002; Keenan, Grace, & Gunthorpe, 2003; Lavelli & Fogel, 2002; McClure, 2000), although sex differences in infancy are not always found (e.g., Lavelli & Fogal, 2005).

In either case, the assumption that prototypical sex differences are not specialized (e.g., developmentally) or that they may even be maladaptive (e.g., interpreting female-biased depression as a "cost") runs contrary to the biological principle that evolved (i.e., naturally selected) behaviors are associated with *adaptive* cost-benefit tradeoffs (e.g., Williams, 1957). A similar limitation of some disease-centered models is that they approach the study of distress from a single, usually valence-based dimension (e.g., describing sadness and aggression in "negative" terms), with minimal description of potential underlying benefits and unique features of these responses. Finally, these models seldom incorporate additional factors, such as context effects (e.g., audience characteristics) that are known to influence affective responses (e.g., magnitude of expressed emotions) across cultures and at early ages (e.g., Costa Dinsbach, Manstead, & Bitti, 2001; LaFrance, Hecht, & Paluck, 2003; Leaper & Smith, 2004). Research on young children (e.g., toddlers) and adults shows that individuals are far more likely to express sadness (e.g., crying) and embarrassment behaviors (e.g., lip biting), for example, when alone or when in the presence of intimate confidantes – individuals in which a history of trust has been established – and to hide these behaviors in the presence of less familiar or less trusted individuals (e.g., Becht & Vingerhoets, 2002; Buss & Kiel, 2004; Costa Dinsbach, Manstead, & Bitti, 2001; Jakobs et al., 1996). Findings like these provide important information on the adaptive trade-offs that may be associated with the development and expression of sadness and other distress behavior; for example, in

relation to potential benefits and dangers of expressing certain behaviors in the presence of different people. In order to understand these trade-offs, a more functional framework of (distress) behaviorism is required.

Non-Disease Models of Distress Behaviors

An alternative approach to the disease-centered perspective is provided by models that emphasize the potential adaptive value of these responses, at least in some contexts. This approach is based on the assumption that behavioral responses that are consistently found in one sex or the other, for instance, reflect evolved biases that have been adaptive for that sex during human evolution (Geary, 1998). A related, though less explored hypothesis, is that distress responses (e.g., experiences of sadness and hostility) are manifested as *expressive* behaviors that may function (e.g., developmentally), in part, to modify the formation and maintenance of different types of social relationships (Geary & Flinn, 2002; Taylor et al., 2000; Vigil, in press; for earlier works, see Alexander, 1987; Frijda, 1993; Trivers, 1971). An example of this approach to understanding affect behaviors is Hagen's (2002) bargaining model of depression. The proposal is that some symptoms of post-partum depression (e.g., lower activity levels), for instance, may be designed to withhold parental care-giving until the infant's father and kin (those with direct genetic interests; Hamilton, 1964) increase provisioning of social support to the mother. According to this model, low mood is described as a particularly adaptive social strategy under conditions when added social support is needed most and direct requests for aid may not be effective.

Socio-Relational Framework of Expressive Behaviors

My proposal is that *many* types of expressive behaviors, that is, behaviors that occur within a real or imagined social context–including the (momentary and prolonged) expression of affect–have *specific* and *functional* social properties and is referred as the "Socio-Relational Framework of Expressive Behaviors" (SRFB). The framework rests on the assumption that a major distinguishing feature of human evolution was an intensification of the social selection pressure to form dynamic and long-term interpersonal relationships, and to maintain these relationships through complex displays of reciprocal altruism (Alexander, 1989; Trivers, 1971). This assumption that the human mind is designed for social competition and cooperative behaviors is the cornerstone of most models of primate intelligence (e.g., the social brain hypothesis; Dunbar, 1998; Geary, 2005; Humphrey, 1976) and human "sociocognitive" models that suggest, for instance, social evaluations implicitly drive cognitive development and performance (Levine & Resnick, 1993). Similar to Trivers (1971) and elaborated in Geary and Flinn (2001), I am proposing that humans may have evolved a suite of psycho-biological systems (e.g., perceptual, processing, expressive, developmental, etc.) designed to navigate the adaptive cost-benefit tradeoffs that are associated with forming different types of relationships.

In terms of distress behaviors, the most likely candidate for the co-evolutionary specialization of the modern human affect/stress response system is perhaps the basic motivation to either *approach* or *withdrawal* from environmental stimuli, depending on whether or not the stimuli signals potential benefits (e.g., food and mates), or whether the stimuli signals potential of threat or danger (e.g., predators; see Buck, 1999; Cacioppo, Klein, Bernston, & Hatfield, 1993; Davidson, 1993; Davidson, Jackson, & Kalin, 2000;

Gray, 2002). In humans, for instance, such a system may be especially sensitive to evaluate potential benefits and dangers of interacting with different people. A related hypothesis is that this system would also be sensitive to the socio-relational impact of events and experiences on the relative social standing of the individual, and to respond to these events through coordinated behavioral strategies designed to modify the individual's relationships in ways that enhance the individual's well-being. In theory, basic approach and withdrawal motivations in humans may be specialized to respond to significant life-events with behaviors that systematically maximize the ability to *attract* fitness-enhancing relationships (e.g., relationships that are supported by reciprocal altruism), for example, while simultaneously *avoiding* or reducing the likelihood of interacting with potentially dangerous individuals (e.g., non-reciprocal relationships in which the risk for exploitation is high).

This interpretation is consistent with research on facial expression processing that shows that while the human amygdala is activated in response to both positively- and negatively-valenced stimuli (Garavan, Pendergrass, Ross, Stein, & Risinger, 2001), people are more sensitive to process threatening faces (expressions of anger and fear) more quickly and accurately than other stimuli, and especially when the signaler is a male (e.g., Goos & Silverman, 2002; Mogg & Bradley, 1999; Öhman, Lundqvist, & Esteves, 2001). Children that have experienced less trustful relationships, such as those that have been physically abused and rejected by their peers, are more sensitive to recognize (and express) facial expressions of anger than are non-abused and average-status (peer-accepted) children (Hubbard, 2001; Pollak & Sinha, 2000; see also Terwogt, 2002). Öhman summarized this work by suggesting that hyper-sensitivity to fearful and angry

faces does not reflect an emotion processing system that is specialized to process the physical characteristics of the human face, per se, but rather an evolved cognitive bias to discriminate threatening from non-threatening individuals (Öhman, 2002).

Reciprocity Potential

According to the SRFB, the social properties that influence the motivation to either be attracted to or to avoid other people may be framed in terms of the construct *reciprocity potential* (Vigil, in press), or potential to have any sort of influence on another person's fitness–either positively or negatively. This potential is determined by the a) ability to affect other people; as well as the b) actual likelihood of doing so. I am hypothesizing that these two concepts–cues of *capacity* to affect others and *probability* to affect others–may be the most basic criteria by which implicit social evaluations are made. This is because low levels of either of these constructs results in limited reciprocity potential and thus little motivation to attend to or interact with these other people (Vigil, in press).

Capacity cues. One possibility is that humans have evolved social processing systems that evaluate phenotypic indicators of capacity and probability cues in other people. For example, capacity cues may be perceived through individual characteristics, such as physical stature and personal competencies, material resources, and perceived dominance, because these types of traits signal increased ability to provide immediate benefits (e.g., socio-political opportunities, food, protection), or ability to inflict immediate harm onto others. Traits that distinguish the individual's competencies and abilities are fundamental components of implicit personality theory (Schneider, 1973). For example, in a review of one suggested capacity cue, perceived physical attractiveness,

Eagly found this characteristic is associated with the perception of personal competencies, but unrelated to perceptions of integrity and concern for others (Eagly, Ashmore, Makhijani, Longo, 1991). Similarly, research on group processes shows that people are more likely to implicitly attend to the actions of others that are perceived as powerful, dominant, and higher-status, rather than to subordinates (Fiske, 1993a).

Animal studies show that among other highly social species (e.g., monkeys, hyenas) individuals prefer to interact with conspecifics that have similar, but slightly higher social status than their own (Holekamp, 2006). These studies demonstrate that the cognitive bias to attend to cues such as dominance (e.g., erect posture, threat stares, assertive speech, etc.) is a corollary feature of social behavior, and especially among primates (Mazur, 1985; Mignault, & Chaudhuri, 2003). From the SRFB perspective, this bias may be interpreted as a modularized detection system that is primed to evaluate cues that signal other people's means and resources and hence capacity to reciprocate social favors, or to inflict physical harm onto the individual.

Probability cues. In contrast to signals of capacity, probability cues may be inferred through interpersonal characteristics such as kindness and empathy and integrity in humans, and submissiveness behaviors in less social species. The basic reasoning is that explicit demonstrations of prosocial behaviors and demonstrations of vulnerability (e.g., head bow, gaze aversion, slow movement patterns) may be adaptive by reducing the perception of threat and disarming the threat interpretation of others. Through complex displays of benevolence, individuals may be signaling their motivations and intentions, and hence probability of reciprocating altruism or likelihood harming others. Of course, the phenotypic manifestation of submissiveness behaviors (e.g., worrying) may also

reflect individual's *actual* vulnerability and inability to reciprocate resources; however, the current reasoning is that such handicaps would not be displayed so explicitly and/or exaggerated, unless there was a fitness advantage to doing so.

As a result of the comparatively unique tendency to form long-term, codependent relationships, humans may be especially sensitive to evaluate the social intentions of others through perceptions of trustworthiness (Trivers, 1971). At least one study suggests the possibility of a specialized neural circuitry (e.g., involving activation of the right superior temporal sulcus) that may be responsible for the detection of trustworthiness in faces (Winston, Strange, O'Doherty, Dolan, 2002). Other research suggests that people elicit specific endocrine responses (e.g., involving oxytocin and vasopressin) when they experience increased trustworthiness and bonding with others (Bartels & Zeki, 2004; Zak, Kurzban, Matzner, 2004). Likewise, behavioral experimental researchers have uncovered numerous factors (e.g., repeated interactions) and interpersonal behaviors that induce perceptions of trustworthiness in others, including self-disclosure, physical touch behaviors, sustained gaze, smiling, and even simple mimicry behaviors (Ben-Ner, Putterman, Kong, & Magan, 2004; Collins & Miller, 1994; Kurzban, 2001; Lakin & Chartrand, 2003; van Baaren, Holland, Kawakami, & van Knippenberg, 2004).

Collectively, these studies suggest that humans (and perhaps other social species) are motivated to categorize others according to dominance status and traits that signal the individual's altruistic tendencies and vulnerability (babyish features; Fiske, 1993b). From the SRFB perspective, these basic motivations reflect the sensitivity to process the abilities and intentions, and hence reciprocity potential, of other people. Research on peer preferences shows that when young adults are asked to rate their preference for

hypothetical peers that vary on ratings of capacity and probability traits, a distinct pattern emerges. Similar to non-humans, people tend to evaluate high capacity traits in others (e.g., physical attractiveness, intelligence, material resources) relatively to oneself, and to prefer others that have similar levels of capacity traits to self-evaluations. In contrast, probability traits (e.g., kindness, friendliness) are appraised in a more linear fashion, such that the highest levels are most preferred, regardless of self-evaluations (Vigil, in press). These findings are important because they suggest that perceptions of prosocial intentions are obligated for most reciprocal relationships, whereas the selective adjustment (increased or decreased display) of one's *relative* capacity attributes may be needed to strengthen individual relationships (e.g., relationships between people that differ in social status).

Other research suggests that humans may be motivated to adjust preference for capacity and probability traits in other people in relation to the context of the relationship. For example, research on mate preferences shows that both males and females place more weight into the appraisal of high capacity traits (e.g., physical attractiveness, material resources) when seeking short-term relationships, and place more emphasis on high probability traits (e.g., kindness, responsibility) when seeking long-term or more exclusive relationships (e.g., Geary, Vigil, Byrd-Craven, 2004; Li, Bailey, Kenrick, & Linsenmeier, 2002; Vigil, Geary, & Byrd-Craven, 2006). From the perspective of the SRFB, capacity cues (physical attractiveness, material resources) may be sought and preferred in short-term relationships, because these types of characteristics do not require repeated interactions to be accurately assessed; they are immediately observable in other people. In contrast, the veracity of probability cues (e.g., kindness, integrity) cannot be

appraised through limited exposure, but instead requires repeated interactions to be accurately evaluated. A complimentary hypothesis is that capacity and probability cues may be perceived as signaling the potential to interchange different types of resources with others. Whereas capacity cues may be used to signal one's *expedient* or immediate resources, such as genetic resources in the case of mate-preferences, probability cues may be used to signal one's willingness to provide more *continuous* provisioning, such as extensive and reliable social support.

In any case, sensitivity to subtle inequalities in perceived capacity and probability cues, and the tendency to increase preference for higher levels of capacity traits in short-term relationships (e.g., dating context) and higher levels of probability traits in more exclusive relationships (e.g., a marriage partner) suggests that mechanisms that process displays of these cues may be integral components of interpersonal-appraisal and motivational systems. Of course, the flip-side of communicative processes is that these detection biases would have co-evolved with a set of systems designed to selectively display or advertise capacity and probability cues through myriad expressive behaviors. According to the SRFB perspective, the behavioral manifestation of distress behaviors may be conceptualized as one such expressive system.

Socio-Relational Properties of Distress Behaviors

The SRFB is based on the hypothesis that most (if not all) expressive behaviors are structurally (e.g., via phenotypic characteristics such facial expressions and felt mood) and functionally (e.g., via socio-relational outcomes such as increased social support or distancing from others) designed, in part, to selectively advertise these basic social properties. For example, externalizing behaviors (e.g., physical aggression, selfishness,

assertiveness, risk-taking) may be interpreted as attempts to display physical prowess, dominance, and other physical capacity cues. Facial expressions of *anger*, for example, share a number of similar features with expressions of *joy* (e.g., direct gaze and toothy displays of the sneer and smile expression), and both are perceived as conveying high dominance (Montepare & Dobish, 2003; Marsh, Adams, & Kleck, 2005). Emerging research also suggests these feelings activate distinct and overlapping neural pathways (e.g., predominant activation of the left hemisphere; Murphy, Nimmo-Smith, Lawrence, 2003).

From a socio-relational perspective, feelings of joy and anger differ on the approach/withdrawal dimension of behaviorism, but are related in that they may both be designed to convey individual competencies. Thus, while expressions of joy and pride may be used to signal the individual's capacity to reciprocate resources with others (vis-à-vis cues that signal the individual's successful experiences and available resources), expressions of anger and hostility may be used to signal the ability to protect oneself under conditions when the perception of trustworthiness of others has been breached.

In contrast, internalizing behaviors (e.g., low-mood, worrying, self-blame, cautiousness) may be interpreted as explicit displays of vulnerability and benevolence, and hence displaying the individual's intentions and thus probability of reciprocating beneficence or inflicting harm. Sadness behaviors such as crying and the production of emotional tears are highly associated with the perception of trust and empathy by others (e.g., Van Tilburg, Unterberg, & Vingerhoets, 2002; Williams, 1982; see also Boone & Buck, 2003). Likewise, the reflexive association between sadness behaviors and empathetic responses (e.g., sympathy weeping) is a major tenant of attachment theories

(e.g., Nelson, 2000) and models of instinctual communication between adults and human and non-human infants (Hill & Martin, 1997; Shipman, Zeman, Nesin, & Fitzgerald, 2003; Tronick, 1989; Zeifman, 2001). From the perspective of the SRFB, expressions of sadness and empathy are specialized examples of probability cues that may be have evolved to signal increased levels interpersonal trustworthiness in order to facilitate the formation of more dependable or new relationships.

Conditional variation in distress. Empirical studies show that humans (as with other highly affiliative species) respond to social challenges with either "dominant" or "submissive" behavioral strategies (e.g., happiness vs. sadness, aggression vs. appeasement, disdain vs. shame, confidence vs. worry, etc.; Aureli, 1997; Bugental & Lewis, 1998). This suggests that the expression of internalizing and externalizing behaviors may be associated with conditional factors, such as individual life-experiences, that affect the individual's relative reciprocity potential. For example, negative life-events may be experienced when they reduce the individual's relative capacity resources (e.g., job and property losses, or loss of established social networks), such as what happened with the hurricane in New Orleans. Because these types of events limit the ability to advertise high capacity cues, they may be responded through a behavioral strategy designed to instead increase advertisement of the probability component of reciprocity potential–at least under conditions when the individual has a receptive social network and when this component of reciprocity potential has not been diminished as well. Through explicit displays of vulnerability (e.g., depressive symptoms), individuals may be able to disarm others' threat interpretation and therefore exploit the tendency of others to respond to perceived vulnerability through reciprocated probability cues in the form of

expressed empathy and compassion. From this perspective, sadness behaviors may be functional for consolidating more cohesive and dependable relationships under conditions when the individual is especially susceptible to social exploitation and thus when high levels of reliable social support are needed most (Hagen, 2003).

In other words, increased manifestation of depressive symptoms and other internalizing behaviors may be adaptive in several ways, such as lowering risk-taking behaviors, that help offset the fitness-costs (i.e., reduced social standing and risk for exploitation) that are associated with the negative life-events that precipitated the sadness (e.g., see Allen & Badcock, 2003). The current suggestion, however, is these behaviors may also operate as expressive mechanisms that function to provide an explicit demonstration of one's vulnerability, and do so in order to reduce the perception of threat to other people. By responding to adversity through submissiveness and appeasement behaviors, individuals may be advertising the single most important criterion for the formation of secure and dependable social relationships, that is, high levels of probability cues in the form of displayed trustworthiness.

Situational variation in distress. As mentioned earlier, a number of contextual factors, such as the familiarity of one's audience, appear to affect the expression of distress behaviors. Another situational factor that has been shown to moderate and perhaps mediate many expressive behaviors (e.g., smiling, laughing, talkativeness, eye-gaze patterns, crying) is the relative group-size of the signaler's audience (i.e., number of potential onlookers/appraisers; Fridlund et al., 1990; LaFrance & Hecht, 2000; Leaper & Smith, 2004; Webbink, 1986). In one experiment, children (both boys and girls) that were exposed to stress (involuntarily losing a competitive game) and placed in larger groups

(consisting of 3 or more children) responded with increased expression of externalizing behaviors (e.g., assertiveness, anger, meanness to others). In contrast, when children were exposed to stress and placed in smaller groups (i.e., dyads), they tended to increase the expression of internalizing behaviors (e.g., self-depreciation, sadness, expressed empathy; Benenson et al., 2002). This pattern emerged equally for both sexes.

In the context of a socio-relational framework, these findings may reflect adaptive cost-benefit tradeoffs that are inherent in the ability to effectively display high-capacity and high-probability cues in larger and smaller group settings. Among larger social networks, individuals are limited in the amount of intimate investment behaviors and hence probability cues that they can allocate to each individual relationship (Geary et al., 2003). In contrast, because capacity cues are more readily observable than probability cues and may be more efficient at signaling the ability to provide expedient resources or to inflict immediate consequences onto others, these behaviors may be particularly suited to maintain the more fluid and temporary relationships that result from larger social networks (Vigil, in press). Similarly, effective displays of probability cues require more extensive histories of investment and thus may not be particularly efficient for maintaining larger social networks (Vigil, in press). Instead, increased displays of probability cues in smaller group settings may simply reflect the greater opportunity to interchange these behaviors across fewer relationships (Geary et al., 2003; Vigil, in press). From this perspective, facultative adjustment of distress behaviors in response to certain situational factors may reflect a behavioral response system that is designed to selectively advertise capacity and probability cues in relation to situational constraints (e.g., size of one's social network) on the ability to effectively display these cues.

Evolution of Sex Differences in Stress Response Behaviors

From the perspective of the SRFB model, phenotypic variation in the expression of capacity and probability cues are predicted to covary with individual differences in the relative quality and quantity of individual relationships in one's social network. As mentioned, emerging research suggests related distinctions in the prototypical social networks and relationship styles of males and females. Girls and women spontaneously form and report a preference for fewer, but more intimate relationships with their same-sex peers. Males, in contrast, evidence the opposite pattern by forming and reporting a preference for larger, but less intimate social networks (Geary et al., 2003; Rose & Rudolph, 2006; Vigil, in press).

From an ultimate standpoint, these differences have been suggested to have arisen from an evolutionary history characterized by *male-based philopatry* and *male-male coalitional competition*. In this type of social system, males tend to remain in close proximity to their male-kin (allowing them to form the largest and most effective coalitions), while females tend to emigrate into the social networks of their husbands upon marriage (see Geary, 1998; 2002; Geary & Flinn, 2002; Geary et al., 2003; Wrangham & Peterson, 1996). This hypothesis is consistent with population genetic studies on extant and historical societies that show that males are more likely to remain in closer proximity to their genetic relatives than females, on average (e.g., Seielstad, Minch, & Cavalli-Sforza, 1998; Hammer et al., 2001). This distinction is important, because it would have resulted in unique social contexts for the daily interactions of males and females during human evolutionary history.

Internalizing Behaviors in Females

With male-biased philopatry, males would have been exposed to and reliant upon more daily interactions with kin, on average, whereas females would have been dependent upon more daily interactions among non-kin or distantly related kin (de Waal, 1993; Geary, 2002; Geary et al., 2003). According to inclusive fitness theory (Hamilton, 1964; Trivers, 1971) and based on behavioral research (Daly & Wilson, 1988; de Waal, 1993, 2000; West, Pen, & Griffin, 2002), relationships between non-kin require more initial investment and maintenance behaviors and are generally more fragile than relationships among kin.

In the context of a socio-relational framework, the tendency for women to solicit more committed and secure relationships among non-kin would have created a heavy reliance on behaviors designed to advertise trustworthiness through exaggerated displays that signal the probability of being a reciprocating social partner (e.g., vis-à-vis intimate self-disclosure, self-depreciation, displayed empathy), and to facilitate these exchanges by forming fewer relationships (Geary & Flinn, 2001, 2002; Geary et al., 2003; Vigil, in press). From this perspective, higher rates of depressive behaviors in girls and women may be interpreted as a behavioral pattern that has evolved to respond to stressors through increased advertisements of probability cues (e.g., via co-ruminative behaviors), relative to males. Likewise, the emergence of sex differences in sadness behaviors during adolescence may reflect the prototypical stage of development when females were more dependent on explicit displays of trustworthiness in order to form and maintain more secure and dependable relationships with female friends.

Externalizing Behaviors in Males

Likewise, and as a result of an evolutionary history of male-male, kin-based coalitional competition, there is predicted to be an overall relaxation of selection pressures for males to *exaggerate* the expression of intimate (one-on-one) altruism and benevolence and other probability cues. In theory, this would have enabled men to form a greater number of relationships, and thus larger and more functional coalitions and to rely more heavily on the behavioral advertisement of externalizing behaviors (e.g., physical aggression), dominance displays (e.g., inflated self-evaluations), and hence capacity cues in order to attract and maintain these greater overall, less intimate, and less exclusive relationships. This interpretation is consistent with findings that adolescent girls report more frequent feelings of shyness, surprise, shame, guilt, and sadness, and are more likely to employ self-blaming coping strategies in response to distress, whereas boys are more likely to explicitly deny experiencing these feelings, and instead report more frequent feelings of contempt (Stapley & Haviland, 1989; Vingerhoets & Van Heck, 1990).

From a socio-relational framework, sex differences in the propensity to manifest distress through higher levels of externalizing behaviors (e.g., impulsivity, risk-taking, inflated self-evaluations, aggressive behaviors) in males and internalizing behaviors (e.g., conscientiousness, modest self-descriptions, sadness behaviors) in females may reflect asymmetries in the social ecologies and relationship demands in which humans evolved, and thus social contexts in which children currently develop (Geary & Flinn, 2002; Geary et al, 2003; Vigil, in press).

Developmental Considerations

Many expressive behaviors tend to vary in frequency and intensity at different ages (Giblin, 1981). One pattern is increased externalizing behaviors, for instance, in adolescence and young adulthood, and especially in males. While both males and females experience increased anger and other capacity-related displays (e.g., feelings of disgust, risk taking behaviors) throughout *older adolescence* (Birditt & Fingerman, 2003), teenage and young adult males are the predominant perpetrators and victims of physical violence (e.g., Holinger, 1980). In turn, experiences of anger and hostility tend to decrease dramatically as individuals transition into older adulthood, with males evidencing sharper declines in the frequency of these feelings than females, on average (Mroczek & Kolarz, 1998).

Other research shows a slightly different pattern in the expression for internalizing symptoms, whereby these behaviors tend to emerge during *earlier adolescence*, decrease during older adolescence, and rise again during adulthood (e.g., Ge et al., 2003). For example, McDermott and Palmer (2002) found that among children exposed to a natural disaster (a bush fire in New South Wales, Australia), younger (under grade 8) and older children (over grade 10) showed higher depression scores than children in middle grades (grades 8-10), and that this effect was stronger for girls. These findings are consistent with broader reviews that show early adolescence is the stage in life when we find the greatest sex differences–favoring girls–in many types of probability displays, included normal sadness behaviors (e.g., crying frequency), self-reported distress, and prosocial behaviors (Davis, Mathews, & Twamley, 1999; Fabes, Carlo, Kupanokk, & Laible, 1999; Ge, Conger, & Elder, 2001; Ge et al., 2003; Twenge & Nolen-Hoeksema, 2002; Van Tilburg et al., 2002). Similar research shows that adolescent

girls are six times more likely to develop PTSD–consisting of exaggerated expression of probability cues from this perspective–than same-age boys (Giaconia et al., 1995). Findings like these highlight the importance of considering age when examining sex differences in distress responses and other expressive behaviors.

CHAPTER 2: CURRENT STUDY

The current project has several broad goals. The first goal is to examine the display of various capacity and probability behaviors in the stress responses of children and young adults displaced by Hurricane Katrina (n = 68), versus a sample of control participants (n = 63) matched on SES, age, and sex, that did not experience these events. The primary externalizing behavior measured in the study was self-reported aggression; the primary internalizing behaviors measured in the study were symptoms of depression and symptoms of distress. Additional measurements included self-evaluations (i.e., self-esteem and self-image) and life-satisfaction; higher scores of these measures were interpreted as capacity displays, and lower scores were interpreted as probability displays. Self-reported anxiety symptoms (e.g., heightened sense of threat, irritability, and somatic disturbances) were also examined and assumed to provide an estimate of the psychological arousal/anticipatory component in the sequelae of distress responses, rather than signifying an expressive outcome or display, per say (e.g., Reiman, Fusselman, Fox, & Raichle, 1989).

A second goal was to examine whether the hurricane affected youth showed different cortisol and AA levels compared to the controls. A third goal was to examine potential sex differences in these psychological behaviors and the physiological bio-markers. Lastly, I sought to examine the possibility that sex may moderate the relations between hurricane-experience and the distress behaviors, and that hurricane exposure and sex may moderate relations between the physiological bio-markers and reported internalizing and externalizing behaviors.

From the perspective of a socio-relational framework, several patterns of response are predicted. The first pattern is that the Katrina participants will report higher probability displays (e.g., lower self-esteem and higher depression) *and* lower capacity displays (e.g., lower self-evaluations and lower aggression levels) than the control participants. This is based on the hypothesis that when we experience an event that decreases our capacity resources (e.g., as the hurricane did in New Orleans), that we are effectively less able to influence others by displaying our capacity cues, and may instead be motivated to increase the advertisement of probability cues. Because probability cues are hypothesized to demonstrate vulnerability, reduced threat, and trustworthiness, these behaviors may be used to facilitate the formation of cohesive and more dependable relationships under conditions when high levels of reliable social support are needed most; again, when our capacity attributes have been diminished.

At the same time, other research shows that individuals who are exposed to repeated stressors (e.g., low SES urban environments) tend to exhibit blunted affect and HPA activity (e.g., Burke, Fernald, Gertler, & Adler, 2005; Lovallo, Dickensheets, Myers, Thomas, & Nixon, 2000). Therefore, a secondary hypothesis is that the Katrina sample may be more habituated to stress exposure and therefore show "lower" anxiety symptoms and blunted physiological arousal in the form of, for example, lower HPA levels–measured through salivary cortisol–and weaker relations between HPA activity and psychological distress.

In terms of sex differences, the third hypothesis is that females will report higher levels of internalizing displays (especially among the Katrina survivors), whereas males would report higher levels of externalizing displays. The fourth hypothesis is that these

displays will be differentially related to physiological responses such that higher HPA activity will be more strongly related to internalizing displays in females, and more strongly related to externalizing displays in males.

And finally, according to the socio-relational perspective and the male-based philopatry model, if stress responses are to be conceptualized as behavioral mechanisms designed to manipulate social relationships, and if females are typically more exposed to intimate social interactions than males, on average, then it makes sense that perhaps females may be more habituated to psychosocial stressors–social interactions that place the individual at risk for negative social evaluations–than males on average. This interpretation is consistent with the earlier mentioned research showing that males typically illicit greater HPA and sympathoadrenal responses to stressful stimuli in experimental settings. Similarly, I hypothesize that females will evidence a higher threshold for physiological arousal and that this habituation may be manifested through, for example, lower symptoms of anxiety and HPA activity, and weaker relations between physiological arousal and psychological distress, in comparison to males, even though females are expected to report more exaggerated symptoms of distress.

CHAPTER 3: METHODS

Event and Setting

Hurricane Katrina struck the North-Central Gulf coast (mostly Louisiana and Mississippi) on August 29, 2005. Though structural devastation and displacement was widespread, the most populated region affected by the hurricane was New Orleans, due in part to several breaches in the levees that protected the city from the surrounding Lake Pontchartrain (Travis, 2005). In the days and weeks following the hurricane, thousands of people had to be rescued from their homes, often through emergency procedures, and many of the individuals experienced trauma associated with lack of security, first-hand reports or direct witness of assault, and lack of food, clean water, and medical assistance (personal correspondence, 2005). In total, about 80% of New Orleans was severely flooded, and combined with the devastation felt across surrounding regions, this event directly caused over 1800 deaths (with just as many people missing) with an estimated cost of over $75 billion (Hurricane Katrina, 2006).

In addition to the direct loss of life, injury, and structural devastation caused by the hurricane, hundreds of thousands of people were either permanently or temporarily displaced from their communities. Many of these refugees were forced to seek shelter in government and community shelters, often being transported across multiple shelter sites throughout the United States (personal correspondence, 2005). For the most severely affected individuals and families, government sponsored relocation camps were built to provide semi-permanent (i.e., indefinitely provided) housing facilities. These facilities typically consist of a mass of travel-trailers located on the outskirts of surrounding towns

and cities. The largest of these camps, located near the city of Baton Rouge, LA, was the site chosen to conduct the present study.

The camp, referred to by the residents and wider community as "FEMA City," consisted of approximately 500 travel trailers, each housing an average of three people (not including infants and young children) at the time of data collection. The site included a central tent and barracks area, which served as the local post office and cafeteria and where supplies (e.g., clothing) were dispersed; several small laundry houses; and a basketball court. Meals were served three times a day. Residents typically retrieved these from the central building and brought them back to their trailers to eat with their families. Despite the frequent efforts taken to provide the residents with comfortable conditions (e.g., seasonal festivities), the general mood in the camp was low.

Participants

The participants from the relocation camp included 165 refugees (50 males), with ages ranging from 5-80 years old; however, only children (11 yrs and older) to young adults (under 22 yrs) were used in the current study (n = 68). All of the Katrina participants reported having been relocated from the New Orleans region.

The control sample included 116 children and guardians (63 participants were between 11 and 21 yrs), from mid-Missouri (Columbia, MO and Jefferson City, MO). These participants were recruited in residential neighborhoods and selected based on matching characteristics (e.g., age, race, SES) of the Katrina participants, and as described in more detail below. None of the control participants had experienced the hurricane first-hand, nor had they been recently relocated from the hurricane affected region.

Procedure

The data from the target population was collected from October 28, 2005 through November 2, 2005, (approximately 2 months after the hurricane). At that time, the relocation camp had been in operation and populated for about three weeks. The data from the control participants were collected from August, 2006 through January, 2007.

For both samples, the researchers targeted individuals and families with children between the ages of 5 and 18. Participants were approached, asked to participate in the study "Child and Family Wellness after a Major Natural Disaster," and notified of their rights outlined by the University of Missouri Institutional Review Board. Once individuals agreed to participate, the researchers were often invited into their trailers/homes, upon which, an initial cortisol sample was collected (described in more detail below) from each of the family members. Participants over the age of 10 or 11 were asked to complete a survey packet that consisted of items designed to assess psychological functioning and family functioning; adult participants were also asked to provide demographic information. This usually took between 30 and 45 min to complete. For younger children (10 years and younger), parents/guardians were asked to complete a short behavioral assessment of their child (i.e., Child Behavior Checklist; not used in the current study), which took about 10 min to complete. A second cortisol sample was then collected, upon which, the participants were debriefed and given a small monetary payment ($5) for their participation.

Saliva Collection

The saliva samples were collected between the hours of 7:00a.m. and 7:00p.m. Participants were asked to place a small cotton swab in their mouth to absorb the saliva,

and then to return the cotton to a Salivette® collection container. The samples were then placed in a cooler and later stored in a refrigerator. The second saliva sample was typically collected about 60 to 90 min after the first collection. For each participant, additional information was collected, including the participants' wake-time, daily meals, and sleep pattern (to assess the potential for sleep disturbances). This information was collected to help control for the circadian rhythm of cortisol fluctuations (e.g., Bartels, de Geus, Kirschbaum, Slyter, & Boomsma, 2003) and other factors (e.g., caffeine consumption) known to affect cortical measures. Upon return to our lab, the samples were stored in a sub-zero freezer; the frozen samples were then sent to an assay laboratory (Salimetrics, State College, PA); the AA samples were assayed using a commercially available kinetic reaction assay, and the cortisol samples were assayed using a sensitive enzyme immunoassay.

Measures

The survey included a number of standardized, self-report instruments designed to measure psychological and family functioning in adolescents and adults (not all measures were used in the current study). For some instruments, entire scales were administered to allow for a direct comparison across normative samples and other studies; for other instruments, partial scales were used that consisted of items that represent the instrument's respective sub-scales (this enabled for a more streamlined data collection procedure). Each of the instruments has shown to demonstrate high test-retest reliability, and most have demonstrated high convergent and discriminate validity (e.g., Giannopoulou et al., 2006). These instruments are described in more detail below. All of

the consent and debriefing forms and items and measures used in the study are provided in Appendix A.

Many of the instruments have been used with similar child and adult samples who had recently experienced a major natural disaster (e.g., Ginexi, Weihs, Simmens, & Hoy, 2000; Sumer, Karanci, Berument, Gunes, 2005). This research shows that children are able to provide vivid descriptions of their traumatic experiences for years following the event, and that the consistency of these descriptions is positively related to severity of experienced trauma (Fivush, Sales, Goldberg, Bahrick, & Parker, 2004). These findings suggest that the present population was likely to have provided an accurate description of the immediate and subsequent events caused by Hurricane Katrina.

Demographic Variables

In addition to age, ethnicity, and education, the demographic items used in this study were designed to asses participants' previous (prior to the hurricane) and current employment and financial status. Financial items included annual household income, financial resources (e.g., property, vehicles and other substantive material holdings), and history of government financial assistance (e.g., welfare, food stamps).

Psychological Measures

State self-esteem/self-image. Six items from *The Current Thoughts Scale* (Heatherton & Polivy, 1991) were used to assess self-described trait self-esteem/self-image. The original instrument consists of 3 factor subscales designed to measure self-evaluations related to performance competencies, social skills, and physical appearance. Two items from each of these subscales were included and scored on a 5-point scale. These two items, as were all of the partial items included in the survey, were chosen

based on clarity of the item wording. The items were then used to create an overall sum score; Cronbach's alpha (α) for the entire set of items was .71.

Aggression. Eight items from *The Aggression Questionnaire* (Buss & Perry, 1992) were used. The original instrument consists of 4 factor subscales designed to assess physical aggression, verbal aggression, anger, and hostility, and have shown strong cross-instrument reliability (Archer, Kilpatrick, & Bramwell, 1995). Two items from each of these subscales were included and scored on a 5-point scale (overall α = .72).

PTSD. *The Impact of Events Scale - Revised* (Weiss & Marmar, 1997) was used to assess subjective distress caused by a specific event. The instrument consists of 22 items (scored on a 5-point scale), which were revised to refer specifically to Hurricane Katrina. The instrument consists of 4 factor subscales designed to measure hyperarousal, disassociation, intrusion, and avoidance symptoms that parallel clinical diagnoses of PTSD, although the instrument in and of itself is not sufficient for such a diagnosis (overall α = .93).

Anxiety. *The Revised Children's Manifest Anxiety Scale* (Reynolds & Richmond, 1978) was used to assess self-described anxiety symptoms. The instrument consists of 37 items (scored on as Yes or No responses), including several lie (social desirability) items (overall α = .87). This scale has been widely used to measure post-disaster anxiety in children and adults (e.g., Kreuger, Stretch, 2003).

Global self-esteem. *The Rosenberg Self-Esteem Scale* (Rosenberg, 1965) was used to assess self-described global self-esteem. The instrument consists of 10 items and scored on a 4-point scale (overall α = .73). This instrument has been widely used in cross-cultural studies designed to measure post-disaster self-esteem (e.g., Sumer et al., 2005).

Life-satisfaction. *The Satisfaction with Life Scale* (Diener, Emmons, Larsen & Griffin, 1985) was used to assess general happiness. The instrument consists of 5 items and scored on a 4-point scale (overall $\alpha = 70$).

Depression. *The Center for Epidemiologic Studies Depression Scale* (Radloff, 1977) was used to assess self-reported depressive symptoms. The instrument consists of 20 items (scored on a 4-point scale) designed to measure the frequency of depressive symptoms during the previous week (overall $\alpha = .86$). This instrument has also been widely used in other natural disaster studies (e.g., Ginexi et al., 2000).

Statistical Analyses

Because basal cortisol and AA levels follow a diurnal rhythm (Edwards, Evans, Hucklebridge, Clow, 2001; see also Granger et al., 2006), an estimate of the lapse in time from when the participant woke up to the time at collection may be a more reliable way to control for this rhythm than controlling for the collection time alone. Therefore, the participant's wake-time was subtracted from their first and second collection times, respectively (scored in minutes from midnight), and averaged to compute the amount of time the participant had been awake prior to the collection (hereafter referred to as "awake-time"). For some analyses, age was also used as a covariate, in part, because it is a proxy for body mass, which has been shown to influence basal cortisol levels, and because of age differences in some of the psychological measures (Masi, Rickett, Hawkley, & Cacioppo, 2004; see also Shamim, Yousufuddin, Bakhai, Coats, & Honour, 2000). Student's *t*-tests were used to examine mean differences (i.e., according to hurricane-exposure and sex) in the psychological variables and biomarkers. Effect sizes were estimated with Cohen's *d* (mean difference / mean standard deviation; Cohen, 1988).

Multiple regressions, using awake-time and age as covariates, were used to examine potential between-group interactions, and potential cortisol by group and AA by group interactions for each of the psychological variables. Partial correlations were used to examine bivariate relations between basal cortisol and AA and the psychological variables while controlling for awake-time and age.

CHAPTER 4: RESULTS

Preliminary Analyses

Examination of the demographic characteristics of the adult family members (18 yrs and over) of the child participants across the Katrina (n = 57 adults) and control (n = 39 adults) samples revealed non-significant differences (ps > .10) for race, education level, history of government assistance (e.g., welfare, food stamps), the likelihood of currently owning a car, current income, and current financial assets (e.g., monetary holdings/savings, property). Specifically, both samples were over 93% African-American and reported an average education level between the 11th and 12th grades. In both samples, the average yearly income was between $4,000 and $6,000 with current financial assets of less than $200. Over 67% of participants in both samples reported a history of government financial assistance, and less then 27% reported currently owning a car. Significant differences (ps < .05) were found for age and likelihood of being currently employed; the Katrina sample was slightly older (mean age = 31 yrs, SD = 10) than the control sample (mean age = 27 yrs, SD = 8) and were less likely to be employed (25% vs. 47% employment rates, respectively).

For the remainder of the analyses, only children and young adults between 11-21 yrs were used (n = 131, mean age = 15.2 yrs, SD = 2.5, 48 males, 68 Katrina survivors). Missing values for either of the two cortisol or alpha-amylase samples were replaced by the other (3% of saliva collections were missing); each of the two cortisol and AA samples were then averaged. Missing values for the psychological variables were replaced by the sample means for each sex, and according to age-group (11% of the self-

report data were missing). The age-groups were constructed based on sample sizes and normative ages at puberty (M = 12.5, SD = 1.8) and first sexual experience (M = 16.1, SD = 2.8) among similar demographic samples (e.g., Vigil, Geary, & Byrd-Craven, 2005). The groups were preadolescents (11-13 yrs, M = 12.3 yrs, SD = .8, n = 36), older adolescents (14-16 yrs; M = 14.8 yrs, SD = .8, n = 56), and young adults (17-21 yrs, M = 18.4, SD = 1.2, n = 39). The results are presented in two parts: the first part examines sample and sex differences in the survey and saliva variables; the second examines between-group interactions and cortisol and AA by group interactions on the psychological variables.

Group Differences

Sample Differences

The mean scores for the self-image, global self-esteem, depression, life-satisfaction, aggression, anxiety, and distress (PTSD) measures (sum-scores) and cortisol and AA levels are shown in Table 1. As shown in Table 1, and in comparison to the control group, the Katrina sample reported lower self-esteem, higher depression, and lower symptoms of anxiety. The Katrina sample also showed lower cortisol levels and higher AA levels, compared to the controls. Group differences in cortisol, $F(1,130) = 4.91$, $p < .05$, and in AA, $F(1,130) = 6.14$, $p < .01$, remained, when the awake-time variable and age-group were controlled. Across both samples the cortisol and AA levels were similar, though slightly lower than have been reported in experimental studies in general populations (e.g., Kivlighan, Granger, & Booth, 2005; Rohleder et al., 2004).

Table 1

Sample Differences in Psychological Functioning and Salivary Biomarkers

	Control (n = 63)	Katrina (n = 68)	t	d
Self-Image	24.2 (4.3)	22.7 (5.2)	-1.82	-.32*
Global Self-Esteem	31.5 (4.8)	29.3 (5.7)	-2.43	-.43**
Depression	43.1 (9.6)	47.1 10.8)	2.23	.39**
Life-Satisfaction	14.1 (3.4)	13.5 (3.4)	<1	.17
Aggression	26.0 (5.9)	24.1 (5.9)	-1.86	-.33*
Anxiety	43.9 (5.1)	40.9 (6.3)	-2.98	-.52***
Distress	58.2 (15.0)	62.3 (19.3)	1.37	.24
Cortisol	.20 (.15)	.15 (.11)	-2.34	-.38**
Alpha-Amylase (AA)	45.7 (38.7)	63.6 (45.2)	2.42	.42**

Note. Raw mean cortisol values are in ug/dL; raw AA levels are in U/mL. Standard deviations are in parentheses. The ranges for the variables were: self-image (9-30), self-esteem (14-40), depression (20-69), life-satisfaction (5-20), aggression (8-39), anxiety (28-56), distress (22-102), cortisol (.03-1.08), AA (.30-217.40). *$p < .10$, **$p < .05$, ***$p < .01$.

Sex Differences

The mean psychological scores and salivary measures for males and females are shown in Table 2. As shown in Table 2, the only self-report variable to show significant sex differences was for symptoms of anxiety, in which males reported greater overall symptoms than females. Mean differences in cortisol and AA were not significant;

however, after controlling for awake-time and age-group, males showed higher cortisol levels than females, $F(1,130) = 4.54$, $p < .05$. The adjusted cortisol means for males (.21) and females (.16) were significantly different, $t(130) = -2.18$, $p < .05$.

Table2

Sex Differences in Psychological Functioning and Salivary Biomarkers

	Males ($n = 48$)	Females ($n = 83$)	*t*	*d*
Self-Image	23.1 (5.3)	23.6 (4.5)	<1	.10
Global Self-Esteem	29.7 (6.1)	30.7 (4.9)	1.09	.19
Depression	44.4 (10.4)	45.5 (10.4)	<1	.11
Life-Satisfaction	14.4 (3.0)	13.4 (3.5)	-1.65	-.30*
Aggression	24.2 (6.2)	25.5 (5.8)	1.20	.22
Anxiety	44.5 (5.8)	41.1 (5.7)	-3.25	-.59***
Distress	59.2 (16.0)	61.0 (18.2)	<1	.10
Cortisol	.19 (.16)	.17 (.11)	<1	.15
Alpha-Amylase	54.1 (46.6)	55.5 (41.0)	<1	.03

Note. Raw mean cortisol values are in ug/dL; raw AA levels are in U/mL.

Standard deviations are in parentheses. *$p < .10$, **$p < .05$, ***$p < .01$.

Between-Group Interactions and Physiological Effects

To examine potential between-group interactions and the potential that hurricane-exposure and/or sex may moderate the relations between cortisol and AA, and

psychological distress behaviors, two regression analyses were run for each of the psychological variables in Table 1. For the first equation, sample (coded 0 for controls and 1 for the Katrina participants), sex (coded 1 for males and 2 for females), cortisol, and the sample by sex, cortisol by sample, cortisol by sex, and the three-way sample by sex by cortisol interaction terms were simultaneously entered as predictors. For the second equation, sample, sex, AA, and the sample by sex, AA by sample, AA by sex, and the three-way sample by sex by AA interaction terms were entered as predictors. For both sets of equations, the awake-time variable and age-group were entered as covariates. Cortisol and AA were not correlated ($r < .01$), therefore running the regression analyses separately by biomarker allowed an examination of their respective relations with the group categories; this also reduced the number of interaction terms that would be needed for a simultaneous assessment of cortisol and AA. Summaries of the results for the cortisol equations are show in Tables 3 and 4; summaries of the results for the AA equations are shown in Tables 5 and 6.

Table 3

Relations between Sample, Sex, and Cortisol, and Self-Image, Self-Esteem, Depression, and Life-Satisfaction

	Psychological Outcome Variables							
	Self-Image		Self-Esteem		Depression		Life-Satisfaction	
Predictor Terms	β	*t*	β	*t*	β	*t*	β	*t*
Sample	-.19	-2.14**	-.20	-2.13**	.19	2.21**	-.05	<1
Sex	.09	1.00	.10	1.13	.08	<1	-.14	-1.56
Sample x Sex	-.04	<1	-.07	<1	.18	1.98**	.12	1.28
Cortisol	-.03	<1	.13	1.07	.02	<1	.03	<1
Cortisol x Sample	.17	1.57	.20	1.83*	-.07	<1	-.05	<1
Cortisol x Sex	-.20	1.92*	-.04	<1	.03	<1	-.16	-1.56
Cortisol x Sample x Sex	-.04	<1	-.09	<1	.11	1.06	-.08	<1
Awake-time	<.01	<1	-.10	<1	.18	1.69*	.07	<1
Age-group	.21	2.34**	.07	<1	-.22	-2.53***	-.28	-3.21***

Note. The results are from multiple regressions when the predictor variables were entered simultaneously.

*$p < .10$, **$p < .05$, ***$p < .01$.

Table 4

Relations between Sample, Sex, and Cortisol, and Aggression, Anxiety, and Distress

	Psychological Outcome Variables					
	Aggression		Anxiety		Distress	
Predictor Terms	β	*t*	β	*t*	β	*t*
Sample	-.14	-1.70*	-.21	-2.45**	.12	1.42
Sex	.17	2.07**	-.21	-2.32**	.08	<1
Sample x Sex	.32	3.71***	.03	<1	.09	<1
Cortisol	.27	2.33**	.13	1.06	.16	1.38
Cortisol x Sample	-.03	<1	.15	1.45	-.10	<1
Cortisol x Sex	.04	<1	.03	<!	-.08	<1
Cortisol x Sample x Sex	-.06	<1	.01	<1	-.04	<1
Awake-time	.17	1.71*	.08	<1	.29	2.90***
Age-group	-.30	-3.60***	.11	1.30	-.28	-3.21***

Note. The results are from multiple regressions when the predictor variables were entered simultaneously. *$p < .10$, **$p < .05$, ***$p < .01$.

Table 5

Relations between Sample, Sex, and Alpha-Amylase (AA), and Self-Image, Self-Esteem, Depression, and Life-Satisfaction

	Psychological Outcome Variables							
	Self-Image		Self-Esteem		Depression		Life-Satisfaction	
Predictor Terms	β	*t*	β	*t*	β	*t*	β	*t*
Sample	-.12	-1.25	-.22	-2. 36**	.16	1.77*	-.02	<1
Sex	.06	<1	.11	1.22	.04	<1	-.16	-1.72*
Sample x Sex	.05	<1	-.07	<1	.16	1.74*	.18	1.94*
AA	-.18	-1.69*	-.02	<1	<.01	<1	-.09	<1
AA x Sample	.05	<1	-.13	-1.26	-.04	<1	.06	<1
AA x Sex	-.21	-2.15**	.05	<1	.23	2.42**	-.09	<1
AA x Sample x Sex	.13	1.43	.04	<1	.12	1.32	.07	<1
Awake-time	-.03	<1	-.14	-1.48	.16	1.82*	.03	<1
Age-group	.22	2.48**	.07	<1	-.24	-2.79***	-.27	-3.06

Note. The results are from multiple regressions when the predictor variables were entered simultaneously.

*$p < .10$, **$p < .05$, ***$p < .01$.

Table 6

Relations between Sample, Sex, and Alpha-Amylase (AA), and Aggression, Anxiety, and Distress

	Psychological Outcome Variables					
	Aggression		Anxiety		Distress	
Predictor Terms	β	*t*	β	*t*	β	*t*
Sample	-.19	-2.16**	-.19	-2.10**	.09	<1
Sex	.15	1.74*	-.24	-2.69***	.05	<1
Sample x Sex	.33	3.68***	.06	<1	.11	1.18
AA	.06	<1	-.10	<1	.01	<1
AA x Sample	-.04	<1	.06	<1	<.01	<1
AA x Sex	.01	<1	-.09	<1	.12	1.27
AA x Sample x Sex	.03	<1	.08	<1	.09	<1
Awake-time	.06	<1	.02	<1	.22	2.40**
Age-group	-.27	-3.20***	.13	1.43	-.26	-3.05***

Note. The results are from multiple regressions when the predictor variables were entered simultaneously. *$p < .10$, **$p < .05$, ***$p < .01$.

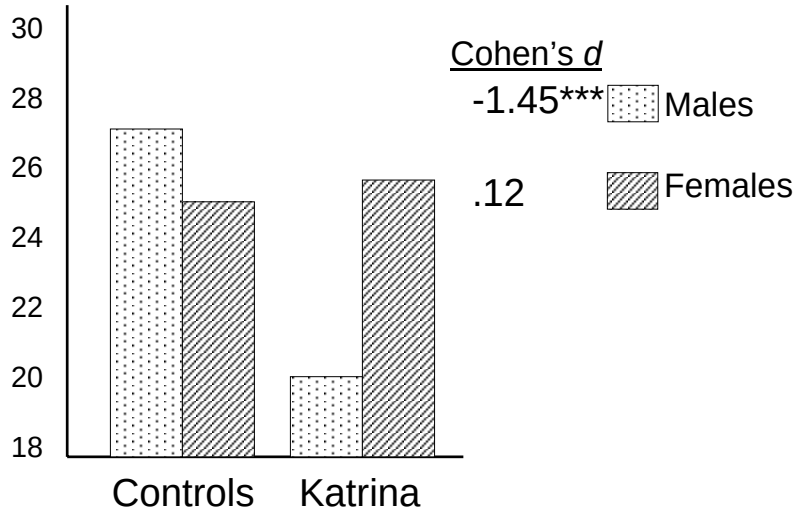
Group Effects and Between-Group Interactions

Examination of the sample effects in Tables 3 through 6, while controlling for the remaining variables and interactions terms, revealed that, for both the cortisol and AA equations, hurricane exposure was independently related to lower self-image, and lower symptoms of anxiety. For the cortisol equations, hurricane exposure was also related to lower self-esteem, and higher symptoms of depression; for the AA equations, hurricane exposure was related to lower levels of aggression. Across Tables 3 through 6, the only significant main effects of sex were for higher aggression and lower anxiety in females. Examination of the sample by sex interaction terms revealed a significant interaction for aggression and depression for both equations, and a near significant interaction ($p = .06$) for life-satisfaction for the AA equation.

To decompose the interactions, the means for the aggression and depression scores among the Katrina and control samples are shown separately for males and females in Figure 1 and Figure 2, respectively. Examination of Figure 1 shows that the sample by sex interaction for aggression emerged due to lower reported aggression among the Katrina than control males; $t(44) = -5.16$, $p < .01$, $d = -1.45$. In contrast, Figure 2 shows that the sample by sex interaction for depression was due to higher symptoms of depression among the Katrina than control females; $t(81) = 3.20$, $p < .01$, $d = .71$.

Figure 1

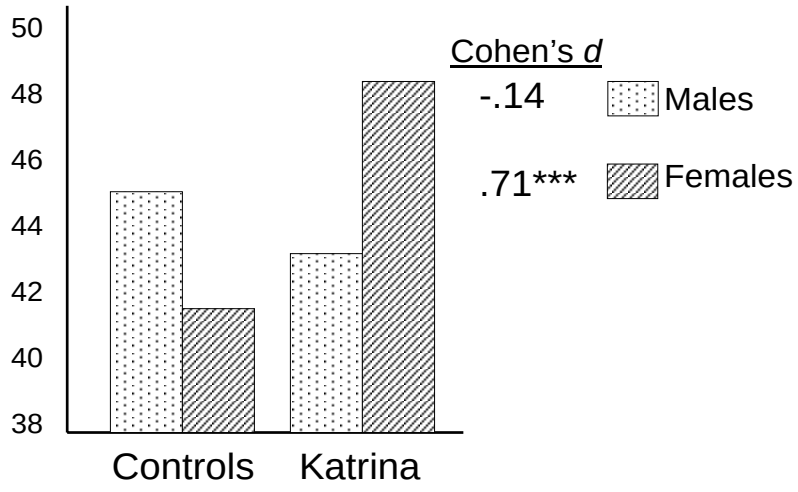
Sample by Sex Interaction for Aggression



Note. The range of the aggression scale is 14-36.

Figure 2

Sample by Sex Interaction for Depression

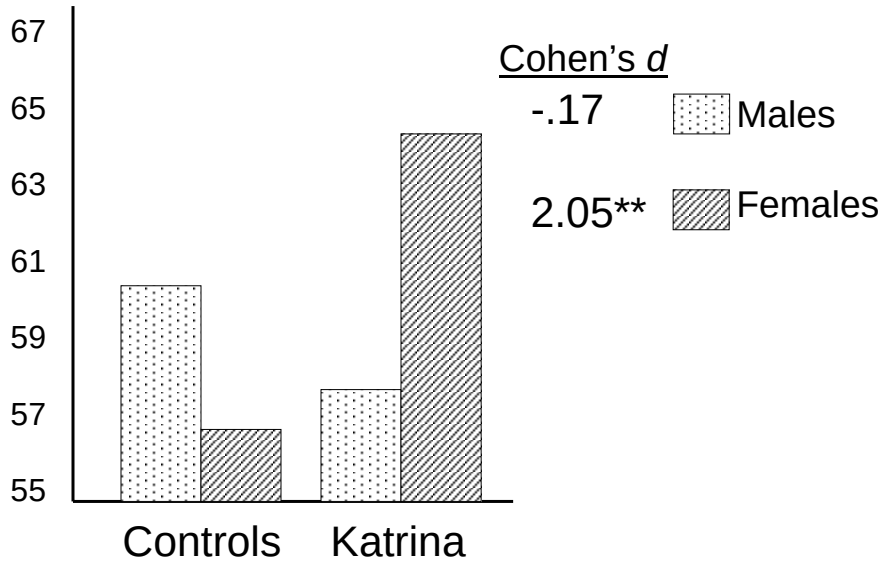


Note. The range of the depression scale is 20-62.

To examine whether the interactions remained if cortisol and AA were not controlled, ANCOVAs were used by entering sample, sex, and the sample by sex interaction terms as predictor variables and age-group as a covariate for each of the psychological scores Similar to above, a significant interaction was found for aggression, $F(1,130) = 20.25$, $p < .01$; and depression, $F(1,130) = 7.40$, $p < .01$. A significant interaction also emerged for symptoms of distress, $F(1, 130) = 4.72$, $p < .05$. As shown in Figure 3, this interaction was due to higher symptoms of distress among the Katrina than control females, $t(81) = 2.05$, $p < .05$.

Figure 3

Sample by Sex Interaction for Distress



Note. The range of the distress scale is 22-102.

Physiological Effects and Group Interactions

Cortisol. Examination of the main effect of cortisol in Table 4 reveals that higher cortisol levels are associated with higher levels of aggression. The partial correlation between cortisol and aggression, while controlling for age-group and awake-time, was .23 ($p < .01$). Examination of the interactions involving cortisol reveal a near significant interaction with sex for self-image ($p = .06$) and a near significant ($p = .07$) interaction with sample for self-esteem.

Because no three-way interactions were significant, partial correlations (controlling for awake-time and age-group) between cortisol and each of the psychological measures were computed separately by sample and sex (Table 7). Examination of the partial correlations across the Katrina and control samples in Table 7 shows a pattern of stronger relations between cortisol and psychological functioning for the control group than among participants exposed to the hurricane. Specifically, higher cortisol was related to higher depression, higher aggression, and greater symptoms of distress in the non-affected sample. In contrast, each of these relations was reduced to non significance in the Katrina sample; however only the correlations between depression and distress were significantly different (ps = .06 and .10, respectively) according to Fisher's *z* transformation.

Table 7

Partial Correlations between Cortisol and Psychological Functioning by Sample and Sex

	Sample		Sex	
Psychological Measures	Control (n = 63)	Katrina (n = 68)	Males (n = 48)	Females (n = 83)
Self-Image	-.10	.06	.06	-.04
Global Self-Esteem	-.16	.19	-.08	.20*
Depression	.27**	-.06	.31**	-.05
Life-Satisfaction	.20	-.05	.28*	-.05
Aggression	.22*	.19	.29**	.21*
Anxiety	.02	.18	.11	.15
Distress	.33***	.05	.35**	.03

Note. The results are partial correlations after controlling for awake-time and age-group. *p < .10, **p < .05, ***p < .01.

Examination to the partial correlations between cortisol and psychological functioning by sex reveals a stronger association for the males, in general. According to Fisher's z transformation higher cortisol was more strongly related to higher life-satisfaction (p = .07), higher depression (p < .05), and higher symptoms of distress (p = .07) in the males than the females.

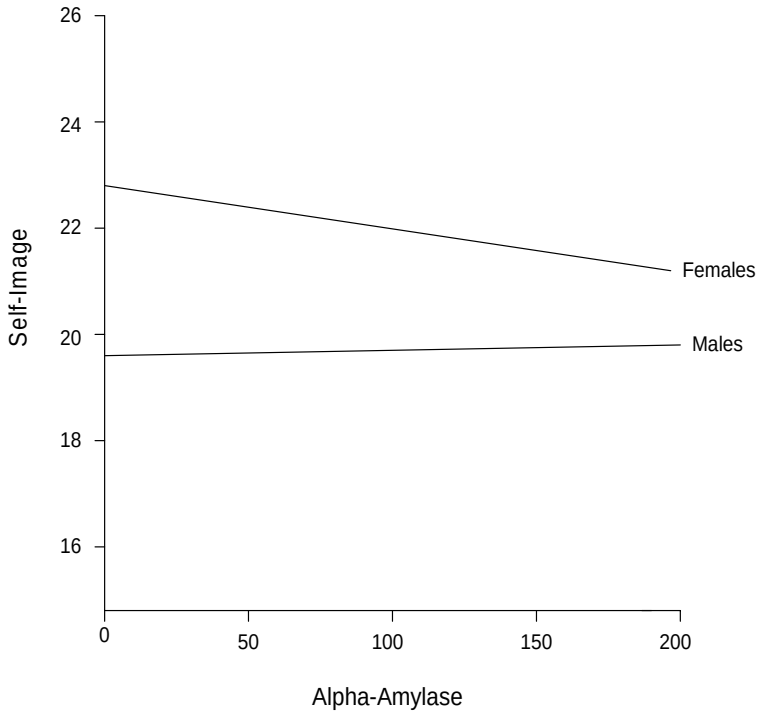
Alpha-amylase. Examination of the main effect of AA revealed a near significant (p = .09) relation, such that higher AA levels were associated with lower self-image

(Table 5); however, the partial correlation between AA and self-image was not significant (r = -.11, p > .10). Examination of the AA interactions revealed a significant interaction with sex for self-image and symptoms of depression.

To facilitate the plotting of regression slopes depicting the linear relations between AA levels and self-image and depression across males and females, the equations were rerun using these respective variables and their interactions (with awake-time and age-group as entered as covariates); the relations are the same for the full equation and this truncated equation. Following procedures described by Whisman and McClelland (2005), these relations are shown in Figures 4 and 5. As shown in Figure 4, the interaction was due to a stronger relation between AA and self-image for the females (b = -.03, p < .01) than males (b = .02, p > .10). Similarly, Figure 5 shows that the interaction was due to a different pattern of relations between AA and symptoms of depression in males (b = -.06, p < .05) and in females (b = .07, p < .05); specifically, higher AA levels were related to lower depressive symptoms in males and to higher depressive symptoms in females. The relations between AA and self-image and between AA and depression for males and females were significantly different (ps < .01)

Figure 4

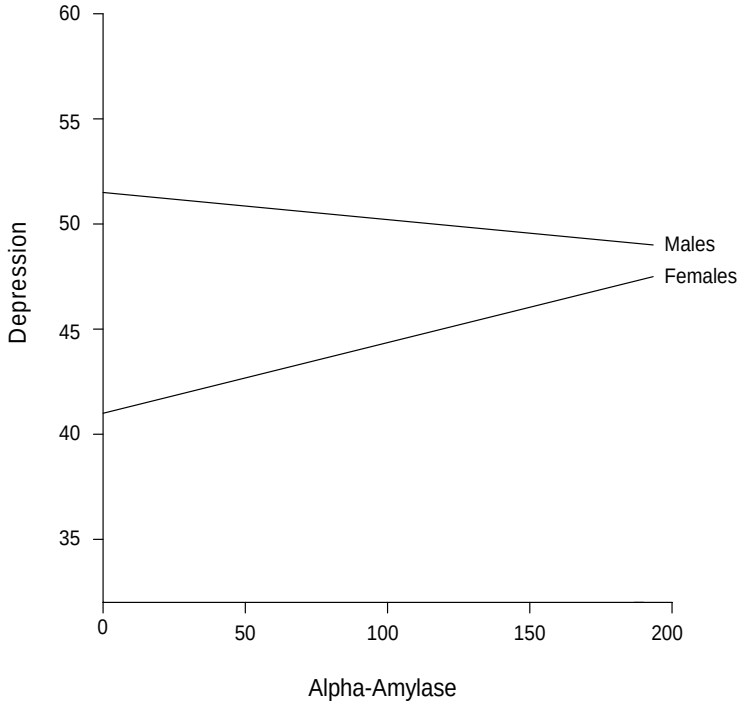
Self-Image and Alpha-Amylase across Males and Females



Note. The slopes of the lines represent the linear relation between self-image and alpha-amylase (U/mL) across males and females.

Figure 5

Depression and Alpha-Amylase across Males and Females



Note. The slopes of the lines represent the linear relation between depression and alpha-amylase (U/mL) across males and females.

Partial correlations between AA and the psychological measures by sample and sex are shown in Table 8. As shown in Table 8, none of the partial correlations between AA and the psychological measures were significant when the samples were split according to hurricane experience. Table 8 again shows that higher AA levels were associated with lower depression in males and higher AA depression scores for females,

and to lower self-image in females but not males. According to Fisher's z transformation, each of the differences was significant (*p*s < .05).

Table 8

Partial Correlations between Alpha-Amylase (AA) and Psychological Functioning by Sample and Sex

	Sample		Sex	
Psychological Measures	Control (n = 63)	Katrina (n = 68)	Males (n = 48)	Females (n = 83)
Self-Image	.01	-.13	.14	-.29***
Global Self-Esteem	.09	-.12	-.04	-.12
Depression	-.01	.05	-.30**	.27**
Life-Satisfaction	.01	-.05	.04	-.06
Aggression	.14	.10	.08	.09
Anxiety	<.01	-.06	-.03	-.17
Distress	<.01	.09	-.11	.20*

Note. The results are partial correlations after controlling for awake-time and age-group. *p < .10, **p < .05, ***p < .01.

Additional Factors

Examination of Tables 3 through 6 also revealed that the awake-time variable was an independent predictor of higher scores on the distress measure. The correlation between the amount of time the participants had been awake prior to the time at

assessment and higher reported symptoms of distress was .28 ($p < .01$). Finally, older-age (i.e., young adulthood) was related to higher self-image ($r = .20$, $p < .05$), lower depression ($r = -.20$, $p < .05$), lower life-satisfaction ($r = -.25$, $p < .01$), lower aggression ($r = -.25$, $p < .01$), and lower symptoms of distress ($r = -.26$, $p < .01$). These are interesting findings in themselves, but to control for the small number of males, between-group interactions with age-group were not examined further. The psychological and bio-marker mean scores for each age-group and age differences are shown in Appendix B.

CHAPTER 5: DISCUSSION

Humans are the most socially complex and codependent species of mammal on Earth. The social selection pressures to form dynamic (e.g., short-term vs. long-term) and beneficial relationships and to protect oneself from potentially dangerous interactions have been suggested to have played a corollary role in the evolution of the human mind (e.g., Dunbar, 1998; Geary, 2005). Similarly, humans may have evolved a corresponding suite of behavioral systems designed to modify the individual's relationships in ways that enhance subsequent fitness. Several theorists have begun to examine normal stress response behaviors, such as depression, within a social context and according to the relational outcomes of these behaviors (e.g., Allen & Badcock, 2003; Hagan, 2003). Similarly, the socio-relational perspective examined in this dissertation is based on the assumption that normal stress responses may be manifested as expressive behaviors that signal two hypothesized components or social properties of reciprocity potential. More precisely, behavioral responses are hypothesized to signal traits that display either a) capacity cues that signal the individual's ability to provide potential resources or inflict injury onto others (e.g., vis-à-vis externalizing behaviors); or b) probability cues that signal trustworthiness through explicit demonstrations of altruism and displayed vulnerability (e.g., vis-à-vis internalizing behaviors). Due to evolved cost-benefit trade-offs on the ability to advertise high capacity and high probability cues in response to significant life-events (i.e., experiences that either increase or decrease the individual's perceived reciprocity potential) and constraints on the sub-ecologies in which males and females evolved, several trauma- and sex-related differences are hypothesized for the

arousal and expressive components of stress response. These predictions were examined in a sample of children and young-adults that lost their homes to Hurricane Katrina and were living in a large relocation camp, and a sample of demographically matched youth that did not experience these events.

Trauma-Related Effects

On the basis of the socio-relational perspective, when people experience an event that decreases their capacity to contribute socially or take care of their own needs as with the hurricane and relocation experience, individuals may respond through a behavioral strategy designed to minimize the advertisement of capacity cues (e.g., vis-à-vis reduced aggression and confidence) and increase the advertisement of probability cues (e.g., vis-à-vis sadness behaviors). In theory, explicit demonstrations of altruism and vulnerability are effective at reducing the perception of threat to other people, thereby demonstrating the individual's benevolent intentions, and signaling their trustworthiness. By selectively advertising the probability component of reciprocity potential, individuals may be better able to facilitate the formation of intimate and more dependable relationships under conditions when highly reliable social support is needed most (Geary & Flinn, 2002; Hagen, 2003).

Group differences in self-reported psychological functioning among the affected and non-affected samples support this hypothesized pattern. The Katrina survivors reported decreased capacity behaviors in the form of lower aggression and lower self-evaluations (i.e., lower self-image and self-esteem) and with a simultaneous increase in the proposed probability behaviors in the form of higher depressive behaviors; though these differences were moderated by sex as described below. This inverse pattern is

important, because it suggests that the traditional approach of categorizing, for example, sadness and aggression behaviors according to a valence-based dimension such as "negative affect" may not fully capture the distinguishing characteristics and interpersonal nature of these behaviors. From the current perspective, internalizing and externalizing behaviors may better reflect a collection of coordinated behavioral strategies that are designed to *optimize* the individual's life-experiences–both positive *and* negative life-events–in ways that enhance the ability to selectively advertise capacity and probability cues. In this sense, the human stress response system may exploit experienced adversities in ways that enhance the ability to effectively display high probability cues in the presence of trusted individuals, for instance, through explicit displays of vulnerability such as sadness and worrying behaviors, and self-blaming coping styles. By reducing the perception of threat and increasing the perception of trust, internalizing behaviors may enhance the opportunity to form more secure and reliable social networks under conditions when the individual is at the greatest risk for social exploitation and rejection, again, when the capacity resources have been diminished.

Another important set of findings was that the Katrina survivors reported lower symptoms of anxiety and showed lower basal cortisol levels and higher basal AA levels than the control group, on average. These findings are consistent with previous research showing that chronic stress exposure is associated with lower morning cortisol levels in other populations (Miller et al., 2007). The Katrina survivors were also more likely to show non-significant or blunted relations between HPA activity–as indexed by cortisol–and psychological functioning, whereas the control group showed a significant concordance between higher cortisol levels and greater symptoms of depression and

distress. These findings are consistent with recent studies showing a relation between HPA insensitivity (i.e., lower cortisol reactivity) and symptoms of depression (e.g., Burke, Davis, Otte, & Mohr, 2005), as well as emerging research uncovering a link between repeated exposure to stressors during childhood (e.g., experiences of abuse and neglect) and blunted affect in other forms, including lower facial expressivity (Schwartz, Fair, Salt, Mandel, & Klerman, 1976) and reduced emotional processing abilities (e.g., Mikhailova, Vladimirova, Iznak, Tsusulkovskaya, & Sushko, 1996**;** Parker & Nelson, 2005; Pollak, Cichetti, Hornung, & Reed, 2000). Likewise, the current study suggests that exposure to a large-scale disaster is related to blunted relations between cortisol activity and self-reported internalizing and externalizing behaviors and experienced distress.

The current findings are also consistent with experimental research showing asymmetrical patterns of HPA and sympathetic activity and manifestation of distress behaviors (e.g., aggression) following a stressful event (Gordis et al., 2006; Granger et al., 2006). Exposure to the hurricane was related to higher AA, but lower basal cortisol levels. In addition, hurricane exposure was related to changes in the concordance between cortisol activity and the behavioral report of depression and aggression, whereas hurricane-exposure did not appear to be associated with changes in the links between AA and psychological functioning. Combined with earlier studies, the current findings suggest that increases in salivary AA and cortisol may result from short-term or acute stressors (e.g., relocation-camp conditions), whereas significant decreases in cortisol regulation may better approximate long-term changes in HPA functioning that result from repeated stress exposure (e.g., Rohleder et al., 2004). Specifically, repeated stress

exposure is associated with lower morning cortisol levels resulting in a "flat" diurnal cortisol rhythm (Miller et al., 2007).

One possibility for the latter pattern may be that individuals become habituated to repeated stress exposure, and that this habituation is, in turn, manifested as lower HPA sensitivity and experienced anxiety. Blunted cortisol reactivity is common in children and adults who have been exposed (or perceived to have been exposed) to repeated stressors and interpersonal rejection, including schizophrenics and children with aggressive and defiant tendencies, children diagnosed with attention deficit and hyperactivity disorder, and individuals with a history of substance abuse (Blair, Granger, & Razza, 2005; Coccaro & Siever, 2002; Jansen et al., 1998; Kariyawasam, Zaw, & Handley, 2002; Wiel, Goozen, Matthys, Snoek, & Engeland, 2004; Wust, Federenko, Hellhammer, Kirschbaum, 2000). Unlike these earlier studies, however, the current investigation found a positive relation between cortisol levels and self-reported aggression. Unfortunately, the use of a single source of measurement does not allow for the parceling of whether higher cortisol is related to actual aggression and/or the self-report of these behaviors. An alternative interpretation of the current findings is that they may better reflect recovery processes that follow a traumatic experience rather than the primary consequences of such experiences. Future studies that are able to provide a more detailed assessment of the full range of possible sequelae from stress exposure through recovery (or worsening) will broaden our understanding of these processes.

In either event, the SRFB leads to the prediction that both the arousal and expressive components of distress responses are each adaptive and social in nature. This hypothesis is intriguing, when one considers the numerous potentially harmful physical

and psychological consequences that are associated with uncontrollable and repeated stress exposure (e.g., low SES; Lachman & Weaver, 1998), including severe psychological impairment, lower immune functioning, and higher morbidity (e.g., Sapolsky, 2004; Segerstrom & Miller, 2004). In other words, the paradox remains as to why so many seemingly deleterious consequences of stress exposure may have been or continue to be adaptive. From the current perspective, however, increased morbidity and susceptibility to illness is consistent with the crux of the hypothesis that individuals may respond to negative-life events through explicit or exaggerated demonstrations of vulnerability. If one considers physical changes in terms of expressive displays, then increased morbidity may partially reflect a broader behavioral strategy designed to advertise probability cues. From this perspective, psychosomatic symptoms (e.g., loss of appetite) and illness-related outcomes of experienced distress may *function* as self-harming mechanisms designed to provide an *honest* indicator of vulnerability and hence trustworthiness to others. In this sense, physical illness may be associated with adaptive cost-benefit tradeoffs in themselves, for example, becoming manifested when the social benefits of these conditions outweigh the physical detriment that they cause. Similar arguments have been proposed for the relatively high prevalence rates and paradoxical health consequences associated with depressive disorders (e.g., see Hagan, 2003). Nuanced approaches like these open up the possibility of interpreting traditionally viewed pathologies, such as depression, from a novel perspective, and provide a backdrop by which to pursue alternative sets of hypotheses and potentially important lines of empirical research. Empirical studies that are able to measure the relations between social status–

and perhaps specific capacity and probability cues that compose this status–and physical health will greatly contribute to our understanding of stress responses (Sapolsky, 2005).

Sex-Related Effects

According to the male-based philopatry and male-male-competition hypotheses, males and females evolved in distinct sub-ecologies that required distinct interpersonal expressive styles. Males are hypothesized to have evolved among more closely related kin and to form larger and hence more competitive coalitional networks that were maintained through the interchange of higher levels of capacity cues, such as inflated-self-evaluations, a lower threshold for physical aggression, and other dominance behaviors (Geary et al., 2003; Vigil, in press). In contrast, females are hypothesized to have evolved among more distantly related kin and non-kin, and to form smaller and more intimate social networks in order to facilitate the exchange of higher probability cues–cues that signal reliability in terms of reciprocal altruism (e.g., expressed empathy) and vulnerability (e.g., modest self-evaluations), and hence, benevolent intentions. Likewise, the current prediction was that males would be more likely to respond to stress through manifested capacity displays (e.g., vis-à-vis higher self-evaluations and aggression), whereas females would respond to stress through manifested probability displays (e.g., vis-à-vis symptoms of sadness and distress).

The current results were only partially supportive of these predictions. Although males and females reported similar levels of internalizing and externalizing behaviors, on average, there was support for the predicted sex by sample interaction effects. Only males showed group differences in aggression between the affected and non-affected samples (albeit lower levels in the Katrina sample) and only females showed significantly greater

depression and distress in the Katrina youth, compared to the controls. Collectively, these findings suggest that males are more likely to manifest stress response through adjustments in the display of capacity displays, whereas females may be more likely to manifest stress response through adjustments in the display of probability displays. This interpretation is consistent with a recent study that showed a stronger relation between HPA activity and self-reported symptoms of social distress in girls but not boys (Schiefelbein & Susman, 2006). This interpretation also accounts for the current findings of a stronger relation between higher AA levels and lower self-evaluations (i.e., self-image) and greater symptoms of depression in females, whereas higher AA was associated with lower symptoms of depression in males. To my knowledge, this is among the first studies to find sex difference in the link between salivary AA and self-reported symptoms of depression.

Consistent with previous studies, males showed higher basal cortisol levels than the females, on average (e.g., Shamim et al., 2000). However, males also reported greater symptoms of anxiety, and showed a greater concordance between cortisol levels and symptoms of depression, distress, and life-satisfaction. In contrast, these psycho-physiological links were largely absent in females (for similar findings see Delahanty et al., 2005; for findings on sex differences in HPA activity and distress behaviors in rats, see Klein, Popke, & Grunberg, 1998). In other words, the pattern of higher anxiety and greater concordance between HPA activity and distress behaviors among the males essentially mirrored the findings described above of greater anxiety and a greater psych-physiological concordance among the control group than the Katrina sample. These results are also consistent with experimental research showing a lower threshold for HPA

responses to stressful stimuli (e.g., public speaking tasks) and to changes in family structure (e.g., father absence) in males (Flinn, Quinlan, Decker, Turner, & England, 1996; Kajantie & Philips, 2005, but see Dickerson & Kemeny, 2004).

The combination of these results opens up the simple interpretation that perhaps females may be more habituated to psychosocial stressors than males, on average. Though speculative, this interpretation makes sense from a socio-relational framework. For example, if stress response behaviors (e.g., sadness, aggression) are to be conceptualized as expressive mechanisms designed to respond to socio-metric evaluation and threat through behaviors that modify the individual's relationships, and if females are more exposed to intimate social interactions (and hence social evaluations) than males, on average, then perhaps females are less reactive (e.g., evidencing blunted HPA responses) to psychosocial stimuli, when compared to similarly exposed males. This hypothesis is not, however, consistent with other research that shows that men produce greater stress responses (e.g., higher cortisol spikes) to achievement-oriented tasks (e.g., physical competition), whereas females respond more to social interactions that place the individual at risk for interpersonal rejection (Schiefelbein & Susman, 2006; Stroud, Salovey, Epel, 2002; Kivlighan et al., 2005).

An alternative socio-relational hypothesis that does account for these findings is that males and females are sensitive to stressors that disproportionately threaten the capacity and probability components of reciprocity potential, respectively. Psychosocial stressors that threaten the individual's capacity attributes, for instance, in terms of naturalistic stressors that result in job and material losses, such as the hurricane, or experimental stressors designed to highlight the individual's competencies (e.g., public

speaking tasks) may be experienced as more significant for males than females. If the motivation to advertise high capacity cues (e.g., dominance status) is relatively lower for females, then they may produce smaller responses to events that threaten these cues. Likewise, if females are motivated to place more emphasis on the advertisement of probability cues, then the types of stressors that threaten, for example, the perception of an individual's altruism or perceived trustworthiness may be more stressful for females.

This interpretation is consistent with findings that show that adolescent boys report greater concern over lack of attainment in academic and athletic domains and greater overall distress from failure to be "successful" (Benenson & Schinazi, 2004). In contrast, other research shows that girls report greater distress over the possibility of attaining more success than their friends, and are more likely to prefer equal outcomes and attainment status with peers their. According to the present framework, the perception of inequality (i.e., differences in status) may disrupt the ability for females to advertise probability cues, for example, in terms of modest self-evaluations. This interpretation is also consistent with findings that females may experience more distress in response to experiences that diminish their sense of chastity, such as experiencing (nonviolent) sexual abuse as a child, in comparison to males on average (Elliot, Mok, & Briere, 2004). Some models have suggested that perceived chastity is an indicator of interpersonal trust and therefore important for male's mate preferences, and that experiences of rape affect the perception of chastity (Vigil et al., 2005). In this sense, perceived chastity may be an example of a probability cue that is more highly cherished in females, and thus an attribute that, when threatened, may result in greater psycho-physiological stress responses in girls and women.

Additional Considerations

Multiple regression analyses also revealed that age was an independent predictor of several of the psychological measures. Overall, older age (i.e., young adulthood vs. adolescence) was related to decreases symptoms internalizing (e.g., lower depression and symptoms of distress) and externalizing behaviors (lower aggression). Unfortunately, the small samples sizes of males did not allow for a direct assessment of the potential moderating role of age between the relations investigated. Previous research suggests that age moderates sex differences in many expressive behaviors, including symptoms of depression and the experience of discrete emotions (e.g., feelings of anger; McDermott & Palmer, 2002; Mroczek & Kolarz, 1998). Other studies have documented age differences in HPA and sympathetic activation (e.g., Granger et al., 2006). Therefore, future research that is able to examine multiple physiological and psychological indicators of stress response will greatly contribute to our understanding of potential changes in expressive styles across the lifespan, such as increased aggression during adolescence (Lorber, 2004).

Another interesting finding that has never been documented, to the best of my knowledge, is that the amount of time the participants had been awake at the time of measurement (referred to as "awake-time") was an independent predictor of self-reported distress. This relation emerged after controlling for hurricane experience, sex, and the respective roles of each biomarker. Of course the replicability of this, as with the other findings, needs to be established. Still, the possibility of a diurnal rhythm in expressed distress is intriguing and worthy of empirical consideration, and exemplifies the potential myriad circumstantial and situational factors that have already been shown (and factors that have yet to be discovered) to effect the manifestation of distress responses. Though

challenging, the state of research is currently ripe to begin to construct theoretically integrative and empirically testable models that can incorporate various situation factors and individual differences in the manifestation of both normative and atypical response behaviors.

In conclusion, the current study is consistent with other multi-physiological measurement studies showing that cortisol and alpha-amylase are uniquely associated with distress behaviors (e.g., aggression; Gordis, Granger, Susman, & Trickett, 2006), but extend these earlier findings in several important ways. By using a naturalistic research design on a sample of children and young adults that experienced a series of severe and established traumatic events, the findings provide novel and potentially useful insights into how the hurricane and relocation experiences may have affected young people, and how males and females may differ in their responses. Exposure to a large-scale disaster appears to be associated with lower anxiety and blunted HPA activity and differential expressive manifestation in males and females; males appear to elicit sympathetic activation in concordance with an inflated sense of self, whereas females appear to respond to stress through deflated self-evaluations and depressive behaviors. I also hope that the current results and theoretical framework used to interpret the findings may help guide future research on developmental correlates of stress response and other forms of expressive behaviors. Physiological concomitants of affective arousal (e.g., cortisol spikes) are associated with felt changes in distress, such as sadness, as well as feelings of elation (Brown, Sirota, Niaura, & Engebretson, 1993). From a socio-relational perspective, variation in these responses evolved to facilitate the fitness advantages that covary with interactive and reactive social outcomes. These advantages may then be

related to basic socio-appraisal and expressive processes and, according to the current findings, individual differences in recent life-experiences and sex-typical interactive styles.

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Appendix A

INFORMED CONSENT (Individual Form)

I _____ agree to be included in the research project "Child and Family Wellness After a Natural Disaster". This study is being directed by Jacob Vigil, M.A. and Dr. David Geary, Department of Psychological Sciences, at the University of Missouri-Columbia.

PROJECT PURPOSE: A lot is known about how people deal with everyday problems, however less is known about how families deal with the special problems created by hurricane Katrina. This study examines family behaviors after a major natural disaster. The data will be collected for scientific purposes only.

VOLUNTARY: I understand the survey is entirely up to me, and that I may refuse to answer any question. I may also choose to withdraw from the study at any time without any penalty.

WHAT DO YOU DO? I understand that I will fill out a survey about myself, my family, and one or more of my children. The survey asks questions about my current housing, my feelings, and how my family deals with problems. I understand that I will fill out a small survey on my child's (children's) behavior, if she or he is between 6 and 13 years of age. In addition, I will be asked to give a small amount of saliva (spit) in a plastic cup to test the amount of stress in the body. I understand that the saliva (spit) will only be used for this purpose and will be protected by the researchers. The entire session should take between 30 and 50 minutes. If I prefer, I understand a researcher will gladly read the survey and record responses.

BENEFITS: I understand that I will receive five dollars for my part, and five dollars for each child between 6-13 years that I complete a small survey (up to five children per family). The current study should also provide important information for doctors to help people respond to these events in the future.

RISKS: I understand that this project may involve emotional discomfort from the survey questions that are associated with the hurricane event or past emotions. I also understand that, while the researchers provide several safety measures to protect my survey responses, there is some (though unlikely) risk of this information being viewed by non-research staff.

CONFIDENTIALITY: I understand that mine and my child's names will be protected and will not appear in any publication. The information gathered by the survey will only be published in a group format. My answers and those related to my child (children) will not be revealed to anyone other than the researchers involved in the study. Instead, my survey responses will be assigned an ID number so that my personal information (e.g., name) can be separated and secured separately from the survey.

Follow up: I understand that I and my child (children) may be asked to be a part of a follow-up study to test the long-term effects of Katrina. To do this, I agree to provide contact information of one relative who can help locate me one year from now.

INJURY: It is not the policy of the University of Missouri to pay human subjects in the event the research results in injury. The University of Missouri does have insurance for any injury caused by the fault of its faculty and staff. Within the limitations of the laws of the State of Missouri, the University of Missouri will also provide medical attention to subjects who suffer injuries while participating in the research projects of the University of Missouri. In the event you have suffered injury as the result of participating in this research project, you are to immediately contact the Campus Institutional Review Board Compliance Officer at (573) 882-9585 and the Risk Management Officer at (573) 882-3735 to review the matter and provide you further information. You can also e-mail Michele Reznicek at: reznicekm@missouri.edu. This statement is not to be construed as an admission of liability.

Your efforts are greatly appreciated. If you have any questions regarding the study, please contact Dr. David Geary (573) 882-6268 or e-mail him at: gearyd@missouri.edu. If you have questions regarding your rights as a participant in research, please feel free to contact the Campus Institutional Review Board at (573) 882-9585.

Signature _____ Date _____

INFORMED CONSENT (Parent Form)

I _____ agree to allow my child (children; Names of up to five children) _____, _____, _____, _____, _____ to be included in the research project "Child and Family Wellness After a Natural Disaster". This study is being directed by Jacob Vigil, M.A. and Dr. David Geary, Department of Psychological Sciences, at the University of Missouri-Columbia. All children under 18 years of age must have the written consent of their parent and/or guardian to be included.

PROJECT PURPOSE: A lot is known about how people deal with everyday problems, however less is known about how families deal with the special problems created by hurricane Katrina. This study examines family wellness after a major natural disaster. The data will be collected for scientific purposes only.

VOLUNTARY: I understand the survey is entirely up to me. My child (children) may refuse to answer any question or choose to withdraw from the study at any time without any penalty.

WHAT DO YOU DO? I understand that my child (children) will fill out a survey about their feelings and family behaviors. Parents and/or guardians of children ages 6-13 years will complete a survey on their child's behavior. I also understand that my child (children) will be asked to give a small amount of saliva (spit) in a plastic cup to test the amount of stress in the body. I understand that the saliva (spit) will only be used for this purpose and will be protected by the researchers. The entire session should usually take between 30 and 50 minutes to complete. If your child would prefer, an investigator will gladly read the survey and record responses.

BENEFITS: I understand that my child will receive five dollars for participating, and I will receive five dollars for completing a behavior checklist for each child between 6-13 years (up to five children per family). The current study should provide important information for doctors to help people respond to these events in the future.

RISKS: I understand that this project may involve emotional discomfort from the survey questions that are associated with the hurricane event or past emotions. I also understand that, while the researchers provide several safety measures to protect mine and my children's survey responses, there is some (though unlikely) risk of this information being viewed by non-research staff.

CONFIDENTIALITY: I understand that mine and my child's names will be protected and will not appear in any publication. The information gathered by the survey will only be published in a group format. My answers and those related to my child (children) will not be revealed to anyone other than the researchers involved in the study. Instead, my survey responses will be assigned an ID number so that my personal information (e.g., name) can be separated and secured separately from the survey.

Follow up: I understand that I and my child (children) may be asked to participate in a follow-up project to assess the long-term effects of Katrina. To do this, I agree to provide contact information of one relative who can help locate me one year from now.

INJURY: It is not the policy of the University of Missouri to pay human subjects in the event the research results in injury. The University of Missouri does have insurance for any injury caused by the fault of its faculty and staff. Within the limitations of the laws of the State of Missouri, the University of Missouri will also provide medical attention to subjects who suffer injuries while participating in the research projects of the University of Missouri. In the event you have suffered injury as the result of participating in this research project, you are to immediately contact the Campus Institutional Review Board Compliance Officer at (573) 882-9585 and the Risk Management Officer at (573) 882-3735 to review the matter and provide you further information. You can also e-mail Michele Reznicek at: reznicekm@missouri.edu. This statement is not to be construed as an admission of liability.

Your efforts are greatly appreciated. If you have any questions regarding the study, please contact Dr. David Geary (573) 882-6268 or e-mail him at: gearyd@missouri.edu. If you have questions regarding your rights as a participant in research, please feel free to contact the University of Missouri's Campus Institutional Review Board at (573) 882-9585.

Signature _____ Date _____

CONSENT TO SERVE AS PARTICIPANT IN STUDY OF PSYCHOLOGICAL REACTION TO A NATURAL DISASTER

I agree to participate in a study of child and family wellness after a natural disaster. I understand that Dr. David Geary, from the University of Missouri at Columbia, is in charge of the study.

I understand that in this study I will fill out a survey that asks questions about my feelings and my family's behaviors. I will also be asked to spit into a plastic cup. I will receive five dollars for helping with this study.

I understand that I don't have to fill out all the questions and can stop at any time without getting in trouble.

I understand that we may try to meet again in about one year to fill out a similar survey.

I understand that the survey will take about 45 minutes and that I can take a break or stop the survey at any time and not get in trouble for it. I understand that my survey will not be shown to my parents or teachers and will only be seen by the scientific researchers.

Signature _____

Date _____

Debriefing Form

Thank you for participating in our study. This study is designed to explore how families respond to stress and cope in the aftermath of a major natural disaster. This information is unique and will contribute by providing information to psychologists and other mental health professionals on how parents, children, and families respond to such a disaster and thus will provide information on how they might better respond to the long-term effects of this disaster and better prepare for any future disasters.

All information is kept strictly confidential: you will not be identified in any publication. This project is directed by Jacob M. Vigil, and is conducted under the supervision of Dr. David Geary, Department of Psychological Sciences, at the University of Missouri-Columbia. If you have questions about the study you can contact us at (573) 884-1563 or e-mail us at: jmv427@mizzou.edu. If you have any concerns about this project, you can contact Michelle Reznicek of the Institutional Review Board of the University of Missouri at (573) 882-9585 or e-mail her at: reznicekm@missouri.edu.

Special Note:
In the event that yours or your child's negative reactions, thoughts, or emotions get worse or continue for long period of time, you should seek professional services. Free counseling services are provided by the Department of Health and Human Services at 1-800-273-TALK (1-800-273-8255).

Information Form

Instructions: Please circle or fill in ONLY ONE response for each question. (Children only answer up to question No. 7)

1) Name (please print):_____

2) I am a: Hurricane victim_____ Volunteer_____ Public Service Personnel_____

3) Age: _____ 4) Sex: **Male** **Female**

5) Race (circle one letter): a) African-American b) European-American c) Latin-American d) Asian-American e) Other_____

6) The highest education level I completed was (circle one number):

1 2 3 4 5 6 7 8	**9 10 11 12**	**13 14 15 16**	**17 18 19 20+**
(grade school)	(high school)	(college)	(graduate school)

---

7) The highest degree I received was (circle one letter):

a) None **b**) GED **c**) High School Diploma **d**) Associate's **e**) Bachelor's **f**) Master's /Doctorate

8) I have used government assistance in the past (e.g., welfare, food stamps, WIC): **YES** **NO**

9) Were you employed before hurricane Katrina? **YES** **NO**

10) Are you currently employed? **YES** **NO**

11) Did you own a car before hurricane Katrina? **YES** **NO**

12) Do you currently own a car? **YES** **NO**

13) What was your housing situation before hurricane Katrina (circle a number)?
a) I lived with family **b**) I lived with friends **c**) I rented a house **d**) I rented an apartment **e**) I owned my own home

14) Last year, my yearly household income was about (circle one letter):
a) less than $5,000 **b**) $5,000-$10,000 **c**) $10,000-$20,000 **d**) $20,000-$30,000 **e**) $30,000-$40,000 **f**) over $40,000

15) What most describes YOUR current financial status (including cash, property, and other financial assets)?
a) Less than $100 **b**) $100-$500 **c**) $500-$1,000 **d**) $1,000-$5,000 **e**) $5,000-$10,000 **f**) $10,000-$30,000 **g**) over $30,000

16) In the next month I expect that my main source of financial support will be (circle one letter):
a) Government Assistance **b**) Community assistance **c**) Family **d**) Friends **e**) Myself

17) I expect to have the same amount of financial/material resources that I had before hurricane Katrina within:
a) about 1 month **b**) about 1 year **c**) about 5 years **d**) about 10 years **e**) over 10 years

18) I believe that at least one of my close friends has died or suffered serious injury because of hurricane Katrina: **YES** **NO**
If yes, how many (circle a number)? **1 2 3 4 5+**

19) I believe that at least one of my family members has died or suffered serious injury because of the hurricane: **YES** **NO**
If yes, how many (circle a number)? **1 2 3 4 5+**

20) I expect to have the same level of social support (friends and family) that I had before the hurricane within:
a) about 1 month **b**) about 1 year **c**) about 5 years **d**) about 10 years **e**) over 10 years

21) Right now, I am most worried about my own:
a) Safety **b**) Education **c**) Financial state **d**) Emotional needs **e**) Health

22) Right now, I am most worried for my children's:
a) Safety **b**) Education **c**) Emotional needs **d**) Health

Instructions: Circle the number that best describes your family BEFORE and SINCE hurricane Katrina.

1 = Almost never 2 = One in a while 3 = Sometimes 4 = Lots of times 5 = Almost always

	"WHEN OUR FAMILY HAS PROBLEMS, WE…"	**BEFORE**	**NOW**
1	Sharing our problems with family	(1 2 3 4 5)	(1 2 3 4 5)
2	Seeking help from friends	(1 2 3 4 5)	(1 2 3 4 5)
3	Knowing we have the power to solve major problems	(1 2 3 4 5)	(1 2 3 4 5)
4	Seeking help from community programs that help families in this situation	(1 2 3 4 5)	(1 2 3 4 5)
5	Watching television	(1 2 3 4 5)	(1 2 3 4 5)
6	Showing that we are strong	(1 2 3 4 5)	(1 2 3 4 5)
7	Attending church services	(1 2 3 4 5)	(1 2 3 4 5)
8	Seeking professional counseling and help for family problems	(1 2 3 4 5)	(1 2 3 4 5)
9	Believing that the problem will go away by itself	(1 2 3 4 5)	(1 2 3 4 5)
10	Having faith in god	(1 2 3 4 5)	(1 2 3 4 5)
11	Each family member has a say in major family decisions	(1 2 3 4 5)	(1 2 3 4 5)
12	Our family does things together	(1 2 3 4 5)	(1 2 3 4 5)
13	Our family members talk about problems and feel good about the solutions	(1 2 3 4 5)	(1 2 3 4 5)
14	In our family, everyone goes his/her own way	(1 2 3 4 5)	(1 2 3 4 5)
15	Our family members know each other's close friends	(1 2 3 4 5)	(1 2 3 4 5)
16	Our family members feel very close to each other	(1 2 3 4 5)	(1 2 3 4 5)
17	Discipline is fair in our family	(1 2 3 4 5)	(1 2 3 4 5)
18	Our family members go along with what the family decides to do	(1 2 3 4 5)	(1 2 3 4 5)
19	In our family, everyone shares duties	(1 2 3 4 5)	(1 2 3 4 5)
20	When problems arise in our family, we try to be fair	(1 2 3 4 5)	(1 2 3 4 5)
	"THESE STATEMENTS DESCRIBE ME AND HOW I FEEL…"	**BEFORE**	**NOW**
21	If I have to be violent to protect myself, I will	(1 2 3 4 5)	(1 2 3 4 5)
22	When people are really nice to me, I wonder what they want	(1 2 3 4 5)	(1 2 3 4 5)
23	I have become so mad that I have broken things	(1 2 3 4 5)	(1 2 3 4 5)
24	When people bother me, I may tell them what I think of them	(1 2 3 4 5)	(1 2 3 4 5)
25	At times I feel I have gotten a raw deal out of life	(1 2 3 4 5)	(1 2 3 4 5)
26	I have trouble controlling my temper	(1 2 3 4 5)	(1 2 3 4 5)
27	When I am bothered, other people can tell	(1 2 3 4 5)	(1 2 3 4 5)
28	My friends say that I like to argue	(1 2 3 4 5)	(1 2 3 4 5)
29	I feel good about my abilities	(1 2 3 4 5)	(1 2 3 4 5)
30	I am happy with my looks right now	(1 2 3 4 5)	(1 2 3 4 5)
31	I feel as smart as other people	(1 2 3 4 5)	(1 2 3 4 5)
32	I am worried about what other people think of me.	(1 2 3 4 5)	(1 2 3 4 5)
33	I feel ugly	(1 2 3 4 5)	(1 2 3 4 5)
34	I am worried about looking foolish	(1 2 3 4 5)	(1 2 3 4 5)
35	There is a special person who is around when I need them	(1 2 3 4 5)	(1 2 3 4 5)
36	My family really tries to help me.	(1 2 3 4 5)	(1 2 3 4 5)
37	My friends really try to help me	(1 2 3 4 5)	(1 2 3 4 5)
38	I can count on my friends when things go wrong	(1 2 3 4 5)	(1 2 3 4 5)

39	I can talk about my problems with my family	(1 2 3 4 5)	(1 2 3 4 5)
40	There is a special person in my life who cares about my feelings	(1 2 3 4 5)	(1 2 3 4 5)

41	Strangers can be trusted	(1 2 3 4 5)	(1 2 3 4 5)
42	I know strangers will help me	(1 2 3 4 5)	(1 2 3 4 5)
43	Strangers are not very predictable	(1 2 3 4 5)	(1 2 3 4 5)
44	I know how strangers will act	(1 2 3 4 5)	(1 2 3 4 5)
45	I know that strangers want to help me	(1 2 3 4 5)	(1 2 3 4 5)
46	I am sure that strangers will help me	(1 2 3 4 5)	(1 2 3 4 5)

Instructions: Please circle the number of the statement that best describes your feeling BEFORE and SINCE hurricane Katrina.

1 = Rarely or never 2 = Some or a little of the time 3 = Lots of the time 4 = Almost always

"THESE STATEMENTS DESCRIBE MY FEELINGS…"		**BEFORE**	**Right Now**
47	On the whole, I am satisfied with myself.	(1 2 3 4)	(1 2 3 4)
48	At times, I think I am no good at all.	(1 2 3 4)	(1 2 3 4)
49	I feel that I have a number of good qualities.	(1 2 3 4)	(1 2 3 4)
50	I am able to do things as well as most other people.	(1 2 3 4)	(1 2 3 4)
51	I feel I did not have much to be proud of.	(1 2 3 4)	(1 2 3 4)
52	I certainly feel useless at times.	(1 2 3 4)	(1 2 3 4)
53	I feel that I am a person of worth, at least on an equal plane with others.	(1 2 3 4)	(1 2 3 4)
54	I wish I could have more respect for myself.	(1 2 3 4)	(1 2 3 4)
55	All in all, I am inclined to feel that I am a failure.	(1 2 3 4)	(1 2 3 4)
56	I take a positive attitude toward myself.	(1 2 3 4)	(1 2 3 4)

57	My life is close to ideal.	(1 2 3 4)	(1 2 3 4)
58	The conditions of my life are excellent.	(1 2 3 4)	(1 2 3 4)
59	I am satisfied with my life.	(1 2 3 4)	(1 2 3 4)
60	So far, I have got the important things I want in life.	(1 2 3 4)	(1 2 3 4)
61	If I could live my life over, I would change almost nothing.	(1 2 3 4)	(1 2 3 4)

Instructions: Please circle the number of the statement that best describes your feelings DURING THE PAST WEEK.

1 = Rarely or never 2 = Some or a little of the time 3 = Lots of the time 4 = Almost always
(less than 1 day) (1-2 days) (3-4 days) (5-7 days)

"THESE STATEMENTS DESCRIBE MY FEELINGS IN THE PAST WEEK…"		**PAST WEEK**
62	I was bothered by things that usually don't bother me.	(1 2 3 4)
63	I did not feel like eating, I wasn't very hungry.	(1 2 3 4)
64	I was not able to feel happy, even when my family tried to help me feel better.	(1 2 3 4)
65	I felt like I was just as good as other people my age.	(1 2 3 4)
66	I felt like I could not ay attention to what I was doing.	(1 2 3 4)
67	I felt down and unhappy.	(1 2 3 4)
68	I felt like I was too tired to do things.	(1 2 3 4)
69	I felt like something good was going to happen.	(1 2 3 4)
70	I felt like the things I did before did not work out right.	(1 2 3 4)
71	I felt scared.	(1 2 3 4)
72	I did not sleep as well as I usually sleep.	(1 2 3 4)
73	I was happy.	(1 2 3 4)

74	I was more quite than usual.	(1 2 3 4)
75	I felt lonely, like I did not have any friends.	(1 2 3 4)
76	I felt like people were unfriendly.	(1 2 3 4)
77	I had a good time.	(1 2 3 4)
78	I felt like crying.	(1 2 3 4)
79	I felt sad	(1 2 3 4)
80	I felt like people did not like me	(1 2 3 4)
81	It was hard to get started doing things.	(1 2 3 4)

Instructions: These items consist of opposite characteristics. **Choose ONE letter which describes YOU best**.			
82	Not at all emotional	A.....B.....C.....D.....E	Very emotional
83	Not at all excitable in a major crisis	A.....B.....C.....D.....E	Very excitable in a major crisis
84	Not very active	A.....B.....C.....D.....E	Very active
85	Very rough	A.....B.....C.....D.....E	Very gentle
86	Not at all competitive	A.....B.....C.....D.....E	Very competitive
87	Feelings not easily hurt	A.....B.....C.....D.....E	Feelings easily hurt

Instructions: Please circle the letter that describes your feelings about Katrina DURING THE PAST WEEK.

1 = Rarely or never (no days) **2 = Very little of the time (1-2 days)** **3 = Some of the time (3-4 days)** **4 = Lots of the time (5-6 days)** **5 = Almost always (7 days)**

"DURING THE PAST WEEK, BAD THOUGHTS ABOUT KATRINA HAVE BOTHERED ME…" PAST WEEK

88	Any reminder brought back feelings about it	(1 2 3 4 5)
89	I had trouble staying asleep	(1 2 3 4 5)
90	Other things kept making me think about it	(1 2 3 4 5)
91	I felt irritable and angry	(1 2 3 4 5)
92	I avoided letting myself get upset when I thought about it or was reminded of it	(1 2 3 4 5)
93	I thought about it when I didn't mean to	(1 2 3 4 5)
94	I felt as if it hadn't happened or wasn't real	(1 2 3 4 5)
95	I stayed away from reminders about it	(1 2 3 4 5)
96	Pictures about it popped into my mind	(1 2 3 4 5)
97	I was jumpy and easily startled	(1 2 3 4 5)
98	I tried not to think about it	(1 2 3 4 5)
99	I was aware that I still had a lot of feelings about it, but I didn't deal with them	(1 2 3 4 5)
100	My feelings about it were kind of numb	(1 2 3 4 5)
101	I found myself acting or feeling as though I was back at that time	(1 2 3 4 5)
102	I had trouble falling asleep	(1 2 3 4 5)
103	I had waves of strong feelings about it	(1 2 3 4 5)
104	I tried to remove it from my memory	(1 2 3 4 5)
105	I had trouble concentrating	(1 2 3 4 5)
106	Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart	(1 2 3 4 5)
107	I had dreams about it	(1 2 3 4 5)
108	I felt watchful or on-guard	(1 2 3 4 5)
109	I tried not to talk about it	(1 2 3 4 5)

Instructions: **Circle a "Y" if the statement is CURRENTLY true about you and an "N" if the statement is not true**.							
110	I have trouble making up my mind	Y	N	129	I am always nice to everyone	Y	N

111	I get nervous when things don't go right	Y	N	130	I am tire a lot	Y	N
112	Others seem to do things easier than I can	Y	N	131	I worry about what is going to happen	Y	N
113	I like everyone I know	Y	N	132	Other people are happier than I am	Y	N
114	Often I have trouble getting my breath	Y	N	133	I tell the truth every single time	Y	N
115	I worry a lot of the time	Y	N	134	I have bad dreams	Y	N
116	I am afraid of a lot of things	Y	N	135	My feelings get hurt easily	Y	N
117	I am always kind	Y	N	136	I worry about doing things the wrong way	Y	N
118	I get mad easily	Y	N	137	I never get angry	Y	N
119	I worry about what my family will say to me	Y	N	138	I wake up scared some of the time	Y	N
120	I feel that others do not like the way I do things	Y	N	139	I worry when I get to bed at night	Y	N
121	I always have good manners	Y	N	140	It is hard to stay focused on tasks	Y	N
122	It is hard for me to get to sleep at night	Y	N	141	I never say anything that I shouldn't	Y	N
123	I worry about what other people think of me	Y	N	142	I wriggle in the seat a lot	Y	N
124	I feel alone even when there are people with me	Y	N	143	I am nervous	Y	N
125	I am always good	Y	N	144	A lot of people are against me	Y	N
126	Often I feel sick in the stomach	Y	N	145	I never lie	Y	N
127	My feelings get hurt easily	Y	N	146	I worry about something bad happening	Y	N
128	My feelings get hurt easily	Y	N	147			

Please provide the name and address of a relative who will be able to contact you one year from now.

Name of relative: _____Phone number: _____ Relation (e.g. brother, aunt) _____

Address: _____ City _____ State _____ Zip code _____

Email address of a relative or friend (not the same person as above): _____ Name: _____

Instructions: Circle only one answer for each statement **1 = start crying** **2 = hit, bang or slam a nearby object**			Instructions: Circle only one answer for each statement **3 = come over and give me comfort** **4 = leave me alone for awhile**		
148	When I feel **sad**, I am most likely to:	(1 2)	154	When I feel **sad**, I wish other people would:	(3 4)
149	When I feel **angry**, I am most likely to:	(1 2)	155	When I feel **angry**, I wish other people would:	(3 4)
150	When I feel **frustrated**, I am most likely to:	(1 2)	156	When I feel **frustrated**, I wish other people would:	(3 4)
151	When I feel **embarrassed**, I am most likely to:	(1 2)	157	When I feel **embarrassed**, I wish other people would:	(3 4)
152	When I feel **worried about the future**, I am most likely to:	(1 2)	158	When I feel **worried about the future**, I wish other people would:	(3 4)
153	When I feel **frightened**, I am most likely to:	(1 2)	159	When I feel **frightened**, I wish other people would:	(3 4)
			160	When I am **crying**, I wish other people would:	(3 4)
			161	When I am hitting, **banging, or slamming object**s, I wish other people would:	(3 4)

Thank you for completing the survey!

Make sure every question is answered and remember that there is a front and back to every page.

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Name: _____ Date _____ Age: _____ Sex: _____

Time of first collection: _____ Time of second collection: _____

Time woke up today: _____

Sleep comments:

_____
_____

Daily meals:

_____
_____

Physical aches and pains:

_____
_____

Daily conflicts and social stress (1 to 5; 1= very bad 5= very good):

_____
_____

Description of daily routine (out of the ordinary):

_____
_____
_____

Appendix B

Table 9

Means Scores and Group Differences by Age-Group

	Preadolescents (n = 36)	Adolescents (n = 56)	Adults (n = 39)	F
Self-Image	21.9 (5.0)[a]	23.6 (4.5)[a]	24.5 (4.8)[a]	2.80*
Global Self-Esteem	28.9 (5.2)[a]	31.4 (5.1)[a]	30.1 (5.8)[a]	2.54*
Depression	48.3 (11.2)[a]	44.7 (8.9)[a]	42.9 (11.1)[a]	2.71*
Life-Satisfaction	14.5 (2.9)[a]	14.3 (3.3)[a]	12.3 (3.5)[b]	5.49***
Aggression	25.8 (5.4)[a]	26.6 (5.5)[a]	22.0 (6.0)[b]	8.05***
Anxiety	40.9 (6.0)[a]	42.8 (5.6)[a]	43.0 (6.2)[a]	1.54
Distress	67.0 (17.4)[a]	59.9 (15.6)[ab]	55.0 (18.2)[b]	4.72***
Cortisol	.13 (.07)[a]	.18 (.13)[ab]	.21 (.16)[b]	3.68**
Alpha-Amylase	57.5 (47.1)[a]	53.4 (37.1)[a]	54.9 (47.5)[a]	<1

Note. Raw mean cortisol values are in ug/dL; raw AA levels are in U/mL. Standard deviations are in parentheses. The ranges for the variables were: self-image (9-30), self-esteem (14-40), depression (20-69), life-satisfaction (5-20), aggression (8-39), anxiety (28-56), distress (22-102), cortisol (.03-1.08), AA (.30-217.40). Age differences were assessed with ANOVAs by entering age-group as a predictor for each of the psychological variables and bio-markers. Group differences were measured with Tukey's test of mean differences (p <.05); different superscripts indicate group differences. *p < .10, **p < .05, ***p < .01.

VITA

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