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The repeated activation of physiological stress systems in response to the chronic stress associated with poverty in early childhood signals environmental instability, leading to changes in patterns of physiological response that appear to prepare children for future stress. Consistent with an ecological model, poverty creates environmental instability across children's developmental contexts. Families differ in their psychological distress in response to poverty related stressors. Such differences in response (reflective of parental psychological wellbeing) may intensify or buffer the child's perception of environmental instability. This dissertation study tested the hypothesis that children show distinct profiles of physiological response (Sympathetic Nervous System and Hypothalamic Pituitary Adrenal axis activity) when challenged with a socially evaluative stressor using a sample of 156 children attending a Head Start preschool program. Latent profile analysis results confirmed the existence of 4 distinct profiles: *Multisystem Responder, Low sAA Activity, Heightened sAA Responder,* and *Moderate sAA Responder*. Multinomial regression analyses suggested family level stressors (parenting stress, poverty-related stressors, and their interaction) predicted profile group membership, in addition to caregiver employment status and gender. Results and implications for research and intervention are further discussed.

PATTERNS OF PHYSIOLOGICAL STRESS RESPONSE AND FAMILY CLIMATE

OF STRESS IN CHILDREN ATTENDING HEAD START

by

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CHAPTER I

INTRODUCTION

Growing up in low-income environments is associated with a range of chronic stressors, including reduced access to financially dependent resources, reduced access to social services, increased family instability, exposure to violence, and greater caregiver distress (Burchinal & Willoughby, 2013; Evans & English, 2002; Mcloyd, 1998; Sandstrom & Huerta, 2013). Past research shows exposure to stress in early childhood can have lasting effects on children's psychological development (Duncan, Brooks-Gunn, & Klebanov, 1994; McLoyd, 1998). Head Start programs have been one of the Nation's efforts towards promoting healthy adjustment in children growing up in poverty. These preschool programs provide supportive, high quality learning environments aimed at developing school readiness across social, emotional, and cognitive domains. More recently, the field has emphasized the importance of understanding how adversity "gets under the skin" by looking at the effect of "toxic stress" on the physiology of children attending Head Start and how caregivers influence children's experience of stress. For example, Greenberg of the Administration for Children and Families explained, "when a child experiences strong, frequent, or prolonged adversity without adequate adult support, the prolonged stress can disrupt the development of brain architecture and other organ systems, and increase the risk of disease and cognitive impairment well into the adul years." (Greenberg, 2014) As such, ACF has funded several large-scale projects to further understand this process and key factors (cf., Greenberg, 2014).

Activation of the physiological stress response systems can be adaptive as it prepares children for meeting challenges in their environments; however, as Greenberg (2014) described, children who have faced chronic or extreme levels of stress have shown alterations in these physiological systems, which have been associated with problem behaviors in the preschool environment (Blair, Granger, & Peters Razza, 2005; Brotman et al., 2007; Gunnar, Tout, de Haan, Pierce, & Stansbury, 1997; Hunter, Minnis, & Wilson, 2011; Tout, de Haan, Campbell, & Gunnar, 1998). Theory and research suggest that adversity or stability in early childhood is formative in the development of the physiological response system, leaving lasting effects on the patterns of response to stressors. Thus, a better understanding of the biological processes affected by toxic stress and what types of stress are most influential may help the development of appropriate interventions and the identification of those children who would most benefit from such interventions.

Physiological Stress Response

When a child faces a stressor, the sympathetic nervous system (SNS) and hypothalamic pituitary adrenal (HPA) axis are the main systems orchestrating the body's physiological response. The SNS branch activates the fight or flight response, resulting in the release of epinephrine and small amounts of norepinephrine, which leads to increased heart rate, respiration, blood flow to the muscles, and glucose release and a reduction of vegetative function (Bauer, Quas, & Boyce, 2002; Del Giudice, Ellis, &

Shirtcliff, 2011), all facilitating metabolic activation. Recently, researchers have found that salivary alpha amylase (sAA) is a reliable indicator of SNS activation as it is highly correlated with cardiovascular stress reactivity and basal and reactivity levels of norepinephrine, established indicators of SNS activation (Granger et al., 2006; Obradović, 2012). In contrast to the fast acting rapid response (but rather short-lived) of the SNS, the HPA axis facilitates a rapid but more prolonged response to stress. Through a cascade of events, cortisol is released from the adrenal cortex, causing a mobilization of neural and other physiological resources, and also counter regulates the flight or fight response, facilitating recovery from the SNS activation caused by the acute stressor (Boyce & Ellis, 2005; Del Giudice et al., 2011). Under normal conditions, such physiological reactivity helps an individual adapt to environmental stress. The physiological changes produced by the fight or flight response and the HPA activation in the face of a stressor help a person respond to the stressor and then recover after the stress has passed (Dickerson & Kemeny, 2004; McEwen, 1998).

To assess a physiological stress response, researchers have looked at differences between measures of sAA and cortisol before and after a stressor (El-Sheikh, Erath, Buckhalt, Granger, & Mize, 2008; Lisonbee, Pendry, Mize, & Gwynn, 2010; Spinrad et al., 2009; Taylor et al., 2012). Researchers have utilized a range of stress paradigms in attempt to elicit a physiological stress response from children. Paradigms aiming to elicit an HPA axis response tend to show limited effectiveness in preschool samples. Research consistently shows that stressors that are socially evaluative and unpredictable are most effective in eliciting the HPA axis response (Dickerson & Kemeny, 2004). Using this approach, (de Weerth, Zijlmans, Mack, & Beijers, 2013) developed a socially evaluative paradigm that is developmentally appropriate for 5 and 6 year old children, which they called the Children's Reactions to Evaluation Stress Test (CREST). Their experiment took place in a portable lab, a van, outside of their school to reduce the impact of the stress of coming to the lab. The paradigm consisted of completing a series of tasks in front of a confederate judge who provided negative feedback about the child's performance, lasting 20 minutes. Children were debriefed that the judge's rating was wrong and were then left to color with an experimenter. Children provided 6 saliva samples; upon arrival to the van, 15 minutes into the stress task, at the end of the stress task, 5, 15, 25, and 40 minutes post stress task. This paradigm effectively elicited cortisol responses in two thirds of the sample, which as de Weerth and colleagues (2013) point out, is normal to have a third of the population not respond to stress.

Despite the adaptive nature of activation of the physiological stress response systems, research has shown that long lasting or frequent activation caused by chronic stressors can change or damage the system (Wilson, Hansen, & Li, 2011). The majority of studies examining physiological stress response in preschool aged children have focused on the HPA axis, measuring cortisol; however, in response to recent calls for integrating multiple systems into study and the increased feasibility of assessing SNS activity, researchers are moving to use indicators of both systems in developmental research (Bauer, Quas & Boyce, 2002; Granger et al., 2006).

Adaptive Calibration Model

Literature examining the impact of early life stress on physiology has traditionally assumed a linear relationship exists between stress and physiological dysfunction, such that more stress leads to greater maladaptation. Despite a number of studies in this area, findings in across studies of preschool aged children are equivocal (for review see Hunter et al., 2011). In response to such contradictory findings, researchers have used an evolutionary developmental lens to develop a curvilinear model of physiological reactivity (Boyce & Ellis, 2005; Del Giudice et al., 2011; Obradović, 2012; Thompson, 2014). Specifically, these authors argue that physiological reactivity is best thought of as a phenotype that develops throughout stages in an individual's life. Patterns of physiological activity develop in response to the environment, starting in early childhood, to best equip the individual for their current and anticipated future environment.

Consequently, Boyce and Ellis (2005) and Del Giudice and colleagues (2011) explain that in conditions with high levels of adversity and instability, children tend to develop more reactive physiological stress response patterns to meet the challenges in their environments (vigilant profile). Similarly, in conditions with high levels of support and stability, children also tend to develop more reactive stress response patterns; however, in this context, reactivity enables the child to engage with and benefit from these supportive environments (sensitive profile). In environments with moderate levels of adversity and instability, children tend to develop less reactive stress response patterns because the increased demand on physical resources to maintain heightened reactivity is not worth the gains in such environments (buffered profile). Del Giudice and colleagues

(2011) further predicted that in extreme adversity, children would shift from a responsive pattern to an unresponsive pattern, showing low levels of physiological activity at baseline and in response to stress (unemotional profile). These authors described this theory as the Adaptive Calibration Model (ACM) because individuals physiological stress systems develop, or calibrate, to meet the expected needs of their environment (Del Giudice, 2011).

To our knowledge, only two studies have been published testing the presence of the 4 groups described by the ACM and have shown some support for the model. Del Giudice, Hinnant, Ellis, and El-Sheikh (2012) examined parasympathetic and sympathetic activity in 256 8 – 10 year old children from a wide range of socioeconomic backgrounds. Children participated in a star tracing task while physiological measures were collected and caregivers completed questionnaires about economic and family stress, family warmth, and child adjustment. Results confirmed the presence of the predicted groups, although the vigilant group was the smallest compared to the prediction that the blunted, unemotional profile would capture a small subset of the sample. Furthermore, principal components analysis factor loadings were used to create a family stress factor using harsh parenting, parental conflict, warm parenting, and home chaos, and to create an economic stress factor using economic strain, maternal depression, and alcohol use. The results showed that family stress predicted group membership whereas economic stress did not. Moreover, children who showed high levels of family risk were less likely to be in the buffered group compared to the other groups, whereas economic stress was not a significant predictor of group membership. This failure to find a relation of economic stress to children's behavioral profiles may have been due to the breadth of items included in this measure and the differential psychological experience associated with hardships related to economic strain.

The second study examining the existence of groups theorized by the ACM was conducted by Quas and colleagues (2014). These authors used latent profile analysis to determine the presence of patterns of physiological stress response across development by examining 4 samples. One sample included kindergarten sample of 157 ethnically diverse children, ages 4 – 6, from mostly middle-income backgrounds. The other samples were similar were children mean age 7, 10, and 12. Measures of children's SNS, PNS, and HPA Axis activity were taken to assess baseline and response to a series of tasks including social (questions), cognitive (digit repetition), sensory (tasting), and emotion eliciting (watching videos). Specifically, preejection period (SNS), respiratory sinus arrhythmia (parasympathetic nervous system), and heart rate were collected continuously during the reactivity protocol and neutral activities and salivary cortisol (HPA Axis) was collected before and after the protocol.

Although fit indices were inconsistent, these authors drew on theory and the bootstrap likelihood ratio test to determine that the 6-group solution best described their data for the kindergarten sample of 157 children. These groups included a large group of children (52%) showing moderate levels of baseline SNS, PNS, and HPA Axis correlates, and small increases in response to stressors across systems. This group best reflects the ACM's buffered group and was labeled the moderate reactivity group. Additionally, Quas and colleagues (2014) reported the presence of a group (24%) who showed greater parasympathetic specific reactivity than the other groups and likened this group to the ACM's sensitive group, despite their group showing PNS activation instead of SNS activation (Del Giudice et al., 2012). Several small groups were found, including anticipatory arousal (7%; high baseline levels of all correlates; minimal reactivity), multisystem reactivity (7%; moderate responses across systems), and under-aroused (2%; low baseline and stress reactivity across systems). The multisystem reactivity is suggested to reflect the ACM's vigilant profile, whereas the underaroused profile maps onto the unemotional profile (Del Giudice et al., 2012; Quas et al., 2014).

In terms of factors that predicted group membership, they reported that children in the underaroused group came from lower SES backgrounds and that children in the multisystem reactivity group had higher adversity scores (composite of parental wellbeing, income stress, parenting stress, and marital conflict over time) compared to children in other groups except the underaroused group who was excluded due to missing data. Taken together, these results suggest that over- or under arousal of the stress response systems may be related to adversity in early childhood. Although these studies included children from families with a wide range of incomes, the majority of children did not come from significantly disadvantaged families, which is a notable gap in the literature.

Ecological Model

As articulated by Cicchetti and Lynch (1993), an ecological model is useful for conceptualizing the environmental influence emphasized by the adaptive calibration model. The ecological model explicates the importance of understanding the ecology in which the child is embedded. The largest context, the macrosystem, consists of the broader culture or society, which typically has indirect effects on the individual. The next level, the exosystem, is made up of the community and neighborhood in which a child's family lives. Proximal interactions generally occur at the microsystem level, which consists of the family, religious organizations, schools, etc. Lastly, the ontogenic level includes the individual's attributes, which can include behavior and physiology.

Specifically, an ecological model helps to define the multiple contexts of children's lives that are affected by poverty as an indicator of adversity and instability (Garbarino, 1992). Instability can occur in multiple contexts (family, caregiver's workplace, school, etc.) in various ways (access to financially dependent resources, caregiver employment, access to services in community, etc.), all of which can negatively affect a child's development when experienced as negative or distressing by the family (Sandstrom & Huerta, 2013). Felner (2006) recommends using an ecological framework to understand the nuances of poverty's impact on development, pointing out that two children living in poverty may have very different proximal environments with which they interface daily. He explains, "Many of us know people who have said that they 'were poor as a child, but did not know it. We didn't know it because there was always food, the same house (housing stability), a safe place to play, and clean clothes.' But, for others who have grown up in poverty the developmental contexts were far harsher." (Felner, 2006, p. 127). As Barnett (2008) points out, economic hardship may be an expected part of life for some caregivers. This expectation and/or acceptance of such hardship may reduce the related psychological distress that families' experience. Thus using poverty status as an indicator of adversity or instability alone ignores these complexities.

The effect of poverty may be felt across multiple ecological levels that have an eventual direct or indirect effect on the child (Burchinal & Willoughby, 2013). The government and broader society can make policies that affect how society treats the poor and what services are available. For example, in 1964 the government initiated Head Start, a federally funded program that promotes school readiness in children living in poverty through the provision of high quality preschool centers across the United States, whereas in more recent years, there have been budget cuts for programs supporting the poor (Head Start, Supplemental Nutrition Assistance Program, etc.) (Alison, 2013; Purvis, 2014). Community level poverty is associated with higher levels of crime and violence and fewer community resources, such as high quality medical care, childcare, and schools. At the microlevel, poverty can affect parenting characteristics, stability of caregivers, the quality of the home, etc., and at the individual level lack of food, clothing, or healthcare could affect an individual's physiology and behavior.

Theoretical Design of the Present Study

The present study seeks to utilize both the ecological model and the adaptive calibration model because they are complementary in understanding the complexity of the children's environments and each may be of particular importance when trying to understand how poverty affects children's physiology. An integrated adaptive calibration and ecological framework (ACEF) shows that the child's daily proximal experiences in the microsystem signal the stability or instability of the environment (see Figure 2), thus shaping their physiological stress response pattern. In early childhood, influential contexts include the family environment at the microsystem and the community at the exosystem. As the ecological framework suggests, the family's experience of poverty-related stress at the family and community levels affects the child's perception of instability. More specifically, research that has examined the processes underlying the relation between poverty and child outcomes has identified economic pressure, or the day to day frustrations associated with financial hardship as a key mediator of poverty and parent and child outcomes (Conger, Ge, Elder, Lorenz, & Simons, 1994; Conger et al., 2002). Applying the concept of economic pressure to additional stressors associated with low-income status and explicitly focusing on the psychological distress caused by such stressors may be an important distinction for child outcomes. In a family that experiences poverty-related stress but does not experience psychological distress, a child may be buffered from its effect. In contrast, a child whose family experiences fewer stressors relative to another family, but greater psychological distress may experience instability, which, in turn, may influence their physiological response patterns. These models can serve as a framework from which to study the relation of contextual measures of stress and physiological measures of stress reactivity in children in the context of poverty.

Consistent with these frameworks, this study was designed to better understand how poverty affects children's environments by providing information about stability and adversity, and how this information relates to children's physiological stress systems. Although ecological models have described how poverty affects different levels of the system and the adaptive calibration model has proposed profiles of physiological stress response functioning associated with different levels of ecological instability, research has yet to integrate these models and test hypotheses derived from this integration. This integrated approach helps to determine whether poverty-related stressors themselves or the family perception of psychological distress are most influential to the child's physiological response to stressors. Additionally, this approach integrates factors that could mitigate a child's experience of this stress, namely parenting stress and caregiver depression. Applying this framework to a study of children and families enrolled in Head Start, this project strived to better understand what types of poverty-related stress is most salient to children's physiological stress response profiles. Children in this sample are at heightened risk for exposure to a range of stressors related with low-income status; however, within this sample there is great diversity in both the range of stressful situations and family distress experienced concerning these situations. As Garbarino states, looking at poverty in terms of income alone "blankets a host of subtleties and complexities of what poverty means for children," (Garbarino, 1992, p. 220). Thus, a more nuanced examination of different poverty-related potentially stressful situations, perceived distress, and other family level psychological factors that commonly occur in this population may better isolate factors that affect a child's membership within a particular physiological profile.

Literature Review and Critique of the Study of Physiological Stress Response in Low-income Preschool Children

Previous studies of preschool age children have examined the impact of "adversity" on physiology, finding that some indices are influential (Blair, Raver, Granger, Mills-Koonce, & Hibel, 2011; Cutuli, Wiik, Herbers, Gunnar, & Masten, 2010; Essex, Klein, Cho, & Kalin, 2002; Evans, 2003). For example, in a review of literature that examined cortisol reactivity and measures of adversity during development, in children age 0 to 5 years old, Hunter and colleagues (2011) found that prenatal substance use, low-income status, maternal depression, maternal stress, and family level adversity among other factors were linked to cortisol reactivity to stressful situations in a laboratory. Results showed that 27 of the 30 articles demonstrated a relation between adversity and cortisol activity; however, the nature of the relation varied across studies. Researchers have proposed using indices of cumulative risk related to poverty status in place of individual factors or poverty status alone (Burchinal & Willoughby, 2013), as children living in low-income environments vary greatly on their exposure to different poverty-related stressors (Blair et al., 2011; Mendez & Westerberg, 2012; Santiago, Etter, Wadsworth, & Raviv, 2012). Moreover, research focusing on low-income children shows variability in physiological reactivity (Fernald, Burke, & Gunnar, 2008; Fernald & Gunnar, 2009; Hunter et al., 2011). Perhaps a more nuanced examination of which factors or combination of factors associated with poverty status would better account for the relation between poverty and children's physiological response (Cutuli et al., 2010).

Poverty-related stress. As Cutuli and colleagues (2010) point out (and consistent with an ecological model), poverty is associated with stressors that affect families on multiple levels, which could have unique consequences for physiological stress reactivity. Such stressors include access to resources, exposure to danger, and instability in the family unit. Additionally, psychological factors including the family's psychological distress over poverty-related stressors, parental depression, and parents' psychological stress over parenting could play a role. Although researchers have identified the need to examine both HPA axis and SNS activity (Granger et al., 2006; Obradović & Boyce, 2012), studies examining sAA and cortisol response to a stressor typically examine their relation to behavioral outcomes, rather than examining salient family risk factors (for exceptions see Del Giudice et al., 2012; Quas et al., 2014). Further research is needed to fill the gap by identifying which factors in early childhood are most influential in altering physiological stress across the SNS and HPA axis.

To address the need to examine different types of stressors, Cutuli and colleagues (2010) examined the relation between physical resources, psychosocial stressors, morning cortisol levels, and cortisol reactivity to a cognitive task in a sample of 66 children ages 4-7 who were experiencing homelessness. Indices of socioeconomic risk included demographics such as low parental education, parental unemployment, lack of family income during the last month, unsafe neighborhood, substandard housing, and/or inability to pay rent at last residence. Indices of psychosocial stressful conditions included fighting between caregivers at home, divorce or permanent separation from parents, witnessing violence, having been the victim of violence, having been hospitalized, and living with a parent with a serious mental illness or substance use problem, among others. Results showed that psychosocial stressors were associated with higher cortisol levels, but socioeconomic stressors were not. Children who had experienced more psychosocial stressors showed higher cortisol levels in the morning and decreasing cortisol levels over the course of cognitive tasks, whereas children with fewer psychosocial stressors showed lower basal levels and increasing cortisol over the course of the cognitive tasks. The authors point out that although these families faced adversity, children did not experience abuse or neglect, which may explain why their morning cortisol levels were not lower, which has been found in past studies of children who have been maltreated (Hart, Gunnar, & Cicchetti, 1995). The authors suggest that the decrease in children with higher psychosocial stress may have been a result of their being more likely to experience a stressor before the session, and therefore their levels during testing could have reflected a return to baseline from a previous stressor rather than their response to the cognitive tasks (Cutuli et al., 2010). Although these conclusions are tenuous given their speculative, post hoc nature, this study highlights the importance of analyzing conceptually different types of stressors separately as they relate to physiological stress activity.

Evans (2003) measured cumulative stress in a sample of 339 preschool and elementary school aged children at one time point. Stressors that contributed to the cumulative stress score included crowding, noise, housing problems, family separation, family turmoil, violence, income to needs ratio, having a single parent, and maternal high school dropout. Examining the relation between cumulative stress scores and overnight urinary neuroendocrine measures of epinephrine, norepinephrine, and cortisol, showed that higher levels of cumulative stress were associated with heightened levels of baseline norepinephrine, epinephrine, and cortisol. Evans (2003) interpreted these elevations as being indicative of allostatic load, caused by exposure to chronic stressors, making the physiological stress system more sensitive to future malfunction; however, with only one measure of each correlate, it is hard to interpret what these heightened levels represent in terms of physiological stress response activity. Additionally, the use of a stress index masks the identification of specific factors that are most influential.

In contrast, Blair and colleagues (2011) examined the individual effect of a range of poverty-related stressors that are thought to affect stress physiology, including chronic poverty, economic need, economic sufficiency, housing quality, number of adult exits and entrances, maternal education, positive parenting, and negative parenting. Results of this longitudinal study showed evidence for associations between chronic poverty and living in lower quality housing with elevations in cortisol levels from the first year of life through age 4 year. Additionally, economic insufficiency and changes in the number of adults in the home had differential effects on cortisol levels depending on timing. Adult exits seemed to have an increasing effect from infancy to age four, such that the positive relation between adult exits and basal cortisol increased in strength over time, whereas economic insufficiency had a decreasing impact from infancy to age 4, such that insufficiency in infancy was associated with higher levels of basal cortisol in infancy, but was not related to basal cortisol by age 4. Blair and colleagues (2011) explained that this reduced effect might be related to the fact that economic insufficiency is most distressing and disruptive to parenting in the early years of life. These authors also found that African American ethnicity and receiving lower levels of positive parenting was associated with elevations in cortisol levels. Similar to Evans' (2003) findings, these results do not clarify questions about physiological reactivity because they only used one cortisol sample. Additionally, although some of their categories, such as adult exits and entrances from the home, were very specific, others were somewhat broad, such as economic insufficiency.

Taken together, research suggests that stressors related to living in poverty are related to HPA axis functioning; however, which types of stressors are most influential and how the system is affected is still uncertain. Although Cutuli and colleagues (2011) examined conceptually related stressors (socioeconomic and psychosocial), an examination of factors related to danger/safety concerns (exposure to violence in the home and neighborhood) compared to family stability (change in caregivers, living in foster care, parent illness, etc.) could help further identify those factors that are most impactful. Stressors that threaten a child's immediate safety are likely experienced as more distressing compared to perhaps longer lasting, less severe stressors, like paying bills. Past research of psychological outcomes shows that exposure to violence and conflict accounts for the relation between sociodemographic risk factors and symptoms of PTSD (Enlow, Blood, & Egeland, 2013). An extension of this research to stress physiology is needed. Furthermore, with the exception of Quas and colleagues (2014), no studies examined sAA and cortisol response to a stressor and sociodemographic risk in preschool samples.

Primary caregiver psychological distress. As an important component of a child's microsystem, literature has also examined the role of primary caregiver psychological distress in children's physiological response to stress in low-income samples. Such psychological distress can include caregiver depression and stress associated with parenting. According to the adaptive calibration model, less stable environments in early childhood are thought to lead to increased physiological reactivity. Specifically, parental depression has been found to interfere with a caregiver's ability to care for a child, as it is associated with less responsive, warm parenting and more inconsistent, negative parenting (Mistry, Vandewater, Huston, & McLoyd, 2002; Shea & Coyne, 2011). Parental depression is also a specific concern for low income families, with estimated rates of depression among mothers ranging from 5-25%, whereas the rates are markedly higher among low-income mothers, ranging from 40-60% (Kahn et al., 1999; Laforett & Mendez, 2012).

Fernald and colleagues (2008) looked at the impact of maternal depression on children's cortisol levels in a sample of families living in extreme poverty in urban Mexico. The sample of 639 children, age 2.5-6, provided cortisol upon researchers' arrival to the home (baseline), 25 minutes later to assess the response to the stranger's arrival, and 50 minutes later to assess the response to cognitive tasks. Maternal depression, measured by the CES-D, was associated with lower baseline levels of cortisol. Gender moderated this finding such that girls whose mother's showed the highest levels of depression had significantly lower baseline levels of cortisol than all other children. Additionally, these girls showed rising cortisol across the three samples, whereas girls whose mothers had moderate to low levels of depression showed a very slight, nonsignificant increase followed by a decrease back to baseline after the cognitive tasks. In contrast, boys showed no changes in cortisol across tasks. It could be that daughters rely more on their mothers for support or provide more support for their depressed mothers. Therefore, during these challenge tasks, the presence of a non-depressed mother at home may have provided support, whereas the presence of a depressed mother may not have been supportive, or may have been even more stressful. Furthermore, the authors point out that this sample of children showed overall lower levels of cortisol compared to middle class European American preschoolers in the United States (Gunnar & Donzella, 2002). Although this study found support for the relation between maternal depression and cortisol levels for girls, it did not examine other possible factors that could create stress in children's lives.

In a similar study, Fernald and Gunnar (2009) conducted a quasi-experimental study looking at SES and child cortisol in a sample of Mexican families living in extreme poverty in rural areas. The sample consisted of 554 children, age 2-6, in a large scale conditional cash transfer program and 762 children from similar demographic background, but not enrolled in the program. The intervention group families also had more people in the home, lower housing quality, fewer assets, and were more likely to come from indigenous backgrounds. This program presented the opportunity to investigate how poverty affects cortisol activity by looking at families who participated in the intervention (increased income) for at least 3 years and those who maintained extreme poverty status, although this group was not a true control to the intervention. Cortisol was collected in the same manner as Fernald and colleagues (2008). Analyses showed that, using awakening time as a covariate, children in the intervention (increased income) group showed lower baseline and recovery levels of cortisol than children in the control group, but similar reactivity levels. Furthermore, children in the intervention whose mothers reported high levels of depression showed significantly lower basal cortisol levels compared to children in the control group and children whose mothers reported low levels of depression. The authors suggest that children with depressed mothers are more easily influenced by their environment, supporting the idea that depression may disrupt a mother's ability to provide responsive care to buffer the child from other stressors experienced in low income environments. Therefore, when poverty was reduced, the need for the mother to buffer the child from poverty-related stressors was lessened, making the depressed mother's role less influential, though the authors do not explain this process further. Additionally, depression was only measured at one time point meaning a change in depression level over the course of the intervention may have related to the cortisol levels.

In contrast to Fernald and colleagues (2008) findings, the lower levels of cortisol in this study were interpreted as adaptive because they were accompanied with an adaptive response (increase in cortisol) to a stressor, whereas in the previous study, only girls with mother's who showed extremely high levels of depression showed increases in cortisol in response to the stressor, but these latter girls did not show a recovery in cortisol levels. Although these studies found some evidence for differences in gender, few studies have explicitly examined the role of gender and physiological reactivity.

Further investigation is needed to inform questions about the role of gender. Taken together, results from Fernald and Gunnar (2009) and Fernald and colleagues (2008) suggest that in samples of Mexican families living in extreme poverty, maternal depression may interact with low-income status to impact children's cortisol activity.

Essex and colleagues (2002) also found that maternal depression partially accounted for the relation between maternal stress and preschooler's cortisol levels, in a sample of 282 two-parent families. When children were infants and at 4.5 years old, mothers provided information about five areas of stress, including maternal depression symptoms, family expressed anger, maternal parenting stress, maternal role overload, and financial stress, which yielded a composite stress score. At age 4.5 children's cortisol was sampled at a standardized time in the afternoon over the course of three days at home. Results showed that entering time of day, use of medication, and gender as covariates, concurrent maternal stress was associated with higher basal cortisol level for target children and their siblings. Further analysis showed that this was only true for those children who experienced higher levels of maternal stress in infancy. Additionally, maternal depression was the only specific stressor of the five areas of stress that independently contributed to this relation. Additionally, further analyses showed that SES had a main effect on cortisol, even when controlling for maternal stress measures, such that children in the lower SES group (median income = $35-48,000; average parental education = vocational training) had significantly higher cortisol levels than children in the higher SES group (median income = $70-81,000; average parental education = more than college degree). Although there is variability in this sample, the low SES group was still well above the federal poverty line. Taken together, this study shows the independent association between chronic symptoms of maternal depression and median SES (compared to higher SES) and higher levels of afternoon basal cortisol. However, because this study only sampled cortisol at one time point, it is hard to determine what this means for overall daily patterns. Past research of children experiencing stress has found evidence for lower morning levels and flatter diurnal patterns (Fisher, Stoolmiller, Gunnar, & Burraston, 2007). Although the afternoon level is heightened, this could reflect a flatter decline, rather than increased overall cortisol activity.

In addition to looking at the impact of depression and SES, research has looked at the impact of parental depression in conjunction with parenting characteristics in relation to physiological stress system activity. Dougherty, Klein, Rose, and Laptook (2011) examined parental report of depression, laboratory observed parental hostility during a teaching task, and child cortisol levels in a sample of 160 preschool age children and their parents from mostly middle class Caucasian families. Children's cortisol was sampled 20 minutes after adaptation to the laboratory, 30 minutes after a separation stressor, 30 minutes after a frustration-inducing task, and 20 minutes after another frustration-inducing task. Results showed that children did not show a significant increase in cortisol levels to the putative stressor suggesting the task was not stressful and/or the timing to the sample may not have captured the peak level of cortisol in response to a stressor given that there was sufficient time for children's cortisol levels to partially recover after each individual task. Regardless, children whose parents had experienced depression during the child's life and demonstrated high levels of hostility showed higher and increasing levels of cortisol across the testing session, suggesting that having a parent with higher levels of depression and hostility impacts children's HPA axis functioning.

Parenting stress is another type of psychological distress that could provide children with information about the stability of their environment, in turn, affecting the development of their physiological stress response systems. Caregivers who experience parenting stress, defined as "the difficulty that arises from the demands of being a parent," (Hughes & Hughes, 2002), tend to show less supportive, consistent parenting practices (for review see Deater-Deckard, 1998). Research has also found a consistent link between caregiver depression and parenting stress, although the relation between income and parenting stress is less clear (Caley, 2012; Deater-Deckard, 1998; Hughes & Hughes, 2002; Williford, Calkins, & Keane, 2007). Moreover, depression and parenting stress likely create an environment in which the child is exposed to unpredictable negative affect from the caregiver. Such unpredictable and social stress is most likely to evoke HPA axis reactivity (Dickerson & Kemeny, 2004). As such, research has consistently shown that maternal depression specifically affects children's physiological stress reactivity; however, there is limited evidence for the relation between physiological stress reactivity and parenting stress (Essex et al., 2002).

Although parental depression and stress related to parenting are risk factors for children in themselves, this risk may be intensified for children growing up in low-income environments. In the context of poverty, caregivers likely experience increased distress in response to poverty-related stressors. The burden on caregivers' psychological resources could interfere with their ability to provide a stable, supportive family environment for their children. Caregivers' response to poverty-related stressors, as the heads of the household, may determine the resulting family climate of distress, which is assessed less frequently in the physiological literature. Research shows that including measures of material hardship and the caregiver stress associated with such hardship contributes significantly to the negative relation between poverty and child outcomes (Gershoff, Aber, & Lennon, 2007; Mistry et al., 2002). With regard to the impact on children's physiological stress response systems, it could be the family climate of distress itself is what signals instability to a child, thus altering their systems, rather than a specific stressor.

In summary, research has found evidence for the relation caregiver psychological distress, namely caregiver depression, and children's physiological activity in preschool aged children. Similar to research examining poverty-related stressors, the nature of this relation is somewhat inconsistent, with some studies suggesting that preschoolers with depressed caregivers show lower baseline levels or cortisol, with a greater response to a stressor (Fernald & Gunnar, 2008), higher baseline levels of cortisol (Essex et al., 2002), and greater activity in response to an acute stressors (Dougherty et al., 2011). Furthermore, none of these studies examined sAA as a correlate of SNS functioning. These inconsistent findings may be related in part to methodological issues as discussed below.

Methodological Considerations for the Present Research

One shortcoming of past studies assessing physiological stress reactivity is a lack of theoretical model to guide hypotheses and interpretation of results. Without a theoretical model that considers multiple systems of physiological stress response and its dynamic nature, most previous research has relied on measures from one system (HPA axis), using one correlate measured at one or two time points. These methods prevent the examination of patterns of response across multiple systems of physiological stress response and create uncertainty over the meaning of different levels of biological correlates. Using multiple measures from multiple stress systems may provide a better understanding of how physiological reactivity of multiple systems relate to preschoolers' behavior both independently and interactively. It could be that multiple profiles are associated with negative outcomes and that the same profiles can lead to multiple maladaptive outcomes. Additionally, studies assessing physiological reactivity have used a range of stress-inducing paradigms and have interpreted findings with regard to reactivity even when the paradigm has not elicited a cortisol response, which can make the interpretation of varying levels of physiological response tenuous because they do not clearly represent physiological activation (Gunnar, Talge, & Herrera, 2009).

Moreover, numerous studies examining different stressors have used cumulative stress indices rather than examining which specific markers of stress are related to stress physiology (for exception see Blair et al., 2011; Cutuli et al., 2010). In order to determine what factors are most influential, comparing the effect of different types of poverty related stressors is needed. As Felner (2006) explained, families experience poverty very differently. Some may express great distress over poverty-related stressors, whereas others may express little to no distress. Thus, capturing not only the mere presence of a marker of stress, but also the child's exposure to psychological expression of distress in response to the marker of a stressor is needed. It may be that the psychological distress is the key factor in signaling instability to a child, rather than the lack of resource, change in household composition, or exposure to violence. Studies examining the family stress model have similarly examined economic pressure instead of mere financial hardship (Barnett, 2008; Conger et al., 2002, 1994), but no studies have used this approach in examining physiological stress response in preschool children.

The research that has been conducted with preschool aged children examining risk factors and physiological stress response has primarily consisted of children from economically advantaged backgrounds, with several exceptions (Blair et al., 2011; Cutuli et al., 2010; Evans, 2003; Fernald et al., 2008; Fernald & Gunnar, 2009). As outlined by the adaptive calibration model, children experiencing significant levels of poverty are at greater risk for receiving signals of an unstable environment, thus shaping their physiological stress response patterns (Del Giudice et al., 2011). Researching physiological stress response and poverty-related stress in samples of children from low-income backgrounds alone may better capture children from a range of profiles of physiological response. Children attending Head Start and their families would be ideal for such research, given the fact that families participating in this program are below the federal poverty line. Although all families experience poverty, they also vary greatly in the number and type of poverty related stressors experienced, their expression of distress in response to such stressors, and they can exhibit great resilience (Lamb-Parker, LeBuffe, Powell, & Halpern, 2008; Mendez & Westerberg, 2012). Additionally, the preschool age of Head Start children is ideal to examine how family level factors may have already shaped their physiological stress response systems. Thus, this sample would enable the examination of what poverty related stressors are most closely related to physiological stress response as well as factors that may buffer children from the effect of poverty-related stress.

Summary

Taken together, the integrated ACEF argues that instability in the environment early on, across multiple contexts, affects the development of children's patterns of physiological stress response. A review of the literature found a range of markers of stress that signal such instability and relate to children's physiological stress response systems, including poverty-related stressors and parental depression. However, few studies carefully assessed what poverty-related stressors are most influential and how different types of stressors affect physiological responses.

Drawing on the ACEF helps to conceptualize different types of poverty related stressors across children's contexts that have been examined by past research (Blair et al., 2011; Cutuli et al., 2010). At the exosystem level, poverty is associated with increased safety concerns (witnessing violence, household safety, and neighborhood safety) (Ceballo, Dahl, Aretakis, & Ramirez, 2001). Some poverty-related stressors occur in the family, at the microsystem level, influencing the child's daily experiences directly. These factors include financial/resource limitations (income, difficulty paying bills, difficulty buying food, limited access to medical care, etc.) and family unit instability (changes in household composition, arguing among parents, deaths in the family, and moves) (Blair et al., 2011; Conger et al., 2002; Cutuli et al., 2010; Mistry et al., 2002). Factors both at the neighborhood or community level and family level can lead to increased family psychological distress. As the ACM explicates, exposure to violence and signals about danger in the environment shapes children's physiological stress response. Although stressors related to limited resources and family stability signal stress and instability to a child, these signals may not be as strong as those related to exposure to acute threatening conditions.

Moreover, this distress may be especially burdensome for a parent with high levels of depression or parenting stress, important markers of stress in a child's life. For an already depressed or stressed caregiver, the psychological distress over a lack of resources, family instability, or danger could interact with their psychopathology, having a synergistic effect. Using the ACEF, this study aimed to examine the differential influence of poverty-related stressors (family instability, limited resources, and safety concerns), psychological distress in response to poverty-related stressors, and caregiver psychological distress (depression and parenting stress) on children's physiological response to an unpredictable, socially evaluative stressor in the preschool environment.

The Present Study

This study strives to address several shortcomings in the literature examining the effects of stress in early childhood, its impact on physiological stress response, and children's adjustment in a sample of preschool children attending Head Start. First, this study was theoretically grounded, using an integrated adaptive calibration and ecological framework to describe how stress in early childhood impacts stress physiology, and in turn how it relates to behavior. This study also used more precise definitions of poverty-related stressors and assessed the perception of family distress to better understand how low-income status affects children. Given the compelling evidence showing the negative impact of caregiver depression on child outcomes, this study also accounted for the role of parent psychopathology as a marker of stress. Reviewing the literature across children and adults, Gunnar, Talge, and Herrera (2009) and Dickerson and Kemeny (2004) concluded that stress paradigms that are socially evaluative, unpredictable are most effective in producing a cortisol response. Following these guideline, De Weerth, Zijlmans, Mack, and Beijers, (2013) developed and validated a developmentally appropriate protocol for preschool aged children, that was adapted for the present study. A strength of this study is the measurement of both SNS and HPA axis at three time points to assess for basal activity, reactivity, and recovery in response to a stress paradigm. Using these three time points allowed for the construction of profiles of physiological reactivity. Lastly, drawing on a Head Start sample allowed for examination of these processes at an important time point when children may begin to show differences in physiological stress response as a consequence of their environment stability. Additionally, Head Start families all experience poverty, while simultaneously varying greatly in their experience and expression of associated stressors and distress.

Based on past research and theory this study aimed to address previously discussed weaknesses of past research in order to examine the influence of the poverty-related stressors, caregiver psychological distress, and family distress in response to poverty-related stressors on children's patterns of physiological stress response. The present study addressed the following questions:

1) What poverty-related markers of stress are Head Start families exposed to and which of these are perceived as distressful by the family? It was hypothesized that Head Start families would identify multiple markers of stress, given their low-income status; however, there would be a diverse range in type and number of markers of stress and also in the psychological distress associated with each marker. It was also hypothesized that markers of stress related to limited resources would be most common; however, would not always be perceived as distressing to the family. In contrast, markers of stress related to safety concerns would be least common; however, more consistently experienced as distressing.

2) How do children's sAA and cortisol levels change over the course a socially evaluative stress-inducing paradigm? Given the ACEF model and the fact that children attending Head Start generally experience more poverty-related markers of stress than children in the general population, it is expected that there would be four types of physiological responses to the stress inducing paradigm: 1) children who show increases in sAA and cortisol in response to the stressor paradigm, followed by a return to pre-task levels after a recovery period (buffered or moderate reactivity); 2) children who show greater increases in sAA and cortisol in response to the stressor with smaller decreases after a short recovery (reactive); 3) children who do not find the task to be stressful and thus show moderate levels of pre-task and no increase in sAA or cortisol; and 4) a few children who show very low levels of sAA and cortisol at all time points (blunted), similar to the under-aroused group found by Quas and colleagues (2014). In contrast to those children who did not find the paradigm stressful, it was expected that these children to have significantly lower sAA and cortisol levels before and after the stress paradigm.

3) Are children's physiological profiles predicted by a family climate of stress? It was expected that children whose families experience high levels of distress over limited resource stressors, family unit instability, and safety concerns, as well as high levels of parenting stress would be more likely to be placed in the reactive profile. It was also hypothesized that children whose families experience poverty-related stressors, but did not experience distress over these items would more likely fall in the buffered group. Finally, given that stressors related to safety were expected to bring about the highest levels of psychological distress, it was hypothesized that this subarea would be more strongly related to group membership compared to other subareas.

4) Do caregiver depression, parenting stress, and family distress interact in their relation to physiological profile membership? It was hypothesized that family psychological distress in response to poverty-related stressors would interact with caregiver depression and parenting stress, such that there would be a multiplicative rather than additive effect in predicting group membership. At the moderate to high levels of all three variables, it was expected that children would fall in the unemotional group, whereas children with moderate to high levels of one or two of these variables would be more likely to be in the reactive group. Children with low to moderate levels of one or more of these variables would be more likely to fall in the buffered group. There was not good evidence to suggest that elevations on one variable would be more influential than others given that few studies have compared these variables.

CHAPTER II

METHOD

Participants

Child demographics. Participants were 156 children (56.4% female, M_{age} = 57.21 mos., SD = 4.42) and their caregivers, recruited from 25 3- and 4-year old preschool classrooms at 8 Head Start Centers in a suburban county in the Southeastern United States. The majority of children (70.2%) were participating in their first year of Head Start, but of those children, 46.8% had participated in preschool and/or daycare prior to Head Start for an average of 1.95 years. Children who had participated in Head Start before this year had participated for an average of 2.14 years. Children were ethnically diverse with the majority being African American (60.8%). The other children represented in this study were Latino (18.9%), African (8.8%), biracial (5.4%), Asian (2.7%), European American (2.7%), and Native American (.7%), with a small percentage of these children born in Africa and Asia (5.1%). Twenty-nine percent of children were reported by caregivers to have taken medication within the last two weeks. The type of medication included asthma (37.1%), cold medicine (25.7%), allergy medicine (11.4%), antibiotics (5.8%), stimulant medication (2.9%), and 17.1% of caregivers endorsed their children taking a medication did not report the type.

Primary caregiver demographics. The majority of caregivers (68%) were born in the United States, whereas 31.6% were born in another country. Of those caregivers born in another country, 42.9% were born in Mexico, 28.6% were born in Africa, 11.9% in Asia, 4.8% in the Caribbean, 4.8% in Central America, 4.8% in South America, and 2.4% in Europe. The majority of caregivers were biological mothers (91%), 6% were biological fathers, 3% were grandmothers, and 1% were foster mothers. Only 3.6% of caregivers reported that someone else had been the primary caregiver for their children for a period of time due to family member illness, parental separation, and interparental violence; however, parents were unsure of the duration of this change. Caregivers marital status was 61.9% single, 27.6% married, 9.7% separated or divorced, and .7% widowed. In terms of education completed, the majority of caregivers reported earning at least a high school degree (23.8% high school diplomas/GED, 23.8% some college, 3.8% vocational training, 11.5% college degree, and 2.3% graduate degree), whereas 3.8% and 30.8% reported completing some middle school or some high school respectively. Caregivers reported being unemployed or looking for work (47%), being employed full time (22%), part-time (17.4%), not working outside the home (11.4%), and being on disability (2.3%). Families consisted of on average 1.68 (SD = .75) adults and 2.68 (SD = 1.38) children. Mean monthly family income was $985.99 and mean monthly income per capita was $288.71, which is 40.5% below than the 2012 federal poverty threshold ($23,283 for a family of four) and 86% below the 2013 mean income per capita for North Carolina ($2107) (National Center for Children in Poverty, 2014; US Census Bureau, 2015).

Procedure

Data were collected from October through January over two years (2012-2014). Each year teachers were recruited to participate in the study through announcements at teacher trainings and by center directors. Because of snow days and changes in the staff at one center causing it to withdraw from the study, additional data from 14 children were collected in March 2014 from two classrooms recruited by center directors. Teacher participants signed informed consent forms and sent home consent forms to their students' parent or guardian (caregiver). Children whose caregivers returned completed consent forms in participating centers were taken from their classroom one at a time to complete a socially evaluative stress paradigm and provided four saliva samples, one prior to and three following the stressor. Caregivers were called to complete measures by phone or were interviewed in person depending on their preference. After multiple attempts at contacting caregivers, interview packets were sent home with children via their teacher and returned by the caregiver via mail. Children received two small toys for their participation in the stress task and caregivers were mailed a $10 gift card for completing the interview.

Child participants completed the stress paradigm in a private location at their Head Start centers between the hours of 9:30am-12:00pm. This time was chosen to standardize data collection across all children to reduce the potential influence of the normal decrease in cortisol levels over the course of the day; however, awakening time was not measured, which could have impacted the pre-task measure of cortisol (Bäumler, Kirschbaum, Kliegel, Alexander, & Stalder, 2013). This morning window of time also avoided interference with Head Start's scheduled meals. When the research team arrived at the centers, teachers were asked what time child participants finished eating and brushing their teeth, and to have the child drink a half glass of water. The experimenter returned at least 30 minutes after the child ate, drank, and/or brushed his/her teeth. Before retrieving the child, the experimenter asked a teacher if the morning had been typical for the child. When teachers reported that the morning had not been typical, the experimenter would work with the child on a different day when the morning was reported to be typical when possible.

The paradigm lasted approximately 60 minutes and consisted of two parts; the stress tasks and recovery. The supplies needed for the stress paradigm and saliva collection were portable and easily set-up allowing flexibility in where the visit could take place. Centers provided a quiet room or isolated section of the building for the research team, depending on availability. All members of the research team were trained in administering the paradigm through videos and live practice to ensure standardized procedures. Members of the research team were also trained in collecting saliva following standard procedures.

The stress paradigm consisted of three stress tasks intended to elicit a cortisol response from children, which was adapted from the CREST paradigm, developed and validated by de Weerth and colleagues (2012) for 5 and 6 year old children. A designated researcher met the child at his/her classroom, brought him or her to the testing location, and collected a pre-task saliva sample. The researcher then told the child to select one of three prizes (1 desirable, 2 undesirable) to earn as a reward for doing well on the activities and introduced a confederate judge who would be evaluating the child's performance. The child was told the judge would decide if his or her performance is good enough to earn the selected prize. Throughout the tasks the judge provided feedback that the child made errors (regardless of actual errors). After the tasks were completed, the judge told the child she was leaving for five minutes to decide if the child earned the prize. The child waited in the testing room with the experimenter, doing a relaxing activity (i.e. coloring, playing with Play Doh®). When the judge returned, the child was told that his or her performance was great and that she or he earned the most desired prize, ending the stress period. The child was then debriefed on the tasks and stayed in the room with the experimenter, coloring or playing with clay to allow time for physiological recovery. The child's saliva was sampled three time points: 5, 20, and 40 minutes post stressor (when the judge announced the child earned the prize). After the last sample, the child chose an additional toy and was escorted back to the classroom. This paradigm was completed with 7 participants ages 4-5 in a lab based pilot study conducted by Westerberg and Mendez. In this pilot, participants were able to complete all tasks and 66% showed a cortisol response (sAA was not assayed in the pilot); however, they were not distressed after the debriefing or bothered by saliva collection procedures. During this pilot, parents completed measures and did not find any questions to be confusing or inappropriate.

Measures

Salivary cortisol and alpha amylase. Children's saliva was collected at four time points during the paradigm to capture their pattern of physiological activity in response to the stressor across two systems, the SNS and HPA Axis. Saliva was collected at pre-task, 5, 20, and 40 minutes post the stress paradigm by project staff trained in saliva collection. Samples from the pre-task, 5 minute post, and 20 minute post stressor were assayed for sAA and samples from the pre-task, 20 minute post, and 40 minute post samples were assayed for cortisol. These times were chosen based on the normal response curves of sAA and cortisol in response to an acute stressor to capture the basal, reactivity, and recovery measures of sAA and cortisol (de Weerth et al., 2013; Dickerson & Kemeny, 2004; Gordis, Granger, Susman, & Trickett, 2008; Granger et al., 2006). Immediately after collection, saliva was stored in labeled tubes in a cooler. Within two hours of collection, saliva was transported from the cooler into a freezer, where it was kept frozen until shipment. After data collection was completed each year, samples were transported on dry ice, using overnight shipping. In year 1, deidentified samples were sent to and assayed by the Center for Interdisciplinary Salivary Bioscience Research in Baltimore, MD. In year 2, this lab moved from Baltimore to Scottsdale, AZ and was renamed the Institute for Interdisciplinary Salivary Bioscience Research. These labs were run by the same director, utilized the same equipment, and followed the same standardized procedures for sAA and cortisol assay. Controls were run on each type of assay to check validity and proficiency testing samples were also run between the two labs. Each year the lab disposed of saliva samples after assays were complete. The university IRB approved all procedures related to handling, storing, and disposing of biological specimens. Data was returned to the study staff in a deidentified state.

Demographics. See Appendix A for copy of measure. Parents completed a demographic survey regarding their relationship to the student attending Head Start, their ethnicity, marital status, employment status, education level, number of adults and children in the household, income, and social support. Income per capita was calculated by dividing monthly reported income by the number of people supported by this income. Given its potential effects on sAA and cortisol levels (Granger, Hibel, Fortunato, & Kapelewski, 2009; Kosoglou et al., 2013; L.-J. Wang, Wu, Lee, & Tsai, 2014), caregivers were also asked if there child had taken any medication and if so, what kind, in the past two weeks, to capture the period of time during which the child participated in the paradigm.

Poverty-related stress inventory. See Appendix B for copy of measure. This measure asked caregivers to endorse the presence or absence of physical and psychosocial stressors faced by their families including family unit instability (changes in the number of adults/children, family moves, death of family member, etc.), limited resources (difficulty paying bills, buying food, access to medical care, etc.), and safety concerns (witnessing violence, dangerous household, dangerous neighborhood), as well as space for parents to add additional stressors not listed. If a caregiver responded, "yes" to an item, he or she was then asked to rate how distressing this experience was for their family using a 4-point scale (1 = not stressful to 4 = very stressful). Parents reported on stressors and family distress for the past year. This score yielded three total scores (*Total Poverty-Related Stressors* score, found by summing the number of stressors endorsed, a *Family Distress* score, found by summing the scores for perception of stress for all stress items, and an *Family Distress Index* score found by dividing the *Total Family Distress* score by the *Total Poverty-Related Stressors* score.

Because the *Family Distress* scale aimed to capture the amount of distress experienced by the family, caregivers who did not endorse exposure to a particular marker of stress were given a score of zero for distress because by not being exposed to this marker, they presumably did not experience any associated distress. The *Family Distress Index* score differentiates the amount of distress experienced from the family's tendency towards responding to a stressor with distress and can be conceptualized as a characteristic of the family's coping with contextual challenges. Additionally, subscales reflecting the types of poverty-related stress assessed, including *Family Instability*, *Limited Resources*, and *Safety Concerns*, were found by summing the items in each category, as well as their respective *Total* and *Family Distress Index* scores, computed the same way as the total scales. Reliability statistics were

Caregiver depressive symptoms. Current parental depression was assessed using the Center for Epidemiological Studies—Depression Scale (CES-D; (Radloff, 1977). This 20-item scale asks respondents how often the parent has experienced symptoms of depression during the past week ("could not shake off the blues," "bothered by things that don't usually bother you," "Didn't feel like eating"). Higher scores indicate higher levels of depressive symptoms, with scores at or greater than 16 suggesting clinical levels. This scale has been validated and used with low-income minority populations, finding the measure had 95% sensitivity and 70% specificity to identify those diagnosed with depression through clinical interview and good internal consistency (α = .80) (Laforett &

Mendez, 2012; Thomas & Brantley, 2004). Reliability for the present sample was also good (α = .84)

Parenting stress. The Parenting Stress Index - Short Form (PSI-SF) (Abidin, 1995) is a 36-item questionnaire that is completed by the parent, designed to measure parenting stress. The measure yields three subscale scores: Parental Distress, Parent–Child Dysfunctional Interaction and Difficult Child, and one total scale score, Overall Parenting Stress. Parents respond to items using a five point likert scale (strongly agree to strongly disagree). Twelve items load onto each of these subscales, and all items are summed to yield a total scale. The Parental Distress subscale measures perception of parenting competence, conflict with a spouse, social support, and limitations related to having a child. The Difficult Child subscale measures the parent's perception of child characteristics, including demandingness, negative temperament, and noncompliance. Lastly, the Parent–Child Dysfunctional Interaction subscale measures the parent's positive feelings from interacting with the child and the parent's perception of the child meeting their expectations. Evidence to support the validity of the Total Stress score and individual subscales has been found in previous studies with Head Start families (Reitman, Currier, & Stickle, 2002; Whiteside-Mansell, Ayoub, Mckelvey, Faldowski, & Hart, 2007). Results from the present sample showed good reliability across scales (α = .79 - .90). The Total Stress score was selected for use in the present study (referred to as "Parenting Stress") to capture the overall stress the caregiver experiences related to the role of being a caregiver, rather than examining the specific influence of the child or relationship with the child.

Behavior Coding

To provide external validity for profiles of physiological response interval coding was used to capture children's positive, negative, and frustrated affect during the stress tasks (Camras et al., 2007; L. L. Cohen, Bernard, McClelland, & MacLaren, 2005; Osborne, 2013). Past research has shown that behavior during stress paradigms is related to children's experience of stress (Lisonbee, Pendry, Mize, & Gwynn, 2010; Spinrad et al., 2009). The experimenter and judge coded children's behavior in-person at 3 intervals during each stress task in person by (9 total intervals) for positive affect (smiling, positive tone, etc.), anxiety/sadness (turned down mouth, slumping of body or head, negative tone, etc.), and frustration (furrowed brow, annoyed, frustrated tone, throwing things, etc.) (See Appendix C for coding record). Behaviors seen in each area were summed and converted to z-scores to create 3 scores of relative affect (positive, negative, and frustrated). Raters completed intensive behavior coding training using tapes from the pilot study data and simulations to establish reliability. Because of the low base rate of many of the behaviors coded, inter-rater reliability was calculated using Pearson correlations, showing high reliability (r = .85 – 1.00) (Uebersax, 1988). Kappa coefficients across behaviors ranged from 0 – 1, with those that were < .40 occurring for less than 5% of children and those < .50 occurring for less than 7% of children, reflecting the rare occurrence of the behavior rather than poor agreement (L. L. Cohen et al., 2005; Uebersax, 1988).

Data Analysis

Preliminary analyses were conducted in SPSS v21, including descriptive statistics for all study and demographic variables and normality was assessed for continuous variables. Pearson correlations were computed for all study and demographic variables and one-way ANOVAs were run when appropriate. To address the first hypothesis, frequencies, means, and standard deviations were run for the items reflecting poverty-related stressors on the chronic stress inventory, item level psychological distress, Total Poverty-Related Stressors, and Total Family Distress using SPSS v21.

Latent profile analysis was conducted using M*plus* v7.2 statistical software to determine the different profiles of physiological stress response to the stress paradigm. Full information maximum likelihood (FIML) estimation was used, which has been found to be efficient and less biased than standard methods for handling data missing at random (Arbuckle, 1996). Given the use of multiple measures of sAA and cortisol, latent class analysis allows the detection of different patterns of activity across these multiple measures (Del Guidice et al., 2012). Latent profile analysis is a type of person-centered analysis can be used to identify distinct groups of individuals within a sample, each with its own distribution (McLachlan & Peel, 2000). All measures of sAA and cortisol were entered into the model to determine different profiles. To find the number of classes that best fit the data, a series of models with different numbers of classes from one to six classes was run. Each model was assessed based upon recommended indices of fit, Aikake Information Criterion (AIC), Bayesian information criterion (BIC), Sample Adjustment BIC, and entropy.

Upon completion of the latent class analysis, a series of multinomial regressions were run using SPSS v21 to determine which family risk factors were associated with membership of the child in a particular physiological profile. In this analysis, group membership was the dependent variable. Following the approach of many studies of physiological stress response in children, child gender, medication use, and age were entered as covariates (Bauer et al., 2002; Blair et al., 2011; Essex et al., 2002; Granger et al., 2009), as well as caregiver employment and income per capita. Independent variables were also entered into the model to determine which were predictive of group membership. For the first multinomial regression, Caregiver Depressive Symptoms, Parenting Stress, Total Poverty-Related Stressors, and Family Distress Index were entered into the model following covariates. These analyses were repeated for each of the subscales of the Chronic Stress Inventory, yielding a total of 4 models (Table 1). To test for interactions among family risk factors, a fifth model was run with child gender, age, and medication use, caregiver employment, and family income per capita entered as covariates and the main effects of Caregiver Depressive Symptoms, Parenting Stress, and Poverty-Related Stressors. Two- and three – way interactions for Depression, Parenting Stress, and Family Distress Index were then entered into the model using forward entry. This model was repeated replacing the Family Distress Index with Total Poverty-Related Stressors (Model 6). Interaction effects were not tested for the Stress Inventory subareas due to a lack of power given the number of participants who endorsed items within each area.

Sample Size

A power analysis was conducted to determine the appropriate sample sizes needed to ensure sufficient statistical power for the chosen data analyses. It is recommended that structural equations models (latent profile analysis) have at least 100 participants to have sufficient power. For a regression with 8 independent variables, Cohen (1992) recommended a sample size of at least 107 to detect a medium effect. Multinomial regressions had 8 independent variables without interactions, and up to 12 terms entered with interactions, meaning a sample of 130 would provide sufficient power. A power analysis conducted using G*Power3 showed 100 participants would provide sufficient power to detect model significance. Overall, the target sample size of 150 provided enough power to complete analyses to test study questions.

CHAPTER III

RESULTS

Preliminary descriptive analyses were conducted to test for normative distribution of each measure. Table 2 lists descriptive information for study variables after extreme cases were dropped or Winsorized, meaning the extreme value was replaced by the value equal to 3 standard deviations above the mean. These data reflect the 156 children who completed the stress paradigm and 134 caregivers who completed interviews. One case was dropped because there was not sufficient saliva in the swabs to assay for sAA and cortisol and two cases were dropped due to an extreme value for a cortisol measure (11.55 *SD* above the mean) and an extreme increase in sAA (11.96 *SD* above mean Δ). All other values that were more than 3 standard deviations above the mean were considered extreme (Blair et al., 2011) and were thus Winsorized. This is technique is used to reduce the impact of extreme values without losing data and has been used more recently with biological data (Allwood, Handwerger, Kivlighan, Granger, & Stroud, 2011; Grunau et al., 2007). Using this technique changed 2 and 5 values for the pre-task sAA and cortisol measures respectively, 4 for 5 minute post sAA, 2 and 1 for 20 minute post sAA and cortisol respectively, and 1 for 40 minute post cortisol. After making these transformations, saliva data points were no longer skewed. The values for kurtosis were greater than 2 for the 20 and 40 minute post cortisol samples and all sAA samples, suggesting their distributions may be peaked. However, because subsequent analyses examined class membership, transforming data points may obscure naturally occurring groups within the sample. All other variables appeared to be normally distributed. For cases who had missing data at the item level, variable total scores were computed by taking the mean of the items completed, multiplied but the number of items on the scale (Osborne, 2013). No case had more than 20% items missing per scale and no single item had more than 5% missing data.

Children

Preliminary analyses showed relations among demographic and study variables. Specifically, one-way ANOVA showed significant differences in child ethnicity and parent education (F (5, 123) = 6.56, $p < .001$). Tukey's HSD test showed that overall, Asian children had less educated parents compared to African American, biracial, and African children ($p < .001$) and African American children had caregivers who were more educated than Latino children ($p < .05$). Children's ethnicity was also related to the number of adults (F (5, 123) = 2.15, $p < .05$) living at home. Tukey's post hoc test showed that African American children had significantly fewer adults at home compared to Latino children ($p < .05$).

Additionally, child ethnicity was related to Parent – Child Dysfunctional Interaction (F (5, 124) = 3.73, $p < .01$), such that caregivers of African American children reported lower levels of this type of parenting stress compared to caregivers of European American ($p < .05$) children. Child ethnicity was also related to Total Poverty-Related Stressors (F (5, 127) = 3.41, $p < .01$) and Total Family Distress (F (5, 126) = 3.90, $p <$ .01), with Latino children's caregivers reporting fewer poverty-related stressors and less family distress compared to biracial children ($p < .01$) and African America children's caregivers reporting less distress than biracial children ($p < .01$).

Caregivers

Caregivers' relationship to the child was related to the number of adults (F (2, 126) = 3.92, $p < .05$) and children (F (2, 129) = 3.69, $p < .05$) at home, with grandmother reporters coming from homes with significantly fewer children than father reporters ($p < .05$). Marital status was related to children's ethnicity, such that children who were Latino, African, or Asian were more likely to have caregivers who were married compared to African American, white non-Hispanic, and biracial children, who were more likely to have parents who were single ($X^2 = 48.93$, $p < .001$). Marital status was also related to the number of adults at home (F (3, 126) = 6.44, $p < .001$), with Tukey's post hoc test showing that single caregivers had significantly fewer adults at home compared to married caregivers ($p < .001$). Children who had a change in caregiver in the past year (n = 3) had caregivers who reported lower scores on Caregiver Depressive Symptoms (m = 11.00 vs. m = 13.14) and Family Distress Index (m = 2.22 vs. m = 2.74) and higher scores on Parenting Stress (m = 85.33 vs. m = 74.75) and Total Poverty-Related Stressors (m = 5.00 vs. m = 3.72); however, given the small size of the group with a change in caregiver, these differences were not significant.

Caregiver education was significantly related to employment status (F (6, 121) = 2.45, $p < .05$), with Tukey's post hoc test showing that caregivers with a college degree were significantly more likely to have a higher level of employment (full or part time) compared to those who completed some high school ($p < .01$) or some college ($p < .05$).

Similarly, employment status was significantly related to income to capita (*F* (4, 113) = 3.45, $p < .05$), with Tukey's post hoc test showing those employed full time reported significantly higher income per capita compared to those who are unemployed ($p < .01$).

Family Risk Variables

Table 3 shows correlations among family risk factors. Consistent with past literature, Caregiver Depressive Symptoms was significantly related to measures of Parenting Stress, Poverty-Related Stress, and Family Distress Index (Mistry et al., 2002; Shea & Coyne, 2011). Parenting stress subscales and total scale were all significantly and positively related and chronic stress inventory scales were also positively related.

Physiological Variables

Overall 27.8% of the sample showed a significant increase in cortisol from pre-task to 20 minute post and 67.8% showed a significant decrease from 20 minute post to 40 minute post. For sAA, 65.9% showed an increase in sAA from pre-task to 5 minute post, whereas 47.4% showed a decrease from 5 minute post to 20 minute post. Mean levels and ranges for sAA and cortisol levels were within the expected ranges based on laboratory recommendations and past research with similar samples (Blair et al., 2005, 2011; Lisonbee et al., 2010; Salimetrics, 2014a, 2014b). Pre-task measures of cortisol were related to the time of day the sample was taken with samples taken earlier being higher than those taken later in the morning ($r = -.27$, $p < .001$). The time of breakfast, whether a child brushed his or her teeth, time of brushing teeth, whether it had been a typical morning, and child use of medication were not related to cortisol or sAA levels. Measures of cortisol were significantly and positively related to each other, and this relation was strongest for the 20 and 40 minute post samples. Similarly, measures of sAA were significantly and positively related to each other. Across sample type, there were no significant relations among sAA and cortisol measures. Table 4 shows correlations among physiological measures.

Additionally, pre-task sAA was also significantly related to child age (r = -.20, p < .05) and the 20 minute post sAA sample was significantly related to the time of the first saliva sample (r = .19, p < .05). Pre-task cortisol was significantly related to Family Distress Index (r = -.23, p < .05). Cortisol 20 and 40 minute post were related to Parental Distress (r = -.24 p < .05; r = -.23, p < .05). Additionally, children who had a change in caregiver showed significantly higher levels of sAA 5 minutes post stressor (m = 119.21) compared to those who did not have a change in caregiver (m = 32.64) (F (1, 111) = 22.55, p < .001). There were no significant relations between cortisol or sAA levels and teacher or classroom.

Family's Experience of Stress

Descriptive statistics show that families in the study were exposed to a diverse range of markers of stress and different levels of psychological distress were associated with these markers (Table 5). The most frequently reported markers of stress in the past year were difficulty paying bills, difficulty buying clothes, job loss, and family moves. A subset of caregivers (11.20%) reported exposure to additional markers of stress not included in the stress inventory. These items included family member illness, limited access to transportation, and pregnancy, among others. Caregiver's report of family distress associated with exposure to stressors showed that the additional stressors were rated as most distressing (M = 4.00), followed by job loss (M = 3.30), difficulty buying food (M = 3.19), limited access to childcare (M = 3.12), and difficulty paying bills (M = 3.03). These scores ranged from "Moderately Stressful" (3) to "Very Stressful" (4).

Latent Profile Analysis

In order to detect the presence of distinct patterns of physiological activity in the present sample, latent profile analysis was employed, using the pre-task, 5 minute post, and 20 minute post measures of sAA and the pre-task, 20 minute post, and 40 minute post measures of cortisol sampled across the stress paradigm. Analyses were conducted using M*plus* Version 7.2 latent class analysis. To determine the number of classes that best characterized the data, a series of analyses were conducted with models estimating two through six classes, which were then evaluated based on indices of fit (AIC, BIC, Sample Adjusted BIC, and Entropy). Given that cortisol measures were uncorrelated with sAA measures, covariances among samples within type alone (cortisol vs. sAA) were constrained to be allowed differ across classes (Taylor et al., 2012). To avoid local maxima, analyses were run with 1000 random starts and 100 final optimizations. The best loglikelihood value was replicated for models with two through four classes; however, were not replicated for models with five or six classes. Of those models that were successfully estimated, all fit indices were best for the model with four groups (see Table 6), which is consistent with the Adaptive Calibration Model (Del Giudice et al., 2011). The four classes were spread unevenly, with 41, 60, 38, and 17 children in groups one through four respectively. One-way ANOVAs were completed to detect differences on mean levels of sAA and cortisol sample across groups and Tukey's post hoc analyses tested for significant differences between groups. Paired sample t-tests were also conducted between sAA measures and cortisol measures within groups. Table 7 shows the significant differences in mean level responses of sAA and cortisol across groups and t-tests, whereas Figure 3 shows patterns of mean level response of sAA and cortisol by group.

Results show one small group who showed a significant cortisol response and recovery and a pattern of sAA response and recovery, though nonsignificant. Drawing from terminology from Quas and colleagues (2014), this group was named the *Multisystem Responder Group*. In contrast to study hypotheses and the Adaptive Calibration Model, this group was the smallest (n = 17) rather than the largest. The largest group (n = 60) showed decreasing cortisol across the paradigm, and the lowest levels of cortisol compared to other groups, though not significantly lower. This group also showed a significant sAA response to the stress paradigm and a continued increase, though nonsignificant, at 20 minutes post stressor, as opposed to the expected recovery. This group was labeled the *Moderate sAA Responder Group*. This group's pattern of response suggests that these children perceived the paradigm as stressful; however, did not show an increase in cortisol in coordination with the sAA increase. The next largest group, characterizing 41 children, showed decreasing levels of sAA and cortisol across the paradigm and notably, had significantly lower levels of sAA across measures. This group was named the *Low sAA Activity Group* (under-aroused). Consistent with study hypotheses, this group likely reflects children who did not perceive the stress paradigm to be stressful, and thus did not show a physiological response. Lastly, a group of 38 of children were characterized by significantly higher levels of sAA across measures compared to other groups. This group, named the *Heightened sAA Responder Group*, showed a significant sAA response and no recovery. This group also showed the highest pre-task levels of cortisol and decreasing cortisol levels across the paradigm. This pattern suggests this group perceived the paradigm as stressful, showing an SNS response; however, they did not show a corresponding increase in cortisol at the time sampled.

Validation of Profiles with Behavior Coding

To further substantiate the meaningfulness of the 4-groups, ANOVAs were run comparing children's affect that was coded during the stress tasks across groups. Results showed significant differences on total negative affect (F (3, 152) = 3.37, p < .05) and frustrated affect (F (3, 152) = 2.64, p < .05). Specifically, children in the *Moderate sAA Responder Group* showed significantly less negative affect during the paradigm compared to children in the *Multisystem Responder Group* (p < .05). In contrast, children in the *Low sAA Activity Group* showed significantly more frustrated affect than children in the *Heightened sAA Activity Group* (p < .05). See Figure 4 for z-scores by group.

Demographic Factors and Physiological Profiles

Groups were determined using data from the 156 children who participated in the stress paradigm; however, most demographic data and family risk variables was only available for the 134 children whose caregivers completed an interview. Although there are no significant differences in the displayed variables (See Table 8 for descriptive statistics), one-way ANOVA shows significant differences in caregiver employment and group membership (F (3, 128) = 4.86, p < .01), such that children in the *Multisystem*

Responder Group have caregivers who are more likely to have higher levels of employment compared to all other groups. No other variables were significantly related to group membership, including demographic variables such as whether or not the child had participated in Head Start or preschool prior to this year, caregiver immigrant status, and child ethnicity.

Family Risk Factors Related to Physiological Profile

A series of multinomial logistic regressions provided evidence suggesting that family level risk factors are related to children's physiological profile group membership using the data collected from 134 caregivers who completed interviews. The *Moderate sAA Responder Group* was set as the reference because it showed moderate levels of sAA and cortisol relative to other groups and was the largest group. Following the approach of past studies of physiological stress response in children, child gender, medication use, and age were entered as covariates to all six models (Bauer et al., 2002; Blair et al., 2011; Essex et al., 2002; Granger et al., 2009), as well as family income per capita and caregiver employment to isolate the markers of stress that were hypothesized to influence children's profiles of physiological stress response. Caregiver employment disaggregated the data to such that data became too sparse for the analysis. To overcome this problem, caregiver employment was dichotomized into working full or part-time versus not working. The first model examined Caregiver Depressive Symptoms, Parenting Stress, Total Poverty-Related Stressors, and Family Distress Index. Family Distress Index was used instead of Total Family Distress to reduce problems associated with multicollinearity, given the strong significant correlation between Total Poverty-Related

Stressors and Total Family Distress (r = .91, p < .001) compared to the marginal, small correlation between Total Poverty-Related Stressors and Family Distress Index (r = .17, p < .10). In order for a case to be included in the analysis, the caregiver had to have endorsed experiencing at least one poverty-related stressor in order to have a score for Family Distress Index, resulting in an n of 94 for Model 1.

Results showed the overall model was significant (χ^2 (27) = 39.77, p < .05), with Caregiver Employment (χ^2 = 8.90, p < .05) and Child Gender (χ^2 = 8.62, p < .05) contributing significantly and Parenting Stress (χ^2 = 7.38, p < .10) and Poverty-Related Stressors (χ^2 = 4.84, p < .10) contributing marginally. Table 9 shows parameter estimates and odds ratios for the different groups. Results show that compared to the *Moderate sAA Responder Group* the children who are male are more likely to be in the *Heightened sAA* or *Multisystem Responder Group*. Children whose caregivers reported lower levels of Parenting Stress were more likely to be in the *Heightened sAA Responder Group* and caregivers who reported being employed were more likely to be in the *Multisystem Responder Group* compared to the *Moderate sAA Responder Group*. Although Poverty-Related Stressors and Family Distress Index did not contribute significantly to the model overall, model estimates suggested that children whose families experienced more stressors, but experienced less distress were more likely to be in the *Multisystem Responder Group* compared to the *Moderate sAA Responder Group.*

Subareas of Stress Inventory

Given the fact that the stress measure captured three areas of stress, additional models were run to test if these specific areas uniquely contributed to group membership.

To be included in the model, caregivers had to endorse experiencing at least one stressor from the given area. The variables from Model 1 were entered but with Family Instability Stressors in place of Total Poverty-Related Stressors and Family Instability Family Distress Index in place of the Family Distress Index (n = 63). This model was not significant. This procedure was repeated for Limited Resource Stressors and Limited Resources Family Distress Index (n = 79). The overall model was significant (χ^2 (27) = 45.96, $p < .01$), showing that Limited Resources Family Distress Index was a significant predictor of group membership (χ^2 = 8.93, $p < .05$). Additionally, child gender (χ^2 = 8.21, $p < .05$) and Parenting Stress (χ^2 = 11.92, $p < .01$) significantly predicted group membership in the overall model (see Table 10). Caregiver employment was marginally related (χ^2 = 6.47, $p < .10$). Results showed that children who are male and whose parents report lower scores on the Limited Resources Family Distress Index were more likely to be in the *Heightened sAA Responder Group* or *Multisystem Responder Groups* compared to the *Moderate sAA Responder Group*. Children whose caregivers reported lower scores on Parenting Stress were more likely to be in the *Heightened sAA Responder Group* compared to the *Moderate sAA Responder Group*.

This procedure was again repeated for Safety Concern Stressors (n = 48). The overall model was significant (χ^2 (27) = 44.07, $p < .05$) and the Safety Concerns Family Distress Index contributed to the model above the effect of other markers of stress and control variables (χ^2 = 17.13, $p < .001$) (Table 11). Additionally, child gender significantly contributed to the model (χ^2 = 11.91, $p < .01$). Results suggest that children who are male were more likely to be in the *Heightened sAA Responder Group* and

Multisystem Responder Groups compared to the *Moderate sAA Responder Group*. Children whose caregivers reported higher scores on the Safety Concerns Family Distress Index were more likely to be in the *Moderate sAA Responder Group* compared to all other groups.

Interactive Effects

To test for interaction effects, the two-way and three-way interactions among the family markers of stress (Caregiver Depressive Symptoms, Parenting Stress, and Family Distress Index) were added to Model 1 using forward entry. This model was not significant. This technique was used again, replacing Family Distress Index with Total Poverty-Related Stressors (n = 103). Using this method, the final model was significant (χ^2 (27) = 39.89, $p < .05$) with the interaction between Parenting Stress and Poverty-Related Stressors being the only additional marginally significant predictor of group membership. Results showed that Employment (χ^2 = 13.69, $p < .01$) contributed significantly to the model predicting group membership, whereas, Parenting Stress (χ^2 = 6.94, $p < .10$), Total Poverty-Related Stressors (χ^2 = 7.00, $p < .10$), and the interaction between Parenting Stress and Poverty-Related Stressors (χ^2 = 6.34, $p < .10$) marginally contributed to the model predicting group membership. See Table 12 for parameter estimates and odds ratios. The interaction, though marginally significant, suggests that children with higher scores on both Parenting Stress and Poverty-Related Stressors were more likely to be in the *Low sAA Group* compared to the *Moderate sAA Responder Group*, whereas higher levels of Parenting Stress and Poverty-Related Stressors were independently related to membership in the *Moderate sAA Responder Group*. See Table 13 for a summary of multinomial logistic regression results.

CHAPTER IV

DISCUSSION

Using an integrated adaptive calibration and ecological framework (ACEF), the present study aimed to overcome weaknesses in past research in order to further develop our understanding of how poverty "gets under the skin" by examining preschool aged children's patterns physiological stress response and family level stress. In contrast to much of the work examining physiological stress response in preschool aged children, this study responded to the push to incorporate multiple measures of activity in multiple stress response systems, namely the fast acting (but short-lived) sympathetic nervous system, which produces the "fight or flight" response, and the longer-lived actions of the HPA Axis (Bauer et al., 2002; Del Giudice et al., 2011; Granger et al., 2006; Quas et al., 2014). Guided by the ACM, this study measures correlates of the SNS and HPA axis to identify patterns of physiological stress response (Del Giudice et al., 2011). Additionally, the present study carefully measured stressors associated with low-income status, and importantly, examined the associated psychological distress. Analyses also examined the potential additive or interactive role of caregiver depressive symptoms and parenting stress, which have been associated with low income status and children's stress physiology (Dougherty et al., 2011; Essex et al., 2002; Kahn et al., 1999; Laforett & Mendez, 2012). These family level risk factors were used to examine what factors are most closely related to patterns of physiological stress response.

Family Climate of Stress

With regard to poverty-related markers of stress, results provided mixed support for the first study hypothesis. Specifically, families experienced diverse stressors and rated them with varying levels of distress across items; however, those items relating to limited resources were described as most stressful of the presented items, rather than those related to safety. Caregivers who reported additional items reported those as most stressful, which may in part be related to the fact that they were salient enough to be recalled when asked about the presence of additional stressors. When looking at total exposure to markers of stress, families again reported a wide range, showing that poverty alone does not capture the complexities of the hardship faced in this context. Although caregivers endorsed different levels of family psychological distress at an item level, total distress levels were strongly related to the number of stressors faced, which is likely related to the way these constructs were measured; that is, the more stressors a family faced, the more opportunity the family had to report associated psychological distress. However, examination of the family's tendency to experience distress in response to a stressor (Family Distress Indices) showed only a marginal weak relation, highlighting the importance of the distinction between exposure to markers of stress and the experience of distress.

Past research has identified economic pressure as being a key link between poverty and less optimal child outcomes (Conger et al., 2002; Mistry et al., 2002). Extending the idea of the psychological pressure, or distress, experienced in response to financial hardship to other types of poverty-related stress is an important construct to capture. As the present findings support, such distress is related to children's pattern of physiological response to a socially evaluative challenge in their environment. As further discussed below, examination of subtypes of stressors and associated psychological distress also proved important in understanding the relation between poverty-related stressors, psychological distress, and physiological stress response.

Furthermore, caregiver depressive symptoms were moderately related to poverty-related stressors and a family's tendency to experience distress in response to such stressors, and parenting stress was weakly related, again suggesting that family perception of distress is a distinct construct. Together these factors contribute to a family climate of stress as these factors wear on caregivers' psychological resources and their ability to manage family stress (Conger et al., 2002; Y. Wang & Dix, 2013). Children living in a climate of high psychological distress may receive signals of an unstable, adverse environment, which shapes their physiological stress response systems. However, some factors may be more potent than others. In contrast to past research that has developed composite scores or stress/risk indices combining distinct constructs (Del Giudice et al., 2012; Evans, 2003; Quas et al., 2014), the present study examined these constructs both as composites and as distinct types, allowing for a more specific understanding of which factors are most closely related to physiological stress response.

Use of Person-Centered Methods to Determine Profiles of Physiological Stress Response

One of the primary goals of this study was to assess children's physiological stress reactivity profiles to a socially evaluative stress paradigm in a sample of preschool aged children from low-income families. Results showed that overall, children showed significant decreases in cortisol levels across the stress paradigm, whereas they showed a significant increase in sAA from pre-task to 5 minute post and a nonsignificant increase from 5 minute post to 20 minute post. However, across children distinct patterns were apparent. Latent profile analysis suggested the presence of 4 distinct profiles of response in the present sample: *Moderate sAA Responder Group, Low sAA Activity, Heightened sAA Responder Group,* and *Multisystem Responder Group*. In contrast to the hypothesis that two reactive groups would emerge with different magnitudes of response across both systems, results showed that 2 profiles showed a significant increase in sAA *or* cortisol and one group showed a marginal increase in sAA, rather than increases across both systems.

Specifically, one small group of children, the *Multisystem Responder Group* was the only group to show a significant increase in cortisol followed by a recovery during the stress paradigm, similar in magnitude to the Responders Group found by de Weerth and colleagues (2013). This group also showed an increase in sAA, though nonsignificant, which may be due to the small sample size of the group (n = 17). Furthermore, this group exhibited more negative, anxious affect compared to children in the *Moderate sAA Group,* suggesting children in the former group demonstrated behaviors that matched their physiological response. This type of response has been considered to be an adaptive response to a perceived stressor in past literature (Gunnar & Quevedo, 2007; McEwen, 1998) and is similar to the Multisystem Reactivity Group found in Quas and colleagues (2014), which was also small in size. Because there was only one group who showed a response on both systems, it is unclear whether their reaction reflected a heightened response or a moderate response. As Quas and colleagues (2014) found in their developmental approach looking at samples in kindergarten through early adolescence, there was some evidence that a multisystem response may be a more mature and adaptive response. The small size of the *Multisystem Responder Group* may be related to the younger age of children in the sample whose systems are undergoing development.

Results also showed the presence of a group of children, *Heightened sAA Responder*, who showed significantly higher levels of sAA across the paradigm. These children showed a significant increase in sAA from pre-task to immediately after the paradigm, suggesting they found the paradigm stressful. However, these children showed stable levels of sAA from 5 to 20 minute post. This pattern of response may reflect physiological stress response systems that are still developing. Perhaps a child who has yet to develop this adaptive HPA axis response, but finds the classroom environment and the paradigm stressful would show these high pre-task levels of sAA and increases in response to added paradigm stress. This heightened SNS activity and higher pre-task cortisol levels are consistent with the "anticipatory arousal" group found by Quas and colleagues (2014). These authors argued that these children showed heightened sAA levels starting the paradigm because they anticipated the stress paradigm.

The lack of decrease from 5 to 20 minutes after the paradigm in the *Heightened sAA Responder Group* may be due to the timing of the third sample. Perhaps their sAA samples would have been lower had it been measured at 30 minute post stressor. This response could be related to inter-individual differences or a still developing efficient SNS response. Past research has shown that the preschool climate can elicit a stress response for children who are inhibited and anxious (Gunnar, Kryzer, Van Ryzin, & Phillips, 2011). Although Gunnar and colleagues only looked at the HPA Axis, alterations in this system were likely accompanied by alterations in the SNS. Additionally, the *Heightened sAA Responder Group* showed the highest levels of pre-task cortisol, which could reflect activation in the classroom context.

The *Moderate sAA Responder Group* showed moderate levels of sAA relative to other groups, but showed significant increases across the entire paradigm. These patterns of response suggest that these children perceived the paradigm as stressful and continued to perceive stress after the paradigm had ended, as their moderate sAA levels continued to rise. Furthermore, these children did not mount a cortisol response to help allocate resources to cope with the stressor. It could be that in the absence of the coordinated cortisol response, the SNS continued to be active to help the child cope. In contrast to the *Heightened sAA Responder Group*, the moderate sAA levels produced by the *Moderate sAA Responder Group* may not have been enough to help children adequately cope with stress, causing the continued activity of the SNS. Compared to the findings of Quas and colleagues (2014), this group appears most similar to the Moderate Reactivity Group, which similarly was the largest groups and showed moderate response on SNS and PNS, but no increase in HPA activity.

Lastly, the *Low sAA Group* may reflect children who did not perceive the paradigm as stressful and/or children who are less susceptible to the environment with regard to physiological stress response. This group is similar to the underaroused group found by Quas and colleagues (2014) consisting of 2% of the sample. Interestingly, children in this group showed the highest levels of observed frustrated affect compared to other groups, and significantly higher levels compared to the *Heightened sAA Group*. Thus, it is likely that these children did experience the paradigm as stressful and/or challenging demonstrated in their behavior; however, did not show physiological activation to help support a response to this stressor. Past research has shown lower levels of cortisol reactivity in adolescents with conduct disorder compared to those without conduct disorder, despite both groups reporting similar changes in emotions during the paradigm (Fairchild et al., 2008).

Although the present 4 group solution is consistent with the Adaptive Calibration Model (ACM) (Del Giudice et al., 2011, 2012), groups did not completely map onto the group proposed by the ACM. The present groupings were quite similar to the results obtained in the kindergarten sample examined by Quas and colleagues (2014). The difference in number of groups between the present findings and Quas and colleagues (2014) is likely related to the fact that their study used a measure of PNS in addition to SNS and HPA Axis. The differences in the present groups compared to the ACM may be related to developmental factors as discussed further below.

The distinct patterns of response found in the present study highlight the importance of using person centered approaches to identify patterns of physiological response in preschool samples rather than examining an overall sample mean or patterns. Past research has used hierarchical linear modeling to examine different types of response; however, these models assume a similar pattern of response across all participants. Research has also examined mean responses or correlates of one system, which can conceal important differences in physiological response that may be present. Had only cortisol or sAA been examined in this sample, important distinctions among children would have been overlooked. These results confirm the existence of distinct patterns in this low-income preschool sample, highlighting the importance of person-centered approaches in this area of research. Although Quas and colleagues (2014) included preschoolers from diverse low-income backgrounds, the majority of their sample was more economically advantaged than the present sample. Del Giudice and colleagues (2012) similarly examined a sample with children from low-income backgrounds; however, the majority was more economically advantaged, older (M_{age} = 9.44), and majority European American. More research examining profiles of physiological stress response is needed in low-income ethnically diverse samples to replicate these findings.

Getting Under the Skin: Relations between Profile of Response and Family Stress

Results showed that children's physiological stress response to the stress paradigm was related to some family level markers of stress. For the overall sample, pre-task HPA axis activity level was negatively related to a family's tendency to experience psychological distress in response to poverty related stressors. Additionally, HPA axis activity following the socially evaluative stress paradigm at the expected response and recovery times was negatively related to parenting stress. These relations could reflect children being less responsive to stressors in the school environment when exposed to repeated stressors in the home environment, or it could reflect less activation due to alterations in the stress systems to compensate from the repeated use of physical resources (McEwen, 1998).

Furthermore, results supported hypotheses about the salience of family level markers of stress relating to children's physiological profile group membership. Specifically, higher levels of parenting stress and family psychological distress in response to poverty related stressors were predictive of membership in the *Moderate sAA Responder Group* compared to select other groups. Specifically, children with higher levels of parenting stress were more likely to be in the *Moderate sAA Responder Group* compared to the *Heightened sAA Responder Group*, except for in the model examining exposure to safety concerns, where parenting stress was not related.

In contrast to past research that uses cumulative indices of stressors (Evans, 2003), results showed the importance of looking at distinct categories of stressors and distress versus merely examining whether or not having been exposed to a stressor has an effect, which is consistent with other studies examining risk and stress physiology in low income samples (Blair et al., 2011). Specifically, a family's distress over the exposure to stressors related to limited financial resources (trouble paying bills/buying clothes/food, limited access to childcare/medical care, etc.) and stressors related to safety (worry about neighborhood safety, witnessing violence, etc.) were most salient in predicting group membership, whereas distress related to family instability was not. Higher levels of distress, but not exposure to stressors, were consistently predictive of membership in the *Moderate sAA Responder Group.* The need to examine these constructs separately can also be seen in group descriptive data. Looking at mean differences, the *Moderate sAA Responder Group* shows exposure to fewer stressors than the *Heightened sAA Responder Group* and *Multisystem Responder Group*, but reports the highest level of total and relative distress. This finding suggests that these children are in a family climate of greater psychological distress.

In contrast, the *Multisystem Responder Group* showed the highest number of stressors, but lower levels of total family distress and the lowest level of relative distress, measured by the Family Distress Index, suggesting that children in these families have well developed coping skills. Thus, their significant cortisol response followed by an efficient return to pre-task, paired with a marginally significant increase in sAA followed by a decline likely reflects an adaptive response to stressors. These children's stress systems have likely had the opportunity to develop an adaptive response in their environment, given their exposure to stress and adaptive coping.

In contrast, the *Moderate sAA Responder Group* showed a significant increase in sAA with a continued increase, though nonsignificant, instead of the expected recovery. Additionally, they showed the lowest levels of cortisol and the greatest decline in cortisol compared to other groups. It may be that these children who experience significant distress at home do not have the resources to mount a cortisol response to the stress paradigm. They perceive the paradigm as stressful, thus showing the increase in sAA; however, this stress may not be as salient or unpredictable as the distress at home. This pattern also contrasts the *Heightened sAA Responder Group* who show higher levels of sAA and an increase in sAA followed by no change, and the highest pre-task levels of cortisol. Similar to the *Multisystem Responder Group*, children in the *Heightened sAA Responder Group* showed a higher number of poverty-related stressors experienced, but lower levels of total family distress and less tendency to respond to a stressor with distress compared to the *Moderate sAA Responder Group*.

Furthermore, results showed marginal support for an interaction between parenting stress and the family distress index. Specifically, children were more likely to be in the *Low sAA Activity Group* if they had high levels of both parenting stress and family distress, whereas high levels of one of these measures was predictive of membership in the *Moderate sAA Responder Group.* Given the marginal support for this interaction, future research should further examine the potential interactive effects of multiple markers of stress on children's physiological stress response profiles. It is notable that with the exception of the model examining safety concerns stressors, the *Low sAA Activity Group* and the *Moderate sAA Responder Group* are not distinguishable by any of the independent variables.

Interestingly, results also showed significant relations between demographic factors and group membership. Specifically, children in the *Moderate sAA Responder Group* were more likely to be male compared to those in the *Heightened sAA Responder Group* and *Multisystem Responder Group*. Consistent with past research, preschool aged girls tend to show higher levels of social involvement (Mendez, McDermott, & Fantuzzo, 2002; Zhang, 2011), thus girls may have been more aware of and affected by the potential socially evaluative stress of the paradigm and possible social stressors in the classroom. Additionally, children whose caregivers were employed were more likely to be in the *Multisystem Responder Group* compared to those in the *Moderate sAA Response Group.* The *Multisystem Responder Group* showed high numbers of stressors experiences, but also showed lower levels of experience distress. One explanation for these findings is that caregivers who have the skills to cope with poverty-related markers of stress also have the resources to obtain and maintain employment while raising children. Alternatively, employment may create a sense of stability for caregivers such that other poverty-related stressors might not be as psychologically distressing because the family has the stability of a caregiver with steady employment. No other demographic factors were consistently related to group membership.

Toward Improved Theory Driven Methods

This study strived to use improved methodology to identify preschool aged children's distinct patterns of physiological stress response to a standardized stress paradigm and to determine which aspects of a family climate of stress are predictive of profile membership. The study was theoretically grounded, using an integrated adaptive calibration and ecological framework to describe how stress in early childhood impacts stress physiology. As such, this study followed recommendations from past researchers (Del Giudice et al., 2011; Granger et al., 2006), using measures of sAA and cortisol to assess the functioning of the SNS and HPA axis. Past empirical work has shown that both of these systems are integral to stress response and together can have implications for behavioral outcomes (Bauer et al., 2002; Berry et al., 2012; Gordis, Granger, Susman, & Trickett, 2006).

Using multiple measures of both SNS and HPA Axis activity, results show that examination of just one of these systems would have masked important distinctions in physiological stress response, as some children showed patterns that were similar on sAA, but different on cortisol or vice versa. Coordination of these systems in the periphery may be important indicators of development and adaptive stress response (Bauer et al., 2002; Del Giudice et al., 2011, 2012; Quas et al., 2014).

Additionally, this study examined children's affect measured through observed behaviors to validate physiological profile group membership. This provides insight into children's experiences of stress during the stress paradigm. It may also reveal conditions where the experience of stress is associated with an emotional response, but not associated with an underlying biological response or vice versa. Future research can use such an approach to examine whether the concordance or discordance of emotional response and physiological response to stressors has implications for child outcomes starting in early childhood and through development.

To elicit a physiological stress response in this low-income preschool sample, this study used a novel socially evaluative stress paradigm validated for use with 5 and 6 year olds by de Weerth and colleagues (2013) in the Netherlands. A strength of this paradigm is that it was informed by past literature that recommended stressors that are socially evaluative and unpredictable in nature to best elicit a cortisol response (Dickerson & Kemeny, 2004; Gunnar et al., 2009). Past research examining cortisol reactivity generally relies on laboratory experiments, which has the added benefit of a controlled situation; however, is not typical of what a child experiences day to day. The study completed by de Weerth and colleagues (2013) took students from their classroom to a portable lab setting (a van) and spent 30 minutes relaxing with the child before completing the first saliva swab, in other words, establishing a true baseline.

In contrast to the present results, two-thirds of their sample showed a significant increase in cortisol, compared to almost one third of the present sample when looking at cortisol alone. Incorporating the stress paradigm into the child's preschool day likely captured a more accurate picture of a child's stress response to a socially evaluative stressor, as it would occur in children's lives. In contrast, completing the paradigm in the school setting and using their classroom behavior as a pre-task may have overlooked the fact that some children may have already experienced a stress response in the classroom, which influenced their response in the paradigm contributing to the smaller proportion of the study sample that showed an HPA Axis response compared to de Weerth and colleagues (2013). Although teachers were asked if a child's morning was typical, teachers may not have been aware of the interactions or experiences a child had that caused stress. Alternatively, some children may regularly experience stress in the classroom, thus a typical morning is one in which the child is stressed, for example a shy or inhibited child may find day to day interactions to be stressful (Dettling, Parker, Lane, Sebanc, & Gunnar, 2000). Spending time alone with two adults in a quiet setting may be less stressful than the active, stimulating classroom environment for some children, particularly those who come to school having experienced a great deal of stress at home or find peer interactions challenging.

Limitations and Future Directions

In the present sample, the hypothesis that four distinct profiles of physiological stress response was confirmed through latent profile analysis; however, the nature of these profiles was somewhat different than expected. This difference could in part be related to the current information available about the typical course of the physiological stress response in preschool aged children. Future research should continue to improve methodology in assessment of physiological stress response by using collecting more saliva samples before and after the stress paradigm. Due to resource constraints, the present study sampled three measures of both sAA and cortisol. Given the variability in patterns of response, it may be that children in this sample varied in the rate at which their sAA and/or cortisol rose and fell in response to the stressor. Additionally, taking the first post stress saliva sample 5 minutes after the child was told he or she earned the prize, rather than 5 minutes after the stress tasks themselves may have missed the initial sAA response. Although the judge "deliberation period" was intended to create additional stress by design, children in our sample may not have experienced this period as stressful, instead feeling a reduction in stress as soon as the judge left the room. Having more samples from each child would have allowed examination of this variability

One challenge of conducting laboratory studies aimed at eliciting a physiological stress response is that for preschoolers in particular, there is no standard paradigm that all preschoolers will perceive as stressful without crossing the line of being unethical for some of the children. While some children in the study displayed notable signs of anxiety and/or frustrations, others did not. In understanding stress response, it is important to distinguish which children appraised the situation as stressful versus those who did not. This distinction would aid in the interpretation of patterns of stress response. Perhaps assessing children's perceptions of and behavior during the challenge could help determine whether or not they experienced the paradigm as stressful, providing more insight to their stress response. Children who perceive the challenge as stressful but do not show a physiological response are distinct from those who do not perceive it as stressful. Schlotz, Hammerfald, Ehlert, and Gaab (2011) examined adult men's self-perceptions of physiological reactivity to stressors (whether their hands sweat, experience racing heartbeat, etc. when engaged in a stressful situation), their cognitive appraisals about the situations, and their cortisol response to the Trier Social Stress Task. Their study found that people's report of higher reactivity, specifically in the social evaluation and failure domains, and appraising the situation as more threatening was associated with a steeper slope of the increase in cortisol from baseline to post stressor. Although this work was completed with adults, it is likely that children's physiological stress response to a paradigm is related to their appraisal of paradigm and their tendency to feel physical changes when facing a stressful activity. Thus, having children complete a developmentally appropriate survey of how they feel in different situations (during show and tell, performing a play, etc.) and how they felt during the paradigm might be a way to better capture the potential differences in their physiological stress response. The literature review suggests that this procedure has yet to be done with preschool children.

Given the challenge that researchers have found with eliciting a physiological stress response in preschoolers, it may be more appropriate to move toward aggregating multiple samples to look at level of physiological correlates as "traits" rather than looking at patterns of response (Taylor et al., 2012). Despite the benefit of working with children in their natural environment (school) to examine their stress response, it may not be feasible to do this effectively. Schools and parents may be reluctant to let students out of class for the extended amount of time needed to establish baseline and complete the paradigm and recovery. Additionally, scheduled activities, such as meals, naptime, and recess, limit the window of time during which preschool children are available. Alternatively, it may be necessary to complete stress paradigms outside of school where the experimenter can ensure the child has not experienced stress before participating in the paradigm.

Furthermore, as researchers have consistently found eliciting a cortisol response in preschool populations to be challenging, it may be that developmentally, the stress response systems are in a state of change. As the ACM posits, children's early experiences shape their stress response systems (Del Giudice et al., 2011). The study that confirmed their theory examined school aged children (Del Giudice et al., 2012). The present results and the kindergarten sample in Quas and colleagues (2014) found similar results, partially in line with the ACM. It may be in early childhood, the stress response systems may be still developing and influenced by environmental stress. Thus, it may be that if the sample were followed into middle childhood, groups more similar to the ACM would appear. As children get older and have more experiences with stressors and coping with such stressors, their physiological stress response patterns may become more established. In the present study, the SNS was responsive for more children than the

HPA axis. It may be that during this time in development, the SNS is the primary responder to stress. Given the limited research looking at SNS response to stress in this age group, this should be further examined.

In addition to alternative methods of measuring physiological stress response, future studies could use a more detailed and time sensitive measure of poverty-related stressors. Research has found that the type of measure used to assess stressful life event can affect findings (Karg, Burmeister, Shedden, & Sen, 2011; Monroe & Reid, 2008). When recalling whether or not events occurred over the past year, caregivers may only remember the most salient or most distressing events, which would change results. Specifically, using experience sampling methodology (ESM) to measure poverty-related stress could increase the accuracy of such reports, as past research has done to measure general life stress (Collip et al., 2013). These methods may incorporate electronic notification to ask participants if an event has occurred since the last notification and associated feelings or thoughts they may have had about the event. This technique has not been a focus of assessment of poverty-related stress; however, this may be a more accurate technique for assessing the stress a family experiences over the course of a period of time and the associated distress. For example, a caregiver could complete a weekly or monthly questionnaire that asks whether or not a given stressor has occurred and how stressful it seemed for the family. Increased frequency of assessment of stressors would also allow for testing of whether the timing of the stressor affects children's stress response (i.e. whether it happened the day before the paradigm versus six months before the paradigm).

Furthermore, this dissertation focused on caregiver factors that serve as markers of stress for children; however, children are not passive actors in their environment (Sameroff, 2009). As Whiteside-Mansell and colleagues (2007) explain, parenting stress is a complex construct that involves both caregiver and child characteristics. For example, children's temperamental reactivity and regulation contributes to parenting stress, such that children who are more reactive and less able to self-regulate put higher demands on parents (Coplan, Bowker, & Cooper, 2003). Additionally, research has found relations between child temperament and physiological stress response, with children with more reactive temperaments showing greater physiological activation (Gunnar, Kryzer, Van Ryzin, & Phillips, 2011; Kagan, Reznick, & Snidman, 1987; Talge, Donzella, & Gunnar, 2008; Tout et al., 1998). A child who is more physiologically reactive may show more challenging behaviors (Dettling, Gunnar, & Donzella, 1999; Tout et al., 1998; Watamura, Donzella, Alwin, & Gunnar, 2003), thus creating more stress for a caregiver and the family environment. Taken together, these preliminary findings support future research that examines the bidirectional interaction of parenting stress and children's behavioral and physiological activity.

Implications for Practice and Policy

The results of this study have important implications for practice and policy. Results show that children vary greatly in their physiological response to stress. Additionally, the amount of distress a child experiences in their home environment appears to be related to their pattern of stress response. Many children attending Head Start and their families experience a range of stressors; however, results show that this experience has different psychological implications for families, which is related to children's physiological stress response. Given the importance of the physiological stress response both in terms of helping children respond to stress, but also in terms of excessive activation leading to mental and physical illness (Bauer et al., 2002; McEwen, 1998; Thompson, 2014), interventions to reduce family level distress is an important goal. Furthermore, several interventions that have been designed to change caregivers interactions with their children from high risk backgrounds show evidence of being effective (Thompson & Haskins, 2014). Head Start, as the largest federally funded preschool program for low-income children and their families, is in an opportune position to reach many families at risk for chronic stress.

Head Start could use a two-part approach including identification and prevention/intervention. First, the use and continued development of a detailed stress assessment that measures stressors faced, frequency, and distress experienced could help tease apart the variation in families' experiences found in the present sample. Family advocates could use this stress inventory to screen families and identify those experiencing significant stressors and related distress. Such caregivers and children could participate in two-generation programs that provide services for both parents and children. Theory and research on child development suggests that addressing both caregivers and children is the most effective way to improve child outcomes (McLanahan, Currie, Haskins, Rouse, & Sawhill, 2014). A two-generation program could teach parents stress coping skills, including cognitive coping skills and relaxation skills to use for themselves and to coach children. Children could participate in activities that teach and practice exercises to manage physiological symptoms, such as breathing, imagery, and/or biofeedback. Given that caregivers who experience psychological distress may be harder to engage in such two-generation programs (Laforett & Mendez, 2012), directly addressing their mental health needs is a key component for a program to engage parents in making changes to help children thrive. Head Start teachers should also receive training in identification of children and caregivers affected by stress as well as in implementation of stress coping strategies. Teachers could implement relaxation exercises class wide as they are in a unique position to reach many children and to provide adult modeling of recognition of and adaptive coping with stress.

Given the potential long lasting effects on mental and physical health, funding should be allocated to Head Start and other programs serving young low-income children and their families to increase their ability to effectively cope with stress. Socioemotional development has always been a value of Head Start programs and in 2007, federal mandate allocated funds for improved identification of children with mental health problems, screening for maternal depression, and coordination with agencies who provide health, mental health, and family services (110th Congress, 2007). Although this mandate provided resources for the support of some mental health initiatives for children attending Head Start and their families, such programs need to be further expanded to specifically address stress reduction for families and children. Strength based mental health programs in Head Start that reach across systems (child, teachers, caregivers, etc.) have been found to have a positive affect on children’s mental health, both for identified children and for centers as a whole (Lamb-Parker et al., 2008). Policies that promote screenings and interventions for families experiencing stress in such early childcare programs with incentives for compliance could also help motivate programs to effectively implement such programs. Investing in this important cause early on could not only improve health outcomes, but would also reduce future costs needed to address such health problems.

Conclusion

The results of this study shed light on several important issues when investigating the effects of stress on children's stress physiology. First, continued and nuanced portraits of family stressors and their psychological effect on families are needed. Additionally, looking at individual stressors or types of stressors is important, as some may be more or less potent in their relation to stress physiology. Results confirmed distress was more influential than the experience of the stressors themselves, and distress related to limited resources stressors and safety concerns was most salient. Results also highlight the need to look at multiple physiological stress response systems at multiple times points, as multiple patterns of response were found that would not have been evident with looking at one data point or one system of response. Future research using similar approaches and longitudinal, large datasets is needed to confirm the present findings, further our understanding of the group memberships, and identify behavioral correlates of group membership.

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APPENDIX A

FAMILY INFORMATION QUESTIONNAIRE

We would like to learn about your child and your family. Please answer the following questions.

Has your child taken any medication in the past month? (i.e. inhalers, allergy medication, cold medicine, etc.)
Yes_____ No_______
If yes, what kind?_____________

1. What is your relationship to (the Head Start child)? [INSERT CHILD'S NAME]

___ Mother ___ Stepmother ___ Adoptive mother ___ Grandmother

___ Father ___ Stepfather ___ Adoptive father ___ Grandfather

___ Aunt ___ Uncle ___ Other: ______________________

2. What is your marital status?

___ Single
___ Married/Living together
___ Divorced
___ Separated
___ Widowed

3a. Which best describes the ethnicity of the child's biological parents? [Check all that Apply]

___ Asian ___ Black/ African-American ___ White Non-Hispanic
___ Native American ___ Latino ___ Other:___________

3c. If respondent is not the mother or father, ask for the ethnicity of respondent.
____

3.2. Sometimes people share the responsibility of caring for a child when they are unable to do so themselves (Ex. during a hospitalization/health crisis, working out of state, etc.). Have you always been the primary caregiver for this child?

YES NO

If No, please describe:
3.2a. Who was the primary caregiver?____________________________

3.2b. Thinking about the child's age, from what age to what age was this person the primary caregiver? ______
3.2c. What was the reason for the change?

____

____

4. How many adults and how many children live in your household?

___ Adults ___Children

5. Were you born in the United States? _____Yes ______No

5a. If no, in what country were you born?_______________

5b. When did you come to the United States? ________________

5c. In what country was [the Head Start child] born? __________________________

5d. How old was the child when s/he first came to the US? [Omit if born in US] ____

5e. Where did you live prior to coming to the United States? [Omit if born in US] ___

Now I'm going to ask about your child's previous experience in daycare/Head Start.

5.2. Is this your child's first year of Head Start? YES NO
If yes, skip to 5b. If no complete 5a and 5b.

5.2a. How old was the child when s/he first attended Head Start/EHS?________________

How many years of Head Start/EHS has your child completed?__________________
Notes:____

____

5.2b. Did your child attend preschool and/or daycare prior to Head Start? YES NO

How old was the child when s/he first attended daycare or preschool?__________

How many years of daycare/preschool has your child completed?_____________
Notes:____

6a. What is your highest level of education?

___ 6th-8th grade __9th grade __10th grade __11th grade __12th grade (no diploma)

___High School graduate/ GED __Some college __College Degree
__Graduate School
___Job Training/ Vocational School (if yes, for what job _______________________)

7a. What is your employment status?

___ Employed part-time
___ Employed full-time
___ Unemployed or looking for work
___ Do not work outside the home
___ Disability

7b. What is your current job/profession? [If respondent is employed]

____

8. How old is your child? __________ 8b.What is his/her birthdate? __________________

9. Is your child male or female? __________________________

Do you feel you have a good support network? ___YES ____NO

Who are the people in your support network? [check any that apply]
__Spouse or Partner __Sister(s)__Cousin __Religious Leader ___Mother __Brother(s)
__Child's teacher __Member of faith community __Father __Friend(s) __Aunt
__Grandparent(s) _________________ [what faith?] __Uncles(s)
___Other (explain) ________________

11. Overall, what is your monthly income? Your best guess is fine. _________________________________

11a. How many people are supported on this income?_________

11b. How much difficulty do you have paying bills each month? Would you say…

1	**2**	**3**	**4**
No difficulty at all	A little difficulty	Some difficulty	A great deal of difficulty

11c. In general, how much money do you have left over at the end of the month? Is it …

1	**2**	**3**	**4**
More than enough money left over	Some money left over	Just enough to make ends meet	Not enough to make ends meet

11d. How do you feel about your neighborhood as a place to raise children? Would you say it is

__Excellent __Good __Average or Just Fine __Bad __Very Bad

Thank you for sharing about your family. Let's continue on to the next section.

APPENDIX B

CHRONIC STRESS INVENTORY

	In the past year?	In your child's life?
1. Has your family moved…	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
2. Have any adults moved in or out of your house…	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
3. Have there been changes in the number of children in your house… (new birth, custody change, etc.)	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
4. Has anyone close to your family died...	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful	Very Stressful Moderately Stressful

	Somewhat Stressful Minimally/Not stressful	Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
5. Has anyone in your family lost a job…	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
6. Has your family had difficulty paying your monthly bills…	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
7. Has your family had difficulty buying enough food for your family…	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
8. Has your family had difficulty buying clothes…	Yes No	Yes No

If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
9. Have you worried about household safety…	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
10. Has your family had difficulty accessing medical care…	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
11. Has your family had difficulty accessing childcare…	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
12. Have there been arguments among adults in your home…	Yes No	Yes No

If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
13. Has anyone in your family witnessed violence…	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
14. Have you worried about safety in your neighborhood…	Yes No	Yes No
If yes: How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful
	In the past year?	**In your child's life?**
15. Has your family had any other unexpected events…	Yes No	Yes No
If yes: What?____________ *If yes:* How stressful was this for your family?	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful

	In the past year?		In your child's life?	
If there are Additional Events:	Yes	No	Yes	No
Event:____________ *If yes:* How stressful was this for your family? ______________________ Event: ____________ *If yes:* How stressful was this for your family? _______________________	Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful		Very Stressful Moderately Stressful Somewhat Stressful Minimally/Not stressful	

APPENDIX C

BEHAVIOR CODING RECORD SHEET

			Task 1-Statue				Task 2-Story				Task 3-Tower				
			pre judge	post judge	post judge	Notes	0-15 N1/N2	15-30 N3/N4	30-47 N5/N6	Notes	6-4 min	4-2 min	2-0 min	Notes	Total √s
Positive	Tone	Positive	☐	☐	☐		☐	☐	☐		☐	☐	☐		
	Mouth	Smiling	☐	☐	☐		☐	☐	☐		☐	☐	☐		
		Laughing	☐	☐	☐		☐	☐	☐		☐	☐	☐		
	Body	Alert	☐	☐	☐		☐	☐	☐		☐	☐	☐		
		Bouncy	☐	☐	☐		☐	☐	☐		☐	☐	☐		
Negative	Tone	sad, soft, whiney	☐	☐	☐		☐	☐	☐		☐	☐	☐		
	Mouth	Turned Down	☐	☐	☐		☐	☐	☐		☐	☐	☐		
		Quivering	☐	☐	☐		☐	☐	☐		☐	☐	☐		
	Body	Slumped Over	☐	☐	☐		☐	☐	☐		☐	☐	☐		
		Nervous Fidget	☐	☐	☐		☐	☐	☐		☐	☐	☐		
Frustrated	Tone	Angry, irrit/whiney	☐	☐	☐		☐	☐	☐		☐	☐	☐		
		Grunt/Moan	☐	☐	☐		☐	☐	☐		☐	☐	☐		
		Sigh	☐	☐	☐		☐	☐	☐		☐	☐	☐		
	Eyes	Furrowed Brow	☐	☐	☐		☐	☐	☐		☐	☐	☐		
		Squinted	☐	☐	☐		☐	☐	☐		☐	☐	☐		
	Mouth	Pursed Lips	☐	☐	☐		☐	☐	☐		☐	☐	☐		
	Body	Arm-X/Hand-hips	☐	☐	☐		☐	☐	☐		☐	☐	☐		

APPENDIX D

TABLES AND FIGURES

Table 1

Plan for Multinomial Regressions

Model	1	2	3	4	5	6
Common Covariates						
Age (Mos)	X	X	X	X	X	X
Male	X	X	X	X	X	X
Medication Use (Yes)	X	X	X	X	X	X
Employment (Yes)	X	X	X	X	X	X
Income per Capita	X	X	X	X	X	X
Caregiver Depressive Symptoms	X	X	X	X	X	X
Parenting Stress	X	X	X	X	X	X
1) Pov. Rel. Stressors	X				X	
Family Distress Index						X
2) Family Stability Stressors		X				
Family Stability Distress Index		X				
3) Limited Resource Stressors			X			
Limited Resource Distress Index			X			
4) Safety Concerns Stressors				X		
Safety Concerns Distress Index				X		
5) Dep. X Par.Stress					X	
Dep. X Fam. Distress Index					X	
Par. Stress X Fam. Distress Index					X	
Dep. X Fam. Distress Index X Par. Stress					X	
6) Dep. X Par. Stress						X
Dep. X Pov. Rel. Stressors						X
Par. Stress X Pov. Rel. Stressors						X
Dep. X Pov. Rel. Stressors X Par. Stress						X

Note. This table summarizes the variables entered in each of the six multinomial logistic regressions. Dep. = Caregiver Depression. Par. Stress = Parenting Stress. Pov. Rel. Stressors = Poverty-Related Stressors. Fam. Distress Index = Family Distress Index

Table 2

Descriptive Statistics for Study Variables

						Skewness		Kurtosis	
	N	Min.	Max.	*M*	*SD*	Statistic	*SE*	Statistic	*SE*
Depression	130	0.00	44.21	12.46	9.54	0.94	0.21	0.26	0.42
Parental Distress	130	12.00	52.00	27.40	7.87	0.38	0.21	0.26	0.42
Parent – Child Dys. Int.	131	12.00	37.00	21.21	6.52	0.21	0.21	-0.70	0.42
Difficult Child	130	12.00	44.00	26.35	6.94	0.44	0.21	0.14	0.42
Parenting Stress	129	36.00	122.00	75.29	17.53	0.04	0.21	-0.31	0.42
Total Poverty Related Stressors	134	0.00	9.00	3.58	2.31	0.25	0.21	-0.91	0.42
Total Family Distress	133	0.00	29.00	9.85	7.38	0.65	0.21	-0.38	0.42
Family Distress Index	122	1.00	4.00	2.67	0.81	-0.23	0.22	-0.61	0.44
Cortisol Pre-task (nm/L)	150	.50	8.93	3.29	1.86	1.22	.20	1.14	.39
Cortisol 20 min. post (nm/L)	152	.84	9.64	2.90	1.54	1.92	.20	4.79	.39
Cortisol 40 min. post (nm/L)	151	.33	7.86	2.51	1.23	1.61	.20	4.13	.39
sAA Pre-task (U/min.)	145	.00	112.10	27.15	26.05	1.82	.20	3.30	.40
sAA 5 min. post (U/min.)	156	.12	134.23	33.61	31.09	1.52	.19	2.14	.39
sAA 20 min. post (U/min.)	154	.00	140.38	33.55	30.04	1.55	.20	2.32	.39
ln Cortisol Pre-task	150	-.70	2.31	1.04	.57	-.25	.20	.42	.39
ln Cortisol 20 min. post	152	-.17	3.17	.96	.49	.67	.20	2.24	.39
ln Cortisol 40 min. post	151	-1.11	2.91	.82	.50	.05	.20	2.82	.39
sqrt sAA Pre-task	145	.00	11.82	4.69	2.40	.76	.20	.87	.40
sqrt sAA 5 min. post	156	.34	13.12	5.23	2.62	.65	.19	.27	.39
sqrt sAA 20 min. post	154	.00	15.58	5.27	2.64	.80	.20	1.49	.39

Note. Sample sizes reflect 156 children who completed the stress paradigm and 134 caregivers who completed parent interviews. sAA = Salivary Alpha Amylase, ln = natural log transformed, sqrt = square root transformed.

Table 3

Correlations between Demographic and Family Risk Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Gender	-											
2. Child Age Mos	-.11	-										
3. Income Per Capita	-.15†	-.03	-									
4. Caregiver Education	-.08	.00	.12	-								
5. Caregiver Employment	.13	.08	-.33**	-.27**	-							
6. Caregiver Dep. Symptoms	.16†	-.07	-.17†	-.12	.13	-						
7. Parental Distress	-.05	-.16†	-.04	-.19*	.13	.51**	-					
8. Parent-Child Dys. Int.	-.07	-.07	.03	-.35**	.06	.29**	.55**	-				
9. Difficult Child	-.08	-.08	.13	-.21*	-.02	.45**	.50**	.56**	-			
10. Parenting Stress	-.09	-.13	.03	-.29**	.06	.51**	.84**	.83**	.82**	-		
11. Tot. Pov. Rel. Stressors	-.01	-.02	-.24**	.103	.00	.25**	.18*	-.13	.06	.03	-	
12. Total Family Distress	-.02	-.04	-.21*	.10	.07	.32**	.24**	-.08	.08	.09	.91**	-
13. Family Distress Index	.02	.02	-.02	-.02	.23*	.31**	.28**	.09	.07	.17†	.16†	.50**

Note. $^{\dagger}p < .10$, $*p < .05$, $**p < .01$.

Table 4

Correlation Table for SAA and Cortisol Measures

	1.	2.	3.	4.	5.
1. Cortisol Pre-task (nm/L)	1.00				
2. Cortisol 20 min. post (nm/L)	.36**	1.00			
3. Cortisol 40 min. post (nm/L)	.23**	.80**	1.00		
4. sAA Pre-task (U/min.)	.04	-.08	-.09	1.00	
5. sAA 2 5 min. post (U/min.)	.00	.02	.00	.71**	1.00
6. sAA 20 min. post (U/min.)	-.05	-.01	-.06	.56**	.82**

Note. $^{**}p < .01$

Table 5

Descriptive Statistics for Family Stress Inventory

Stressor	*N*	% Experiencing item	*N*	Mean Distress (*SD*)
Family Moved	134	34.30*	46	1.98 (1.09)
Change in Adults at Home	134	14.90	20	2.15 (1.35)
Change in Children at Home	134	19.40	26	1.69 (1.09)
Family Death	134	21.60	29	2.62 (1.08)
Job Loss	134	35.80*	48	3.30 (0.90)*
Difficulty Paying Bills	134	54.50*	73	3.03 (1.01)*
Difficulty Buying Food	134	27.60	37	3.19 (0.97)*
Difficulty Buying Clothes	134	38.10*	51	2.93 (0.99)
Limited Access to Medical Care	132	14.90	20	2.90 (1.12)
Limited Access to Child Care	134	18.90	25	3.12 (1.09)*
Household Safety Concerns	134	18.70	25	2.54 (1.00)
Arguments among Adults at Home	134	20.10	27	2.23 (1.05)
Family Member Witness Violence	134	8.20	11	2.91 (1.22)
Neighborhood Safety Concerns	134	20.90	28	2.71 (1.01)
Additional Stressor 1	134	11.20	15	3.53 (0.74)*
Additional Stressor 2	134	2.20	3	4.00 (0.00)*

Note. *Most frequent (> 33% of sample)/Greatest distress reported (> 3.0)

Table 6

Model Comparisons of Latent Classes of Physiological Activity

# of Classes	AIC	BIC	N Adj. BIC	Entr.
2	5392.13	5504.98	5387.86	0.77
3	5300.14	5470.93	5293.67	0.83
4	5240.40	5469.14	5231.75	0.86
5	5212.89*	5499.58*	5202.04*	0.87*
6	5188.71*	5533.34*	5175.66*	0.88*

Note. *The best loglikelihood value was not replicated.

Table 7

Descriptive Data for the 4-Group Solution Showing Differences Across Groups

	Low sAA Activity (41)	Moderate sAA Responder (60)	Heightened sAA Responder (38)	Multisystem Responder (17)
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*
sAA Pre-task	9.54 (6.51)[a]	22.13 (12.15)[a]	54.88 (35.06)[ab]	29.77 (25.84)[b]
sAA 5 min. post	7.81 (5.08)[ab]	27.92 (15.55)[a]	66.23 (34.94)[ab]	36.33 (29.51)[b]
sAA 20 min. post	6.94 (4.57)[ab]	29.33 (12.17)[a]	66.43 (36.59)[ab]	33.18 (15.36)[b]
Cortisol Pre-task	3.45 (2.01)	2.98 (1.03)	3.96 (2.27)	3.14 (2.35)
Cortisol 20 min. post	2.81 (1.12)[a]	2.33 (0.63)[b]	2.68 (1.06)[c]	5.96 (2.27)[abc]
Cortisol 40 min. post	2.58 (1.08)[a]	2.03 (0.64)[a]	2.21 (0.74)[b]	4.60 (1.68)[ab]
	t (df)	*t (df)*	*t (df)*	*t (df)*
sAA Base – 5 min. post	-1.39 (37)	2.80** (57)	1.84[†] (35)	1.37 (12)
sAA 5– 20 min. post	-1.20 (40)	0.98 (58)	-0.03 (37)	-0.56 (15)
Cort. Base – 20 min. post	-2.24* (37)	-4.37*** (57)	-3.36*** (36)	6.07** (14)
Cort. 20 – 40 min. post	-1.94[†] (37)	-5.27*** (56)	-4.74*** (37)	-2.48* (15)

Note. sAA is measured in units per minute (U/min.) and cortisol is measures in nanomoles per liter (nm/L).
[a, b,] and [c] signifies values are significantly different across groups.

Table 8

Descriptive Statistics Across Physiological Profiles

	Overall Sample	Moderate sAA Responder	Low sAA Activity	Heightened sAA Responder	Multisystem Responder
# of Children	156	60	41	38	17
% Female	56.40	60.00	63.40	50.00	58.80
% Used meds	29.2	27.90	30.30	32.30	23.10
Mean Age	57.21 (4.42)	57.63 (4.24)	57.46 (4.23)	56.73 (3.99)	56.24 (6.23)
Adults at Home	1.68 (.76)	1.76 (.79)	1.72 (.78)	1.67 (.76)	1.31 (.48)
Children at Home	2.68 (1.38)	2.66 (1.55)	2.95 (1.43)	2.63 (1.20)	2.08 (.86)
Monthly Income	985.99 (697.34)	947.38 (742.44)	964.63 (733.86)	1079.55 (653.74)	930.77 (600.88)
Income per Capita	288.70 (210.70)	279.34 (222.07)	270.57 (224.29)	310.74 (275.63)	311.86 (210.71)
CESD Total	12.46 (9.54)	14.54 (10.74)	10.03 (8.27)	12.90 (9.63)	11.27 (7.54)
Parental Distress	27.39 (7.87)	28.81 (6.83)	25.78 (7.25)	28.10 (9.47)	25.31 (7.32)
Parent- Child Dys. Int.	21.21 (6.52)	22.05 (6.58)	20.09 (5.66)	21.22 (7.00)	21.50 (7.44)
Difficult Child	26.35 (6.94)	26.80 (6.96)	26.48 (8.08)	24.88 (5.89)	28.68 (5.92)
Parenting Stress	75.29 (17.53)	78.79 (15.26)	72.35 (17.88)	74.20 (19.76)	75.49 (16.72)
Total Year Stressors	3.58 (2.31)	3.38 (2.46)	3.32 (2.03)	3.95 (2.25)	4.00 (2.74)
Total Family Distress	9.85 (7.38)	10.15 (8.62)	8.93 (6.60)	10.23 (6.22)	10.31 (8.38)
Family Distress Index	2.67 (.81)	2.88 (.85)	2.56 (.92)	2.65 (.66)	2.41 (.69)

Note. No significant differences across groups.

Table 9

Multinomial Regression with Family Risk Factors Predicting Physiological Profile Group Membership: Family Distress Index

	Low sAA Activity			Heightened sAA Responder			Multisystem Responder		
	B	*OR*	95% CI *OR*	*B*	*OR*	95% CI *OR*	*B*	*OR*	95% CI *OR*
Intercept	2.35			3.53			-4.90		
Child Age (Mos)	0.02	1.02	0.89 – 1.16	0.00	1.00	0.86 – 1.16	0.10	1.10	0.90 – 1.34
Gender									
Male	0.14	1.14	0.35 – 3.73	1.40*	4.05	1.07 – 15.37	2.05*	7.73	1.18 – 50.74
Female	0[a]	.	.	0[a]	.	.	0[a]	.	.
Medication									
Yes	-0.03	0.97	0.29 – 3.24	0.39	1.47	0.39 – 5.58	-0.41	0.67	0.10 – 4.24
No	0[a]	.	.	0[a]	.	.	0[a]	.	.
Employment									
Employed	0.56	0.57	0.16 – 2.11	0.96	2.60	0.62 – 10.84	1.89[†]	6.62	0.97 – 44.99
Unemployed	0[a]	.	.	0b	.	.	0b	.	.
Income Per Capita	0.00	1.00	1.00 – 1.00	0.00	1.00	1.00 – 1.00	0.00	1.00	0.99 – 1.00
Caregiver Depress. Symptoms	-0.04	0.96	0.89 – 1.03	0.01	1.01	0.94 – 1.09	-0.04	0.96	0.86 – 1.08
Parenting Stress	-0.01	0.99	0.95 – 1.04	-0.05**	0.95	0.91 – 0.99	-0.02	0.98	0.92 – 1.04
Poverty-Related Stressors	-.04	.97	0.72 – 1.32	0.23	1.26	0.90 – 1.75	0.49*	1.64	1.02 – 2.62
Family Distress Index	-.65	.52	0.23 – 1.19	-0.74	0.48	0.19 – 1.19	-1.12[†]	0.33	0.10 – 1.08

Note. The reference category is the Moderate sAA Responder Group. [a]This parameter is set to zero because it is redundant. [†]$p < .10$, *$p < .05$, **$p < .01$. B = Beta, *OR* = Odds Ratio, CI = Confidence Interval

.

Table 10

Multinomial Regression with Family Risk Factors Predicting Physiological Profile Group Membership: Limited Resources

	Low sAA Activity			Heightened sAA Responder			Multisystem Responder		
	B	*OR*	95% CI *OR*	*B*	*OR*	95% CI *OR*	*B*	*OR*	95% CI *OR*
Intercept	-1.95			10.24			7.32		
Child Age (Mos)	0.07	1.07	0.92 – 1.24	-0.07	0.93	0.78 – 1.11	-0.04	0.96	0.77 – 1.20
Gender									
Male	-0.07	0.93	0.24 – 3.59	1.54†	4.64	0.94 – 22.92	2.24*	9.37	1.04 – 84.31
Female	0[a]	.	.	0[a]	.	.	0[a]	.	.
Medication									
Yes	-0.21	0.81	0.21 – 3.10	0.23	1.26	0.28 – 5.70	-0.67	0.51	0.06 – 4.33
No	0[a]	.	.	0[a]	.	.	0[a]	.	.
Employment									
Employed	0.26	0.77	0.18 – 3.29	1.27	3.57	0.71 – 17.95	1.80†	6.07	0.74 – 49.85
Unemployed	0[a]	.	.	0[a]	.	.	0[a]	.	.
Income Per Capita	0.00	1.00	1.00 – 1.01	0.00	1.00	1.00 – 1.01	0.00	1.00	0.99 – 1.01
Caregiver Depressive Symptoms	-0.08*	0.92	0.85 – 1.00	0.02	1.02	0.94 – 1.12	-0.01	0.99	0.88 – 1.12
Parenting Stress	0.01	1.01	0.97 – 1.06	-0.07**	0.94	0.89 – 0.99	-0.05	0.96	0.89 – 1.02
Limited Resources Stressors	-0.11	0.90	0.59 – 1.59	0.27	1.31	0.76 – 2.24	0.56	1.75	0.84 – 3.63
Family Distress Index: Limited Resources	-0.41	0.67	0.25 – 1.76	-1.21*	0.30	0.09 – 0.94	-1.92**	0.15	0.03 – 0.66

Note. The reference category is the Moderate sAA Responder Group. [a]This parameter is set to zero because it is redundant. †$p < .10$, *$p < .05$, **$p < .01$. B = Beta, *OR* = Odds Ratio, CI = Confidence Interval.

Table 11

Multinomial Regression with Family Risk Factors Predicting Physiological Profile Group Membership: Safety Concerns

	Low sAA Activity			Heightened sAA Responder			Multisystem Responder		
	B	*OR*	95% CI *OR*	*B*	*OR*	95% CI *OR*	*B*	*OR*	95% CI *OR*
Intercept	-6.60			4.16			-8.41		
Child Age (Mos)	0.30[†]	1.35	0.96 – 1.91	0.17	1.19	0.82 – 1.72	0.30	1.35	0.92 – 1.98
Gender									
Male	2.06	7.82	0.37 – 164.65	4.47**	86.99	3.16 – 2397.58	3.66*	38.91	1.35 – 1133.23
Female	0[a]	.	.	0[a]	.	.	0[a]	.	.
Medication									
Yes	0.05	1.05	0.08 – 14.24	1.44	4.21	0.25 – 70.35	0.25	1.29	0.07 – 24.74
No	0[a]	.	.	0[a]	.	.	0[a]	.	.
Employment									
Employed	0.00	1.00	0.07 – 15.07	1.31	3.70	0.17 – 80.20	2.24	9.38	0.32 – 274.84
Unemployed	0[a]	.	.	0[a]	.	.	0[a]	.	.
Income Per Capita	0.00	1.00	0.99 – 1.00	-0.01*	0.99	0.98 – 1.00	-0.01	1.00	0.99 – 1.00
Caregiver Depress. Symptoms	-0.12	0.89	0.77 – 1.03	-0.08	0.92	0.78 – 1.09	-0.05	0.95	0.81 – 1.12
Parenting Stress	-0.03	0.97	0.87 – 1.09	-0.06	0.94	0.84 – 1.05	-0.08	0.93	0.82 – 1.05
Safety Concerns Stressors	0.07	1.08	0.16 – 7.24	-0.22	0.80	0.10 – 6.40	0.98	2.67	0.24 – 29.79
Family Distress Index: Safety Concerns	-2.17**	0.11	0.02 – 0.64	-2.94***	0.05	0.01 – 0.37	-2.01*	0.14	0.02 – 0.92

Note. The reference category is the Moderate sAA Responder Group. [a]This parameter is set to zero because it is redundant. [†]$p < .10$, *$p < .05$, **$p < .01$. B = Beta, *OR* = Odds Ratio, CI = Confidence Interval.

Table 12

Multinomial Regression with Family Risk Factors Predicting Physiological Profile Group Membership: Interaction Effects

	Low sAA Activity			Heightened sAA Responder			Multisystem Responder		
	B	*OR*	95% CI *OR*	*B*	*OR*	95% CI *OR*	*B*	*OR*	95% CI *OR*
Intercept	4.92			6.01			-3.79		
Child Age (Mos)	0.02	1.02	0.91 - 1.15	-0.04	0.96	0.85 - 1.09	-0.03	0.97	0.82 - 1.15
Gender									
Male	-0.06	0.94	0.32 - 2.79	0.94	2.57	0.78 - 8.49	1.47[†]	4.36	0.83 - 22.89
Female	0[a]	.	.	0[a]	.	.	0[a]	.	.
Medication									
Yes	0.10	1.10	0.35 - 3.50	0.37	1.45	0.42 - 5.03	-0.91	0.40	0.06 - 2.79
No	0[a]	.	.	0[a]	.	.	0[a]	.	.
Employment									
Employed	-0.35	0.70	0.20 - 2.45	1.17[†]	3.21	0.86 - 11.97	2.50[**]	12.20	1.96 - 75.89
Unemployed	0[a]	.	.	0[a]	.	.	0[a]	.	
Income Per Capita	0.00	1.00	1.00 - 1.00	0.00	1.00	1.00 - 1.00	0.00	1.00	0.99 - 1.00
Caregiver Depressive Symptoms	-0.06[†]	0.94	0.88 - 1.01	0.00	1.00	0.93 - 1.07	-0.04	0.96	0.87 - 1.07
Parenting Stress	-0.07[†]	0.93	0.86 - 1.01	-0.07	0.93	0.86 - 1.02	0.04	1.04	0.92 - 1.16
Poverty-Related Stressors	-1.15	0.32	0.08 - 1.28	-0.22	0.80	0.20 - 3.24	1.26	3.51	0.54 - 22.95
Parenting Stress X Poverty-Related Stressors	0.02[†]	1.02	1.00 – 1.03	0.00	1.00	.99 – 1.02	-.01	0.99	.96 – 1.01

Note. The reference category is the Moderate sAA Responder Group. [a]This parameter is set to zero because it is redundant. [†]*p* < .10, ***p* < .01. B = Beta, *OR* = Odds Ratio, CI = Confidence Interval.

Table 13

Summary of Multinomial Regressions

	Low sAA Activity Group				Heightened sAA Responder Group				Multisystem Responder Group			
Model	1	3	4	5	1	3	4	5	1	3	4	5
Covariates												
Age (Mos)	-	-	Pos.	-	-	-	-	-	-	-	-	-
Male	-	-	-	-	Pos.	Pos.	Pos.	-	Pos.	Pos.	Pos.	
Medication Use (Yes)	-	-	-	-	-	-	-	-	-	-	-	-
Employment (Yes)	-	-	-	-	-	-	-	-	Pos.	-	-	Pos.
Income per Capita	-	-	-	-	-	-	-	-	-	-	-	-
Caregiver Depressive Symptoms	-	-	-	-	-	-	-	-	-	-	-	-
Parenting Stress	-	-	-	-	Neg.	Neg.	-	-	-	-	-	-
1) Poverty-Related Stressors	-			-	-			-	Pos.			-
Family Distress Index	-				-				-			
3) Limited Resource Stressors		-				-				-		
Limited Resource Distress Index		-				Neg.				Neg.		
4) Safety Concerns Stressors			-				-				-	
Safety Concerns Distress Index			Neg.				Neg.				Neg.	
5) Parenting Stress X Poverty-Related Stress				-				-				-

Note. This table summarizes the results from the series of multinomial logistic regressions. Variables that significantly predicted group measurement are shown. Pos. = Higher scorers are more likely to be in listed group compared to Moderate sAA Responder Group (reference group). Neg. = Higher scorers are less likely to be in listed group compared to Moderate sAA Responder Group (reference group). Variables that were marginally significant are not highlighted in this table. Model 2 & 6, are not shown as this model were not significant.

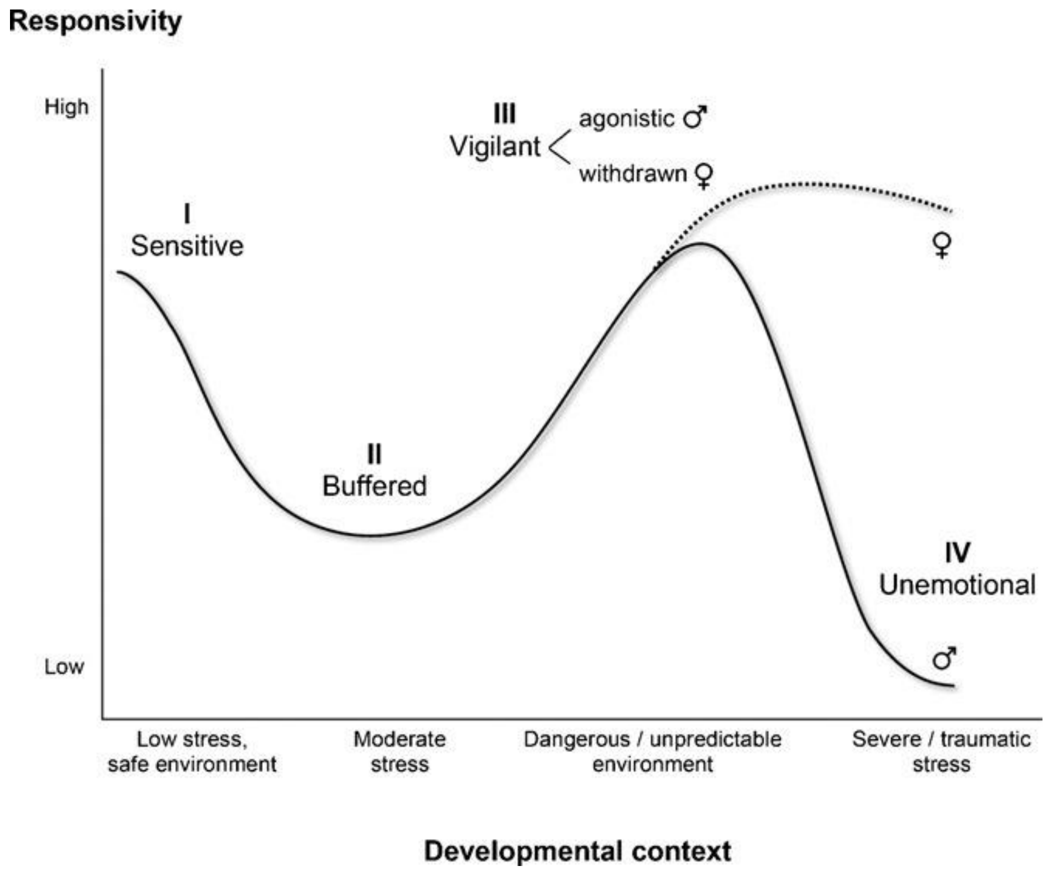

Figure 1. The Adaptive Calibration Model of Individual Differences in Development of Stress Responsivity, Showing the Nonlinear Relation between Early Environmental Stress and the Activity of Physiological Stress Systems. From "The Adaptive Calibration Model of Stress Responsivity," by M. Del Giudice, B. J. Ellis, and E. A. Shirtcliff, 2011, Neuroscience & Biobehavioral Reviews, 35, p. 1577. Copyright 2011 by Elsevier.

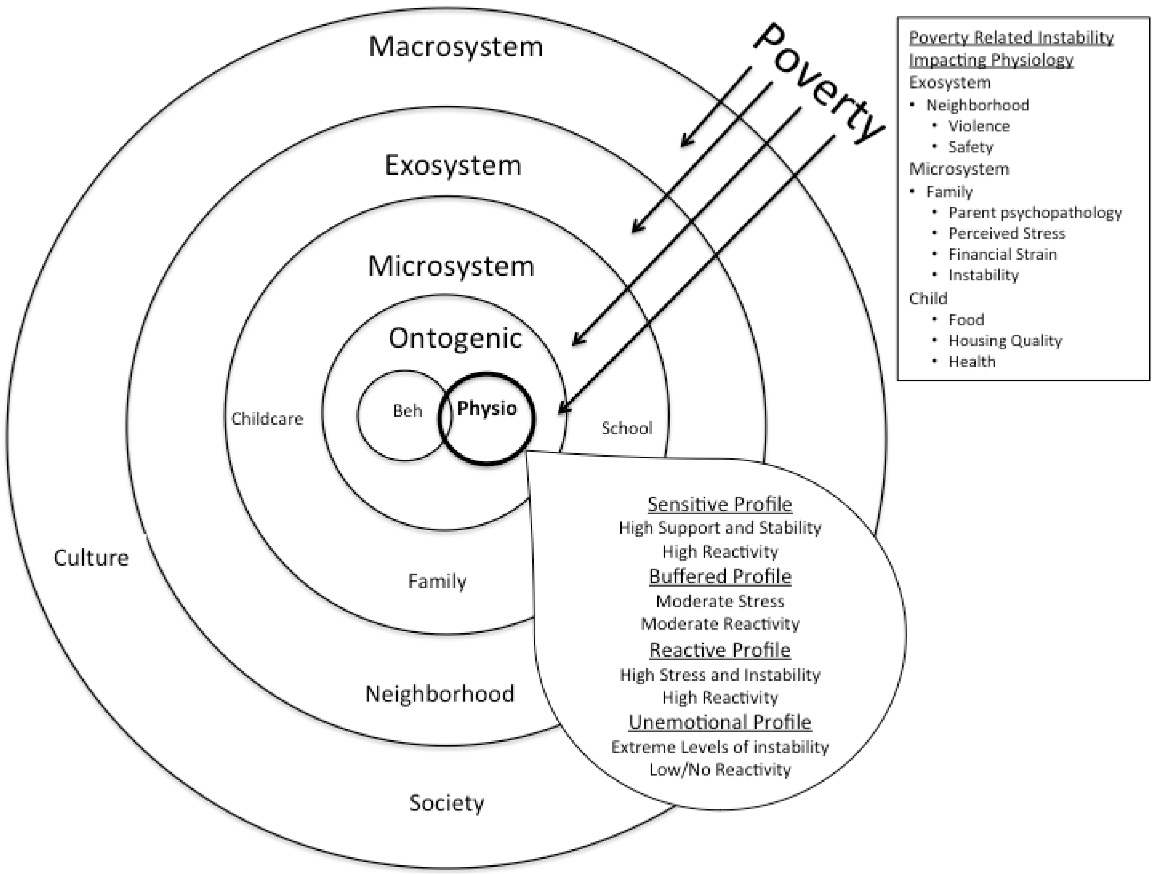

Figure 2. Integrated Adaptive Calibration Ecological Framework

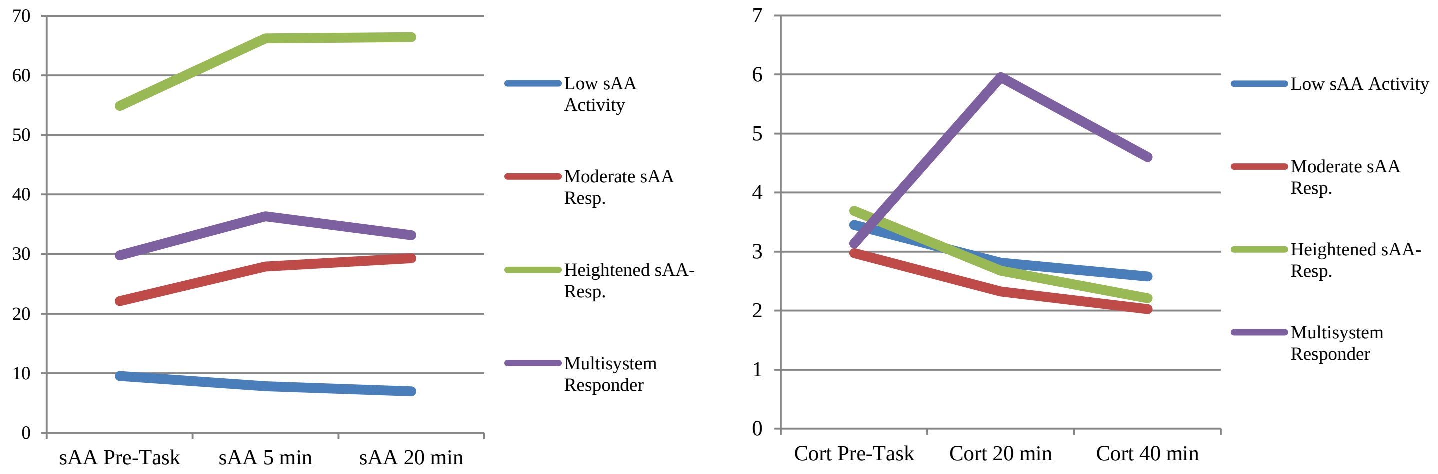

Figure 3. *Physiological Stress Response sAA and Cortisol Patterns by Group: 4-Group Solution. Low sAA Activity n = 41; Moderate sAA Responder n = 60; Heightened sAA Responder n = 38; Multisystem Responder n = 17.*

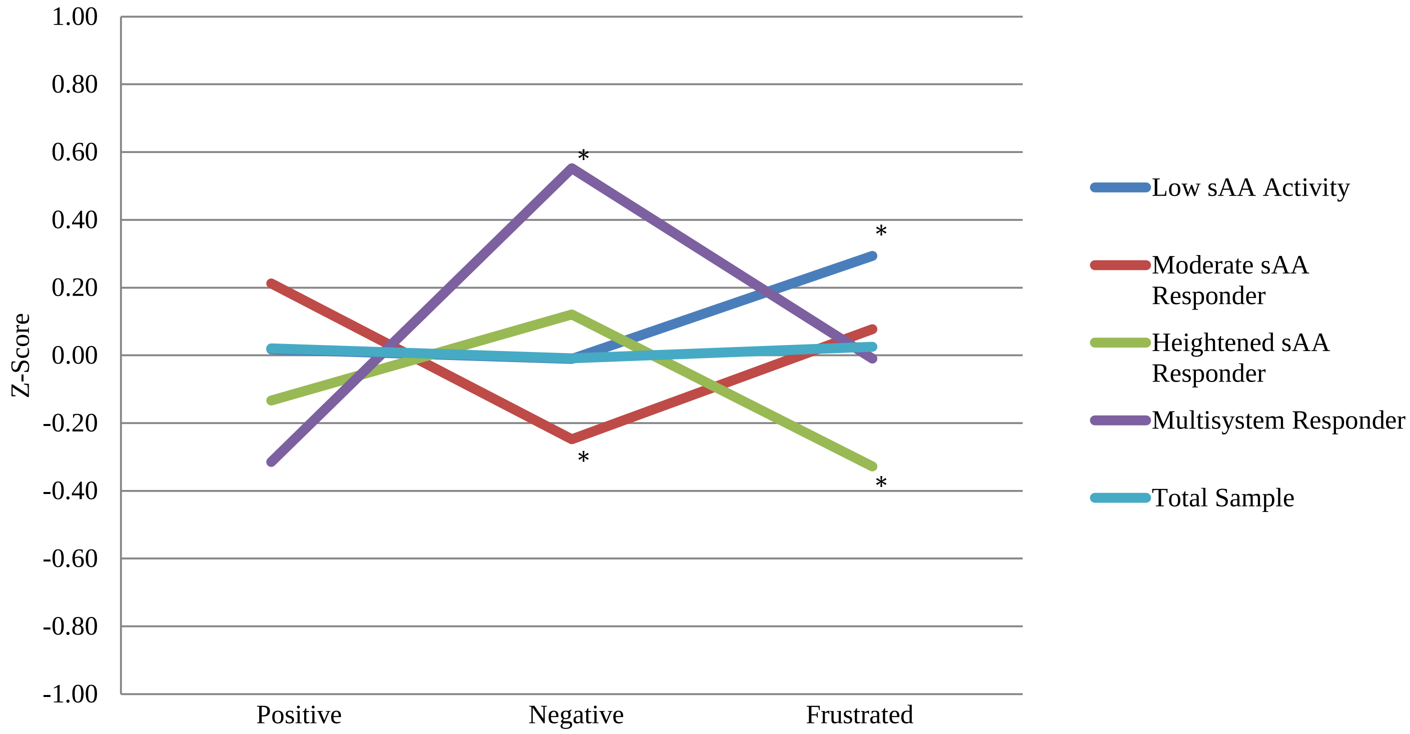

Figure 4. Observed Affect Scores by Physiological Profile. *Denotes significant differences