THE INFLUENCE OF PARENTAL FACTORS ON THE RELATIONSHIP BETWEEN AUTONOMIC AROUSAL AND AGGRESSIVE BEHAVIOR IN CHILDREN

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ABSTRACT

Research has consistently studied environmental and biological risk factors for violence. However, recent studies have begun to examine the contribution of *both* biological and environmental predispositions to aggressive behavior. While there is a growing body of research examining biosocial influences, there has been a distinct lack of comprehensive research exploring the influence of parent-child interaction factors on the relationship between autonomic arousal and aggression. The current study addressed this issue by examining inconsistent discipline and parental involvement as moderators in the relationship between autonomic arousal (specifically sympathetic versus parasympathetic arousal at rest and during a task) and reactive versus proactive aggression. Data were collected from a sample of fourth graders identified as at-risk for aggression (N= 360). Inconsistent discipline was found to be a significant moderator in ten of the sixteen tested models and either gender or race acted as an additional moderator in seven of these models. Parental involvement was not a significant moderator in any of the tested models. Results demonstrated that children exhibiting both proactive and reactive aggressive behaviors may demonstrate heighted or diminished autonomic arousal patterns, but level of arousal depends on contextual and demographic factors (specifically gender, race, and the level of inconsistent discipline). By examining the influence of environmental factors on the relationship between autonomic arousal and different types of aggression, we may be better able to understand under which circumstances children with reactive versus proactive aggression exhibit heightened or reduced arousal patterns.

LIST OF ABBREVIATIONS AND SYMBOLS

α	Cronbach's alpha, a measure of internal consistency
B	Unstandardized regression coefficients
CI	Confidence interval: proportion of intervals that contain the true value of the parameter
df	Degrees of freedom: number of values free to vary after certain restrictions have been placed on the data
F	Fisher's F ratio: A ratio of two variances
M	Mean: the sum of a set of measurements divided by the number of measurements in the set
N	Sample size
p	Probability associated with the occurrence under the null hypothesis of a value as extreme as or more extreme than the observed value
r	Pearson product-moment correlation
R^2	Squared multiple correlation coefficient, fraction of the variability of the response that is fitted by the model
sd	Standard deviation: amount of variation or dispersion of a set of data values
SE B	Standard error of the regression coefficients
t	Computed value of t test
<	Less than
=	Equal to

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CHAPTER 1

INTRODUCTION

In the field of child psychology, much research has focused on the prevention of youth behavioral problems and the reduction of child aggression in particular. One study, following newborns over time, identified 58% of their community sample as being on a rising trajectory of modest aggression and 14% as being on a rising trajectory of high physical aggression (Tremblay et al., 2005). This elevated prevalence of child aggression indicates how common these behaviors are and how important prevention research may be in reducing these numbers. However, while it is clear that certain children will exhibit aggressive behavior, it is more difficult to predict which children will develop aggression and therefore which children should be targeted for intervention. The answer may lie in determining which characteristics and factors predispose individuals to violence. Children who do not learn how to properly regulate their aggression during early life are often characterized by key environmental and biological factors (Tremblay et al., 2005). By identifying these risk factors and targeting children based on their levels of risk, interventions can more effectively reduce child aggression.

Risk Factors for Aggression

Studies on risk factors and predictors of aggression have played a critical role in violence prevention research. Most commonly, environmental factors (e.g. parenting) have been examined and found to predispose individuals to aggressive behavior under certain conditions.

Environmental risk factors. Parental attitudes and behaviors in particular have been examined as environmental risk factors for children's aggressive behavior. For example, low

maternal self-esteem, maternal depression, and reduced parental self-control were found to be significant predictors of aggression (Priddis, Landy, Moroney, & Kane, 2014; Ribeaud & Eisner, 2010). Looking more specifically at parenting techniques, a meta-analysis by Hoeve et al. (2009) found that parental monitoring, psychological control, and negative support (i.e. rejection and hostility) accounted for 11% of the variance in children's delinquency.

Attachment literature has also examined the relationship between insecure attachment and behavioral problems in children. Research has found insecure attachment to be associated with aggressive behaviors (DeMulder, Denham, Schmidt, & Mitchell, 2000; Erickson, Sroufe, & Egeland, 1985). In addition, children may be more likely to develop insecure attachment and be at higher risk for aggressive behaviors when parents utilize physical punishment (Coyl, Roggman, & Newland, 2002; Posada & Pratt, 2008).

Child specific risk factors. While environmental factors, and parenting in particular, are important to consider in the context of predicting aggression, it is also important to consider child-specific characteristics. For example, research has found children's low trustfulness, low self control, and hostile attribution to be related to aggression (Ribeaud & Eisner, 2010). Similarly, children's internalizing symptoms, attention deficit hyperactivity disorder symptoms, social problems, thought problems, affect problems, and narcissism have also been found to be significant predictors of aggression (Priddis et al., 2014).

Environmental and child-specific risk factors may also interact to predict aggressive behaviors. For example, in a sample of ethnically diverse 5 to 10-years-olds, inconsistent discipline and harsh punishment predicted aggressive behavior. In addition, these relationships were moderated by the child's gender such that inconsistent discipline and conduct problems were positively associated for boys, but not girls (Tung, Li, & Lee, 2012). These results

highlight the importance of the interaction between environmental and child-specific risk factors (such as gender and parenting) in the development of aggressive behaviors.

Biological risk factors. Another area of research regarding risk factors for aggression has focused on biological predispositions. These may derive from parental characteristics, such as maternal smoking during pregnancy (Ribeaud & Eisner, 2010); however they may also be based in child-specific psychophysiology, which Scarpa and Raine (2004) define as the study of emotions and behavior in the context of physiological measures. In addition, physiological measures, such as heart rate and skin conductance, have been found to be significant predictors of aggressive behavior (discussed in depth in the "Autonomic Arousal and Aggression" section; Scarpa & Raine, 2004).

Biosocial risk factors. While researchers have consistently studied environmental and biological risk factors individually, recent research has shifted focus to examine the contribution of *both* biological and environmental predispositions to aggressive behavior. This shift has been grounded in biosocial theories of violence which suggest that considering the interactions between biological and psychological factors will provide the best understanding of aggressive behavior development (Raine, Brennan, & Farrington, 1997).

Similarly, the social-push hypothesis may provide insight into the interaction of biological and social factors to predict aggression. This theory suggests that biological factors uniquely contribute to aggression more substantially in individuals without predisposing social factors (Scarpa & Raine, 2007). In other words, biological predictors of aggression (such as autonomic arousal) are more likely to explain aggressive behavior in children who lack social factors that contribute to aggression (e.g. low social class, violence victimization).

Reactive and Proactive Aggression

While it is clear that biological and environmental factors contribute to aggressive behavior, it is unclear how they influence different manifestations of aggression. Violence prevention research has often distinguished between different types of aggressive behavior in order to better understand the underlying causes of violence and therefore the most effective ways to prevent it. One way to distinguish between manifestations of aggressive behavior is to categorize them on two specific dimensions—"form" and "function" (Little, Henrich, Jones, & Hawley, 2003). The "form" dimension captures whether aggression is expressed overtly (i.e. use of physical force) or covertly (i.e. ostracism, spreading rumors), while the "function" dimension examines the purpose the aggressive behavior serves.

The current study focused on the "function" of aggression by examining reactive and proactive aggression. Reactive aggression is often referred to as "hot blooded" aggression, which typically manifests in fear responses and defensive actions in response to threat (Dodge, 1991). Reactive aggression is derived from the frustration-aggression model, which suggests that aggression is an angry reaction to perceived frustration or threat (Berkowitz, 1978; Dollard, Doob, Miller, Mowrer, & Sears, 1939). Alternatively, proactive aggression is often referred to as "cold-blooded," calculating, and fearless aggression and is characterized by motivation towards a reward and a general "underarousal" (Dodge, 1991). Proactive aggression is derived from the social learning theory, which suggests that aggression is an acquired behavior that is motivated by external rewards (Bandura, 1973).

While these two types of aggression have been well defined and are widely used, few studies have explored how biosocial interactions and risk factors affect reactive versus proactive

aggression. The present study attempted to fill this gap by assessing how autonomic arousal and parental factors interact to predict each type of aggression uniquely.

Autonomic Arousal and Aggression

The autonomic nervous system (ANS) is comprised of the sympathetic (SNS) and parasympathetic (PNS) branches. While the SNS prepares the body for fight or flight, the PNS conserves and restores energy. In simplified terms, the SNS may be thought of as the gas pedal, and the PNS as the brake pedal. Therefore, activation of the SNS indicates increased physiological arousal, while activation of the PNS indicates reductions in physiological arousal. There are several ways to measure overall autonomic arousal as well as SNS and PNS activity individually. Autonomic arousal may be measured at rest, signifying baseline levels of arousal, or during a task or stressor, signifying autonomic reactivity. Given that the ANS is believed to represent emotional arousal, recent research on biological risk factors has explored the relationship between ANS activation and aggressive behavior.

Heart rate and aggression. Consistently, the most salient and well-supported ANS predictor of aggression has been resting heart rate. Specifically, research has found that aggressive individuals exhibit an underarousal of the autonomic nervous system as indicated by lower levels of heart rate both at rest and during a stressor (Ortiz & Raine, 2004; Van Goozen, Mattys, Cohen-Kettenis, Buitelaar, & Van Engeland, 2000). This underarousal has been demonstrated as early as preschool, with lower baseline heart rate predicting classroom physical and relational aggression (Gower & Crick, 2011). Additionally, gender, age, and source of behavioral rating have been ruled out as possible moderators in these relationships (Ortiz & Raine, 2004).

While most research supports that there is an underarousal of the autonomic nervous system in aggressive individuals, one meta-analysis by Lorber (2004) demonstrated mixed results when examining heart rate specifically. This meta-analysis found that low resting heart rate was associated with aggression and conduct problems, however, it also found that *high* heart rate reactivity (defined as a change from resting) was related to aggression in adults and to conduct problems in children. Therefore, while it may appear that research supports an underarousal of the autonomic nervous system in aggressive adults and children, some conflicting results, as exemplified by Lorber's meta-analysis, reveal areas where the relationships between autonomic arousal and aggressive behavior are unclear and require further examination.

Parasympathetic arousal and aggression. The heart's functioning is heavily influenced by both the SNS and PNS, making it difficult to distinguish between the unique effects of each system on an individual's heart rate. As a result, recent studies have examined other indicators of ANS activity that more accurately measure either the SNS or the PNS in order to gain a better understanding of autonomic arousal among aggressive individuals. One well-supported indicator of PNS activity is respiratory sinus arrhythmia (RSA) or the naturally occurring change in heart rate that occurs during the breathing cycle. RSA acts as a measurement of vagal tone functionality, which is responsible for the regulation of the body's homeostasis. Therefore, increased levels of RSA indicate reduction of heart rate and an attempt to return to a resting state. One study found that adolescents with comorbid conduct disorder and attention deficit hyperactivity disorder showed lower baseline RSA and lower RSA during a stressor (Beauchaine, Katkin, Strassberg, & Snarr, 2001). These results suggest that there is a parasympathetic underarousal in adolescents exhibiting aggressive or antisocial behaviors.

However, research conducted on the same data as the current study found that higher levels of RSA reactivity predicted externalizing behaviors in general (Jimenez-Camargo & Lochman, 2014).

Sympathetic arousal and aggression. Other studies have examined indicators of ANS activity that correspond more directly to the SNS. One widely supported correlate of aggressive behavior that specifically measures SNS activity is electrodermal activity (EDA) or skin conductance. EDA refers generally to any electrical phenomenon of the skin, while skin conductance is a type of EDA that refers more specifically to how well the skin conducts electricity when an external current is applied (Figner & Murphy, 2011). Given their subtle differences, these two terms are often used interchangeably in the literature. Increased levels of skin conductance indicate increased sympathetic arousal and therefore increases in heart rate and activation of the "fight or flight" response.

Based on measures of skin conductance and electrodermal activity, reduced sympathetic arousal was found in children with disruptive behavior disorders (Van Goozen et al., 2000) and with comorbid conduct disorder and attention deficit hyperactivity disorder (Beauchaine et al., 2001). These findings also held true for infants, with one study reporting that low skin conductance activity taken at age 1 predicted aggressive behavior problems at age 3 (Baker, Shelton, Baibazarova, Hay, & Goozen, 2013). Additionally, a study using the same data as the current study (previously mentioned) found that lower levels of skin conductance reactivity predicted more externalizing behaviors (Jimenez-Camargo & Lochman, 2014).

While these studies presented similar findings regarding skin conductance and aggressive behavior, Lorber's (2004) meta-analysis found more complex results by differentiating between age and type of behavior. Specifically, Lorber found lower resting, task, and change EDA in

adults with psychopathy during negative stimuli. The same results were found for children with conduct problems, but only during *nonnegative* stimuli. In contrast to both findings, the meta-analysis revealed *high* EDA reactivity for aggression in adults (Lorber, 2004). These findings indicate that there may be fundamental distinctions between different types of aggressive and antisocial behaviors that correlate with different patterns of autonomic arousal and that these may additionally depend on individual-specific factors (e.g. age).

Autonomic arousal in reactive versus proactive aggression. Examining reactive versus proactive aggression may provide more insight into the differences in autonomic arousal demonstrated by Lorber (2004). While the theory that overall autonomic underarousal predicts aggressive behavior is well supported, the research is much less clear with regards to reactive and proactive aggression.

In a population of East Asian adolescents, it was found that low resting heart rate was associated with proactive aggression and psychopathy. Low resting heart rate also explained reactive aggression, but only in the presence of high psychosocial adversity (Raine, Fung, Portnoy, Choy, & Spring, 2014). Another study found higher skin conductance reactivity in second graders with reactive aggression (Hubbard et al., 2002). These studies suggest a general underarousal for proactive aggression; however, the results for reactive aggression appear more mixed.

One study, conducted with children ages 6 to 13, complicated results even further, finding no relation between resting heart rate and either type of aggression (Scarpa, Haden, & Tanaka, 2010). In addition, this study found reduced levels of overall autonomic and sympathetic arousal in individuals exhibiting reactive aggression, but elevated levels of overall

autonomic and sympathetic arousal in individuals exhibiting proactive aggression (the opposite of what was found in previously mentioned studies; Scarpa et al., 2010).

The conflicting results regarding autonomic arousal in reactive and proactive aggression warrant the generation of more research in order to determine the true relationship between ANS arousal and different types of aggression. Given the conflicting research, the current study examined the relationship between autonomic arousal and aggressive behavior for different types of arousal (skin conductance vs. RSA), in a unique population (at-risk fourth graders), and at different states (at rest vs. during a task).

Gender and race differences. When considering the multiple influences of biological and environmental factors on the development of aggressive behaviors, it is important to consider how these influences may interact with demographic characteristics (e.g. gender and race). However, most previous literature on aggression has focused primarily on male populations, making comparisons across gender nearly impossible. According to a literature review on aggressive behavior in youth, research over the past 10-20 years has shifted to examining both genders in aggression research; however, there is still a need for more research in this area (Rappaport & Thomas, 2004).

With limited research examining gender differences in aggression in general, it is unsurprising that even less research exists on the influence of biological and environmental factors on aggression in males versus females. However, some research has explored gender differences in autonomic arousal, which may provide some insight into how relationships may present differently across genders. For example, research suggests that while males exhibit dominant sympathetic arousal, females exhibit dominant parasympathetic arousal (Evans et al., 2001; Kuo et al., 1999).

Another area lacking research is race differences in the relationship between autonomic arousal and aggression. However, it may again be helpful to understand differences in arousal patterns for different racial groups in general. One study found Caucasians to have higher systolic blood pressure and cardiovascular reactivity than African Americans (Gump, Matthews, & Räikkönen, 1999). In addition, family and neighborhood socioeconomic status predicted cardiovascular reactivity and hostility in African Americans, but only family socioeconomic status predicted these in Caucasians, implicating different causal pathways for each racial group (Gump et al., 1999).

Overall there has been little research exploring the relationships between autonomic arousal and aggression in the context of race or gender. Thus far, it appears as though no study has examined the interaction of autonomic, parenting, and demographic variables together to predict aggression. The current study aimed to test both gender and race as second moderators in order to explore the influence of demographic characteristics on this relationship. Recent literature suggests differences in general autonomic arousal patterns for males versus females and African Americans versus Caucasians (Evans et al., 2001; Gump et al., 1999; Kuo et al., 1999), leading to the conclusion that these differing patterns may affect how autonomic arousal interacts with parenting variables to predict aggressive behaviors in each group.

Parental Factors and Autonomic Arousal

Some studies have examined how parental factors are related to autonomic arousal. Directionality of these relationships has been difficult to determine; however, research still suggests that certain parental factors are associated with aspects of autonomic nervous functioning.

A review examining proximal risk influences on PNS and ANS functioning demonstrated that children's high resting heart rate was associated with maternal depression, marital conflict, and domestic violence. The review also found that reduced parasympathetic arousal was associated with low parent-child communication, maternal depression, marital conflict, and domestic violence (Propper & Holochwost, 2013).

A different study, examining autonomic arousal in toddlers, found that exposure to interparental violence was associated with increased PNS activity and decreased SNS activity. Specifically, the study found that angry emotional reactivity mediated the association between exposure to interparental aggression and PNS activity. On the other hand, fearful emotional reactivity was found to mediate the association between exposure to interparental aggression and SNS activity (Davies, Sturge-Apple, Cicchetti, Manning, & Zale, 2009).

In contrast, another study found that marital conflict predicted reduced autonomic arousal, but elevated sympathetic arousal. This relationship was moderated by the quality of the parent-child relationship. More specifically, marital conflict was more strongly related to elevated sympathetic arousal when the quality of the parent-child relationship was low (Lucas-Thompson & Granger, 2014).

While some studies have examined the relationship between parental factors and ANS arousal, more research is needed. The current study attempted to expand on the literature by examining parental inconsistent discipline and involvement and their relationships with both autonomic arousal and aggressive behaviors. Research has implicated parental involvement as a protective factor and inconsistent discipline as a risk factor for aggressive behavior (Hamner, Latzman, & Chan, 2015; Loeber & Stouthamer-Loeber, 1986; Sawin & Parke, 1979; Wenk, Hardesty, Morgan, & Blair, 1994). By looking at one positive and one negative parental factor,

this study aimed to gain a better understanding of how parental factors and autonomic arousal interact to predict aggressive behaviors.

Parental Factors, Autonomic Arousal, and Aggression

While many studies have examined the relationships between autonomic nervous functioning and either aggressive behavior or parental behaviors, few have examined the intricate relationships between all three of these factors. Even among the research that has explored these relationships, the results have been mixed as they have focused on a diverse range of parental and familial factors.

Parental characteristics. Parental characteristics have been found to influence a child's autonomic functioning and aggressive behaviors. For example, elevated sympathetic reactivity was found to be associated with externalizing behaviors in 14-year-old boys living in single-parent homes. Similarly, in same age girls, elevated sympathetic reactivity was associated with lower mother-perceived interaction quality. In addition, girls living in single-parent households, who exhibited less parasympathetic regulation, had more externalizing problems and boys with less parasympathetic regulation showed negative relationships between single-parent households and negative day to day affect (Diamond, Fagundes, & Cribbet, 2012). These results suggest that for adolescents living in single-parent households, elevated sympathetic reactivity and reduced parasympathetic regulation predict externalizing behaviors and other negative child characteristics, but that these relationships may depend on the child's gender.

Parent-child interactions. Other studies have looked more specifically at familial interaction factors that may more directly affect the relationship between autonomic arousal and aggressive behaviors. For boys in particular, reduced overall autonomic reactivity combined with low family cohesion has been found to predict low levels of prosocial behavior and high

levels of antisocial behavior (Sijtsema et al., 2013). This research suggests that heightened autonomic arousal may act as a protective factor against family adversity. However, in ethnic minority fourth graders, higher levels of harsh parenting prospectively predicted higher levels of externalizing behaviors in children with elevated resting sympathetic arousal. No results were found for parasympathetic arousal in this same population (Bubier, Drabick, & Breiner, 2009). These conflicting results once again highlight the need for more research to better understand and define how autonomic arousal interacts with different parent-child relationship factors to produce aggressive behaviors.

Attachment literature may also help explain the connection between arousal, parenting, and aggressive behaviors in children. For example, Allan Schore (2001) argues that through attachment transactions, mothers subconsciously monitor and regulate their infant's arousal and emotional expression. Children consequently learn how to regulate their responses to external stressors from their parents early on. Therefore, autonomic arousal and other biological indicators of emotion regulation are likely to form reciprocal relationships with parenting behaviors, in turn influencing children's risk for aggressive behaviors.

Other parent-focused factors. Given the lack of research examining how parenting affects the relationship between autonomic arousal and aggressive behaviors, considering how other parental characteristics affect this relationship may provide additional insight. For example, recent research has found higher levels of delinquency in children with elevated resting sympathetic arousal, reduced sympathetic reactivity, and exposure to marital conflict, but also higher levels of delinquency in boys with reduced resting parasympathetic arousal, elevated parasympathetic reactivity, and exposure to martial conflict (El-Sheikh, Hinnant, & Erath, 2011). These findings suggest that gender may play an important role in parental factors as moderators

in the relationships between ANS and aggression. They also indicate that it may be beneficial to explore the interactions between SNS and PNS activity and how different combinations may act as risk factors for aggression, while others may protect against certain negative outcomes.

Family factors, autonomic arousal, and reactive versus proactive aggression. Very few studies have examined the complex relationships between autonomic nervous functioning, family factors, and aggressive behaviors specifically with regards to reactive versus proactive aggression. One study by Scarpa, Tanaka, and Chiara Haden (2008) explored these relationships within the context of community violence exposure. They found that in the presence of reduced overall autonomic arousal, community violence victimization was positively related to proactive aggression. Alternatively, in the presence of elevated parasympathetic arousal, witnessed community violence was positively associated with reactive aggression (Scarpa et al., 2008). These results support the general underarousal expected for "cold-blooded," proactive aggression and the general overarousal expected for "hot-blooded," reactive aggression. Therefore, although this study may not be linked directly to family influences, it may still provide insight into the combined influences of contextual and biological factors on reactive and proactive aggression (for summary of findings regarding autonomic arousal in reactive and proactive aggression, see table 1).

Table 1

Autonomic Arousal in Reactive and Proactive Aggression Findings

Study	Population Age	ANS Indicator	Reactive Aggression Findings	Proactive Aggression Findings
Raine et al., (2014)	East Asian Adolescents (11-17)	Resting heart rate	In context of psychosocial adversity- overall baseline autonomic underarousal	Overall baseline autonomic underarousal
Scarpa, Haden, & Tanaka (2010)	Chidren (6-13)	Resting heart rate, resting skin conductance, and heart rate variability	Baseline parasympathetic and sympathetic underarousal	Baseline parasympathetic and sympathetic overarousal
Hubbard et al., (2002)	Second graders	Skin conductance reactivity	Sympathetic overreactivity	No relationship found
Scarpa, Tanaka, & Chiara Haden (2008)	Children (7-13)	Resting heart rate and heart rate variability	In the context of witnessed community violence- baseline parasympathetic overarousal	In context of community violence victimization- overall baseline autonomic underarousal

Current Study

Overall there is a clear lack of comprehensive research exploring the influence of parent-child interaction factors on the relationship between autonomic arousal and aggression. Even among the limited research that does exist, conflicting findings complicate patterns in the data that may address this question. The current study aimed to be the first to address this issue directly with its focus on how inconsistent discipline and parental involvement may moderate the relationship between autonomic arousal and aggression. The proposed study further explored how these relationships differ for reactive versus proactive aggression, males versus females, and African American versus Caucasians, as these are other areas lacking research. While the effects of autonomic arousal and parenting on one another are likely reciprocal, parenting variables were chosen as the moderator in order to represent a model of contextual risk factors (i.e. parenting) acting on personal risk factors (i.e. autonomic arousal).

Given the inconclusive evidence supporting a clear pattern of autonomic arousal for reactive versus proactive aggression, hypotheses for baseline arousal were based on the general consideration of reactive aggression as "hot blooded" and proactive aggression as "cold-blooded" (Scarpa et al., 2008). Less research has focused on autonomic reactivity in reactive and proactive aggression; therefore, hypotheses for at-task arousal attempted to explain conflicting findings (e.g. Scarpa et al., 2010) by predicting opposite patterns than were predicted at rest. A pattern of opposing baseline and reactivity arousal has been supported as a risk factor for aggressive behavior in children (El-Sheikh et al., 2011), so similar patterns were predicted for the current study.

Hypotheses

I) Proactive Aggression

a. In the presence of high inconsistent discipline and low parental involvement, there will be a negative relationship between baseline skin conductance (SC)/respiratory sinus arrhythmia (RSA) and proactive aggression and a positive relationship between SC/RSA reactivity and proactive aggression. This will indicate an overall emotional underarousal at rest and overarousal during a task. The same patterns will be observed in the presence of low inconsistent discipline and high parental involvement, but the relationships will be less robust.

II) Reactive Aggression

a. In the presence of high inconsistent discipline and low parental involvement, there will be a positive relationship between baseline SC/RSA and reactive aggression and a negative relationship between SC/RSA reactivity and reactive aggression. This will indicate an overall emotional overarousal at rest and underarousal during a task. The

same patterns will be observed in the presence of low inconsistent discipline and high parental involvement, but the relationships will be less robust.

III) Research suggests that teacher and parent reported aggression are not highly correlated with one another, therefore it is expected that these results will appear for parent reported aggression only.

Research Questions

I) Three way interactions will be found between autonomic arousal, parenting variables, and gender to predict aggression. However, given the lack of research on these relationships, direction is not hypothesized.

II) Three way interactions will be found between autonomic arousal, parenting variables, and race to predict aggression. However, given the lack of research on these relationships, direction is not hypothesized.

CHAPTER 2

METHODS

Participants

Data from 360 fourth graders were collected as part of a larger study assessing the efficacy of the Coping Power program. The Coping Power program is an intervention, delivered in individual or group format, implementing aggression prevention strategies in high-risk children. Participants were recruited from twenty public schools in north central Alabama from a range of urban and suburban schools. Schools were randomly assigned to receive Coping Power in a group-based or individual format, with ten schools receiving each version. Teachers from identified schools completed ratings of all of their students to identify children who would likely benefit from the program based on their aggressive behaviors. Students who fell in the top 25% of the teachers' aggression ratings were eligible for participation. These students were then contacted to undergo an assessment interview with the child and their parents. The sample was 64.8% male (n = 234) and 75.6% (n = 273) of the sample identified as African American. The remainder of the sample identified as Other, but were predominately Caucasian and will be referred to as such throughout the rest of the paper. In addition, 61.9% (n= 223) of the sample had a household income below $30,000 (for demographic breakdown see table 2).

Table 2

Demographic Breakdown of Sample

Characteristic	Number	Percentage
Gender		
Male	234	64.8
Female	127	35.2
Race		
African American	273	75.6
Other	88	24.4
Family Income per Year		
Earns no income/ dependent on welfare	18	5
Earns less than $10,000	44	12.2
$10,000-$14,999	46	12.7
$15,000-$19,999	32	8.9
$20,000-$24,999	51	14.1
$25,000-$29,999	32	8.9
$30,000-$34,999	27	7.5
$35,000-$39,999	17	4.7
$40,000-$49,999	31	8.6
$50,000-$59,999	23	6.4
$60,000-$74,999	20	5.5
$75,000-$99,999	11	3.0
Earns $100,000 or more	9	2.5

For the present study, G*Power analysis recommended a sample size of 68 participants for multiple regression, a moderate effect size of 0.15, error probability of 0.05, and power of 0.8 (Erdfelder, Faul, & Buchner, 1996). The observed sample size of 360 participants met this criterion and was therefore sufficient for the current study. A greater number of participants also increased the power of the statistical analysis being conducted. A Post Hoc G*Power analysis determined that the current sample size would yield a power of .99.

Procedure

The Coping Power program began at the end of the participants' fourth grade year and continued throughout their fifth grade year. Pre-intervention (Time 1) measures were completed with children and parents at the time of enrollment during the spring semester of the students'

fourth grade year. Mid-intervention assessments (Time 2) occurred the summer after fourth grade, and post-intervention assessments (Time 3) occurred the summer after fifth grade. Evaluations were completed at the child's home, unless otherwise specified, and children and parents were interviewed separately. Three cohorts of 120 participants were recruited over three subsequent years. Inconsistent discipline, parental involvement, respiratory sinus arrhythmia (RSA), and skin conductance, along with pre-intervention reactive and proactive aggression were examined only at time 1for the current study in order to avoid any confounding influences of the intervention.

Measures

Physiological measures. Heart rate and skin conductance were recorded with a Biolog, a portable physiological data recorder available to the public. The Biolog was attached to participants through bioelectric and transducer input assemblies. Heart rate and interbeat intervals (collected to determine RSA) were measured through the placement of three electrodes. One electrode was placed just above the collarbone on the participant's right side, another electrode was placed behind the left knee, and a reference electrode was placed on the right side of the neck. To measure skin conductance, electrodes were placed on the volar surface of the distal phalanx of the first and third fingers on the participant's non-dominant hand.

Following the placement of the electrodes, each participant watched a three-minute video. The video was meant to be neutral and unlikely to elicit an emotional reaction. The purpose was to allow participants to acclimate to the device and prevent confounding effects of any physiological responses related to unfamiliarity with the equipment. Participants then participated in the Iowa Gambling Task (IGT), a decision making task where participants are told they will gain and lose money every time they choose from four decks of cards. Some decks

have higher probabilities of drawing winning cards, while others have higher probabilities of drawing losing cards; therefore, typical participants learn to pull cards from "winning decks" and avoid "losing decks." Block and reactivity scores were measured during the duration of the IGT in order to assess autonomic arousal during a task.

RSA and skin conductance were derived using the computer software and procedures outlined in a manual on interbeat interval edition (Byrne, 1993). Physiological recordings were taken during the baseline period (prior to the IGT) and at five subsequent blocks of time (during the IGT). Recordings during each of these time periods were averaged to create an overall arousal level for baseline and all five blocks. To measure physiological regulation of emotion, reactivity scores were created for each block by subtracting the baseline from the average block RSA/skin conductance values. The last three reactivity blocks were averaged together and used in the analysis, given that participants may have still been adjusting to the task during the first two blocks. Therefore, when reactivity scores are discussed throughout the remainder of the paper this will refer to the baseline level for the participant subtracted from the average of blocks 3 through 5.

Inconsistent discipline and parental involvement measures. Inconsistent discipline and parental involvement were assessed using the Alabama Parenting Questionnaire (APQ; Shelton, Frick, & Wootton, 1996). The APQ is a 42-item parent report measuring five parenting constructs: parental involvement, positive reinforcement, parental monitoring and supervision, inconsistent discipline, and corporal punishment. Parent behaviors were rated by typical frequency on a 5-point Likert scale ranging from 1 (*never*) to 5 (*always*). Past research has found the APQ to have excellent construct validity (Shelton et al., 1996) and adequate internal consistency (α = .6 –.8; Lochman et al., 2009). In the current sample, parental involvement and

inconsistent discipline scales demonstrated Chronbach's alphas of .79 and .67 respectively. The inconsistent discipline subscale consists of 6 items (e.g. "the punishment you give your child depends on your mood") and the parental involvement subscale consists of 10 items (e.g. "you play games or do other fun activities with your child").

Child reactive and proactive aggression measures. Parents and teachers both completed the Reactive and Proactive Aggression Questionnaire (RPQ; Dodge & Coie, 1987). Parent ratings were used to gain an idea of behaviors in the home/community setting, while teacher ratings were used to gain an idea of behaviors in a school setting. Parents and teachers reported on the frequency of six aggressive behaviors on a 5-point Likert scale (totals ranging from 6 to 30). Previous studies have found adequate internal consistency for the RPQ (α = .66 for proactive, α = .83 for reactive aggression; Vitaro, Barker, Boivin, Brendgen, & Tremblay, 2006). In the current sample, teacher rated reactive and proactive aggression scales demonstrated Chronbach's alphas of .88 and .87 respectively. Parent rated reactive and proactive aggression scales demonstrated Chronbach's alphas of .71 and .80 respectively. The measure includes three items reflecting reactive aggression (e.g. "when this child has been teased or threatened, he or she gets angry easily and strikes back") and three items reflecting proactive aggression (e.g. "this child threatens or bullies in order to get his or her own way").

Analytic Plan

Sixteen models examining inconsistent discipline as a moderator and sixteen models examining parental involvement as a moderator were tested for four predictors (baseline skin conductance, skin conductance reactivity, baseline respiratory sinus arrhythmia, and respiratory sinus arrhythmia reactivity) and four outcomes (parent rated proactive and reactive aggression and teacher rated proactive and reactive aggression). Gender and race were tested as second

moderators in each of these models. Indirect effects of inconsistent discipline on these relationships were examined using PROCESS, a computational tool run within SPSS to generate moderation, conditional process analyses, and bootstrapped bias-corrected 95% confidence intervals (Hayes, 2013). Two-way interactions were tested using Model 1 and three-way interactions were tested using Model 3.

CHAPTER 3

RESULTS

Correlations

Bivariate correlations, means, standard deviations, *n*s, skewness, and kurtosis for study variables are presented in Table 3. While most of the study's variables exhibited normal distributions, several variables displayed higher levels of skewness and kurtosis (e.g baseline skin conductance and skin conductance reactivity). However, according to Hayes (2013), violations of the normality assumption only significantly affect the validity of statistical tests when a small sample size is used or in extreme cases of normality violations. Given the large sample size of the study, the variables in question were considered to be within acceptable limits of skewness and kurtosis and were not altered.

Correlations revealed that teacher and parent reported proactive aggression were only slightly positively associated with one another ($r = .118$, $p = .025$), indicating that teacher and parent reported data measure fairly independent constructs. The same was true of teacher and parent reported reactive aggression ($r = .183$, $p < .001$). Based on these results, it was determined that examining both reports of aggression would not tremendously overlap. Parent reported reactive and proactive aggression were highly associated with one another ($r = .583$, $p < .001$), as were teacher reported reactive and proactive aggression ($r = .555$, $p < .001$). While these correlations were fairly strong, they did not indicate that measuring reactive and proactive aggression separately would be redundant. Parental involvement and inconsistent discipline were significantly negatively correlated ($r = -.182$, p= .001). It is alsoimportant to note that no

significant correlations were found between autonomic variables and aggression scores or parenting variables.

Table 3

Bivariate Correlations, Means, Standard Deviations, Skewness, and Kurtosis for Study Variables

Variable	1	2	3	4	5	6	7	8	9	10
1. Teacher Proactive Aggression	-									
2. Parent Proactive Aggression	.118*	-								
3. Teacher Reactive Aggression	.555**	.194**	-							
4. Parent Reactive Aggression	.135*	.583**	.183**	-						
5. Inconsistent Discipline	.04	.244**	.075	.257**	-					
6. Parental Involvement	.018	-0.13*	-.005	-.165**	-.182**	-				
7. Baseline SC	.007	.073	.066	.080	.063	-.061	-			
8. SC Reactivity	-.029	-.043	-.096	-.011	.038	-.085	-.262**	-		
9. Baseline RSA	.071	.010	.095	-.015	-.001	.013	-.130	-.065	-	
10. RSA Reactivity	.009	.043	.024	.030	.001	.068	-.040	.037	-.483**	-
M		4.73	7.88	10.05	2.44	3.95	7.59	3.24	7.46	.01
SD	2.81	2.47	3.24	2.95	.68	.54	5.40	5.80	1.06	.50
n	361	361	361	361	335	335	247	245	210	209
Skewness	-.296	1.660	.483	-.002	.143	-.326	1.660	-.492	-.411	.579
Kurtosis	-.284	2.636	-.535	-.783	-.007	-.248	3.601	4.866	.186	1.929

Note: SC = Skin Conductance; RSA = Respiratory Sinus Arrhythmia
*$p < .05$.**$p < .01$.

Regression Analyses

The relationship between parenting variables and aggression was assessed using multiple regression analyses. Demographic variables (gender, race, family income, and cohort) as well as the other form of aggression (reactive or proactive) were entered on step 1 as control variables. Parental involvement and inconsistent discipline were then entered on step 2. Demographic variables were removed from the final model if they did not significantly contribute to the variance in aggression. Parental involvement did not significantly predict any type of aggression and neither parenting variable predicted teacher reported aggression. However, inconsistent

discipline predicted parent rated reactive and proactive aggression (*B*= .458, *SE B*= .191, t= 2.393, *p*= .017 and *B*= .339, *SE B*= .163, t= 2.079, *p*= .038 respectively).

Moderation Analyses: Parent Reported Proactive Aggression

In the following analyses gender, race, and the other form of aggression (proactive or reactive) were entered as control variables unless they did not contribute significantly to the model, in which case they were removed. Parental involvement was not a significant moderator in any of the tested models; therefore, reported models are for inconsistent discipline only. A summary of the results of the sixteen moderation models is show in Table 20.

Baseline skin conductance. Regression analyses revealed that a model including parent rated reactive aggression, gender, race, baseline skin conductance, and inconsistent discipline significantly predicted parent rated proactive aggression ($F_{(5, 219)} = 21.590$, $R^2 = .33$, $p < .001$; regression results are shown in Table 4). Parent rated reactive aggression was a significant predictor in this model and inconsistent discipline exhibited a significant trend (*B*= .431, *SE B*= .803, *p*< .001 and *B*= .354, *SE B*= .195, *p*= .07 respectively).

When inconsistent discipline was examined as a moderator in the relationship between baseline skin conductance and parent rated proactive aggression and parent rated reactive aggression was controlled for, the interaction was significant (*B*= .0867, *SE*= .0316, *p*= .007, 95% CI= [.0245, .1489]). The overall model accounted for 34% of the total variance of parent rated proactive aggression ($F_{(4, 220)} = 28.7632$, $p < .001$). A plot of the interaction indicated that baseline skin conductance was positively associated with parent rated proactive aggression in the presence of high inconsistent discipline (1 standard deviation above the mean), but negatively associated with parent rated proactive aggression in the presence of low inconsistent discipline (1 standard deviation below the mean; Figure 1). The Johnson-Neyman test used for determining

regions of significance indicated significant conditional effects of inconsistent discipline at levels below 1.6103 and above 3.1456 (approximately ± 1 standard deviation). Three-way interactions with gender and race were found to be non-significant.

Table 4

Regression Analysis Summary for Baseline Skin Conductance and Inconsistent Discipline's Interaction in Predicting Parent Rated Proactive Aggression (N= 225)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Parent Rated Reactive Aggression	.431	.803	9.211**	---
Gender	-.408	.277	-1.474	---
Race	.304	.342	.889	---
Baseline Skin Conductance	.011	.026	.425	---
Inconsistent Discipline	.354	.195	1.819†	---
Inconsistent Discipline Moderation Model				
Parent Rated Reactive Aggression	.4305	.0461	9.3362	[.3396, .5214]
Gender	---	---	---	---
Race	---	---	---	---
Baseline Skin Conductance	-.2079	.0798	-2.6954**	[-.3652, -.0506]
Inconsistent Discipline	-.4006	.3274	-1.2236	[-1.0457, .2446]
Baseline Skin Conductance x Inconsistent Discipline	.0867	.0316	2.7477**	[.0245, .1489]
Baseline Skin Conductance x Gender	---	---	---	---
Baseline Skin Conductance x Race	---	---	---	---
Baseline Skin Conductance x Inconsistent Discipline x Gender	---	---	---	---
Baseline Skin Conductance x Inconsistent Discipline x Race	---	---	---	---
Baseline Skin Conductance x Race x Gender	---	---	---	---

†$p < .10$ *$p < .05$ **$p < .01$

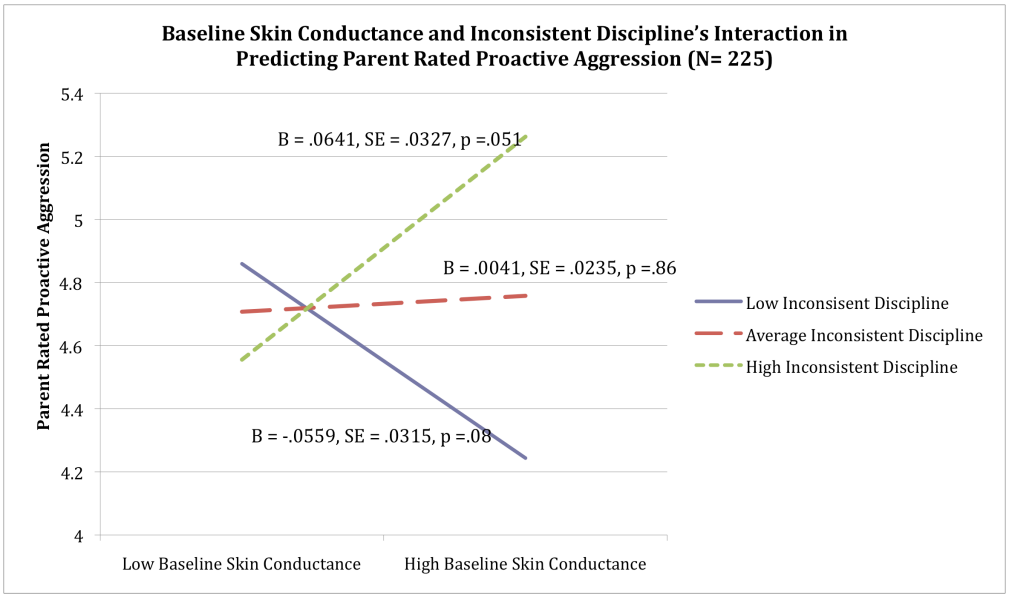

Figure 1: Baseline skin conductance and inconsistent discipline's interaction in predicting parent rated proactive aggression (N= 225)

Skin Conductance Reactivity. Regression analyses revealed that a model including parent rated reactive aggression, gender, race, skin conductance reactivity, and inconsistent discipline significantly predicted parent rated proactive aggression ($F_{(5, 217)} = 21.411$, $R^2 = .33$, p < .001; regression results are shown in Table 5). Parent rated reactive aggression was a significant predictor in this model and inconsistent discipline exhibited a significant trend (B= .433, $SE\ B$= .047, p< .001 and B= .353, $SE\ B$= .195, p= .07 respectively). After controlling for race, gender, and parent rated reactive aggression the interaction between skin conductance reactivity and inconsistent discipline was tested, but was found to be non-significant. Three-way interactions with gender and race were also found to be non-significant.

Table 5

Regression Analysis Summary for Skin Conductance Reactivity Predicting Parent Rated Proactive Aggression (N = 222)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Parent Rated Reactive Aggression	.433	.047	9.264**	---
Gender	-.417	.279	-1.487	---
Race	.211	.311	.680	---
Skin Conductance Reactivity	-.010	.024	-.442	---
Inconsistent Discipline	.353	.195	1.809†	---
Full Model				
Parent Rated Reactive Aggression	---	---	---	---
Gender	---	---	---	---
Race	---	---	---	---
Skin Conductance Reactivity	---	---	---	---
Inconsistent Discipline	---	---	---	---
Skin Conductance Reactivity x Inconsistent Discipline	---	---	---	---
Skin Conductance Reactivity x Gender	---	---	---	---
Skin Conductance Reactivity x Race	---	---	---	---
Skin Conductance Reactivity x Inconsistent Discipline x Gender	---	---	---	---
Skin Conductance Reactivity x Inconsistent Discipline x Race	---	---	---	---
Skin Conductance Reactivity x Race x Gender	---	---	---	---

†$p < .10$ *$p < .05$ **$p < .01$

Baseline Respiratory Sinus Arrhythmia. Regression analyses revealed that a model including parent rated reactive aggression, gender, race, baseline respiratory sinus arrhythmia, and inconsistent discipline significantly predicted parent rated proactive aggression ($F_{(5, 183)} = 24.051$, $R^2 = .39$, $p < .001$; regression results are shown in Table 6). Parent rated reactive aggression and inconsistent discipline were significant predictors in this model ($B = .452$, $SE\ B = .049$, $p < .001$ and $B = .571$, $SE\ B = .211$, $p = .007$ respectively) and gender exhibited a significant trend ($B = -.485$, $SE\ B = .292$, $p = .098$).

Table 6

Regression Analysis Summary for Baseline Respiratory Sinus Arrhythmia, Inconsistent Discipline, and Gender's Interaction in Predicting Parent Rated Proactive Aggression (N = 189)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Parent Rated Reactive Aggression	.452	.049	9.258**	---
Gender	-.485	.292	-1.661†	---
Race	.078	.327	.239	---
Baseline Respiratory Sinus Arrhythmia	.006	.135	.041	---
Inconsistent Discipline	.571	.211	2.704**	---
Inconsistent Discipline Moderation Model				
Parent Rated Reactive Aggression	.4680	.0487	9.6124**	[.3720, .5641]
Gender	---	---	---	---
Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia	.7638	.5096	1.4989	[-.2416, 1.7691]
Inconsistent Discipline	2.8225	1.4778	1.9099†	[-.0932, 5.7381]
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline	-.3077	.1977	-1.5564	[-.6977, .0824]
Full Model with Gender and Race				
Parent Rated Reactive Aggression	.4672	.0485	9.6354**	[.3715, .5629]
Gender	3.5970	2.1606	1.6648†	[-.6661, 7.8600]
Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia	1.5846	.6761	2.3438*	[.2507, 2.9186]
Inconsistent Discipline	3.1421	1.4809	2.1218*	[.2202, 6.0640]
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline	-.3464	.1981	-1.7484†	[-.7372, .0445]
Baseline Respiratory Sinus Arrhythmia x Gender	-.5398	.2846	-1.8966†	[-1.1013, .0218]
Baseline Respiratory Sinus Arrhythmia x Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline x Gender	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline x Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Race x Gender	---	---	---	---

†$p < .10$ *$p < .05$.**$p < .01$

After controlling for parent rated reactive aggression, the interaction between baseline respiratory sinus arrhythmia and inconsistent discipline was tested, but was found to be non-significant. However, once gender was entered into the model as a second moderator (using Model 2) both the interaction between baseline respiratory sinus arrhythmia and inconsistent discipline and baseline respiratory sinus arrhythmia and gender reached trending significance (B= -.3464, SE= .1981, p= .0821, 95% CI= [-.7372, .0445] and B= -.5398, SE= .2846, p= .06, 95% CI= [-1.1013, .0218] respectively). The overall model accounted for 64% of the total

variance of parent rated proactive aggression ($F_{(6\ 182)} = 21.5129$, $p < .001$). This model was unique in that it examined the effects of two separate moderators on the relationship between baseline respiratory sinus arrhythmia and parent rated proactive aggression, but not their interaction (see Figure 2 for a visual representation). When a three-way interaction between baseline respiratory sinus arrhythmia, inconsistent discipline, and gender was examined, trends towards significance were lost.

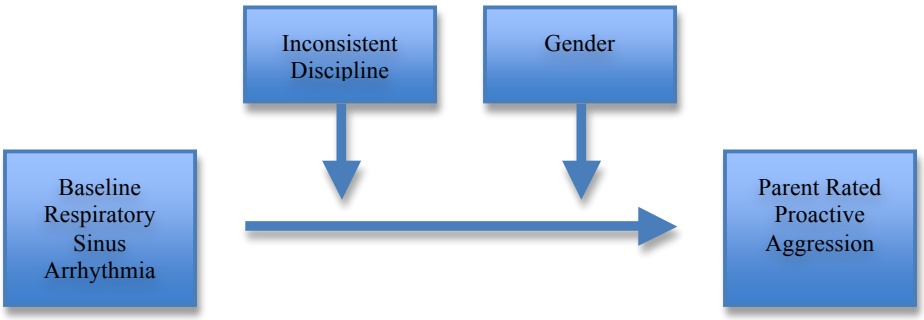

Figure 2: Inconsistent discipline and gender double moderation (model 2)

Plots of the interactions were created, but should be interpreted with caution since a three-way interaction term was not included (Figures 3-5). A plot of inconsistent discipline as the sole moderator indicated that baseline respiratory sinus arrhythmia was negatively associated with parent rated proactive aggression in the presence of high inconsistent discipline, but positively associated with parent rated proactive aggression in the presence of low inconsistent discipline. When these relationships were examined within males and females, there was still a negative association between baseline respiratory sinus arrhythmia and parent rated proactive aggression in the presence of high inconsistent discipline, but this relationship was more robust for females. In males, baseline respiratory sinus arrhythmia was still positively associated with parent rated proactive aggression in the presence of low inconsistent discipline; however, for females there was a negative relationship regardless of the level of inconsistent discipline.

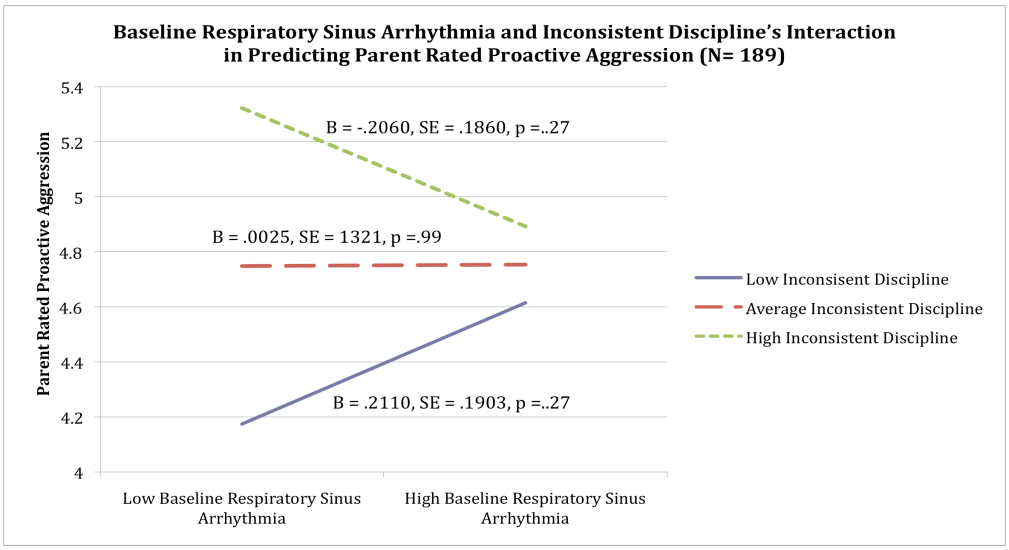

Figure 3: Baseline respiratory sinus arrhythmia and inconsistent discipline's interaction in predicting parent rated proactive aggression (N= 189)

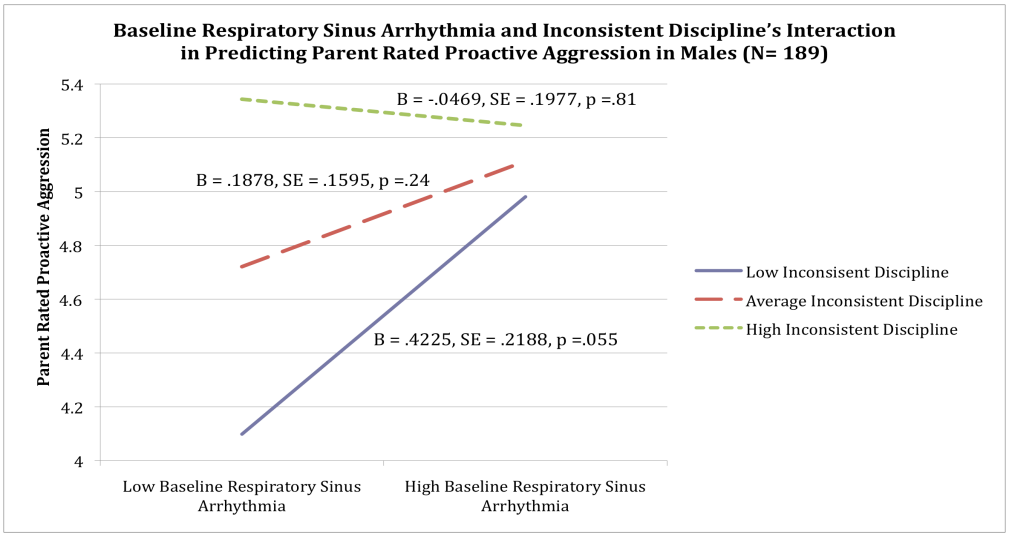

Figure 4: Baseline respiratory sinus arrhythmia and inconsistent discipline's interaction in predicting parent rated proactive aggression in males (N= 189)

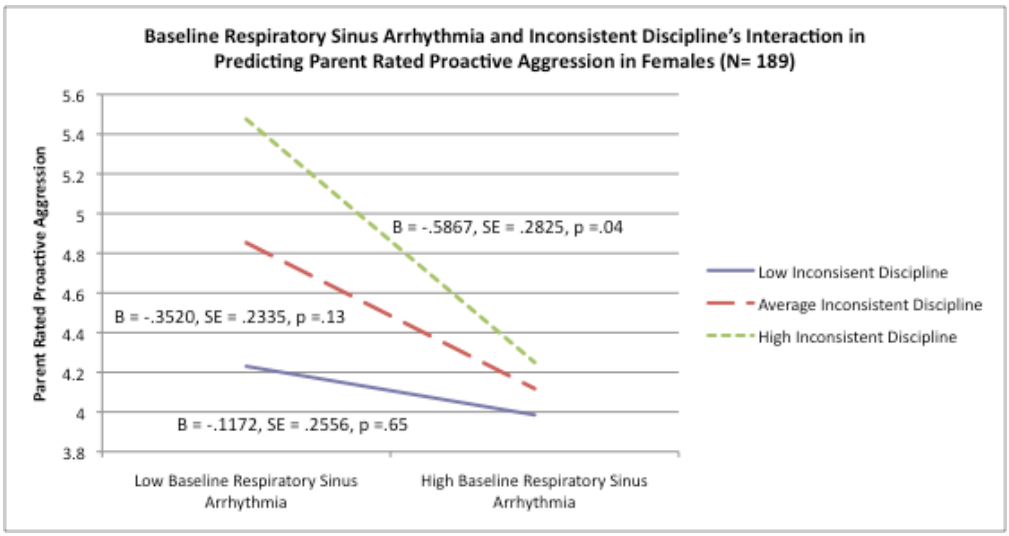

Figure 5: Baseline respiratory sinus arrhythmia and inconsistent discipline's interaction in predicting parent rated proactive aggression in females (N= 189)

Respiratory Sinus Arrhythmia Reactivity. Regression analyses revealed that a model including parent rated reactive aggression, gender, race, respiratory sinus arrhythmia reactivity, and inconsistent discipline significantly predicted parent rated proactive aggression ($F_{(5, 182)}$ = 23.996, R^2 = .40, p < .001; regression results are shown in Table 7). Parent rated reactive aggression and inconsistent discipline were significant predictors in this model (*B*= .450, *SE B*= .049, *p*< .001 and *B*= .570, *SE B*= .211, *p*= .008 respectively) and gender exhibited a significant trend (*B*= -.487, *SE B*= .293, *p*= .098).

After parent rated reactive aggression and gender were controlled for, inconsistent discipline trended towards significance as a moderator between respiratory sinus arrhythmia reactivity and parent rated proactive aggression (*B*= .7253, *SE*= .3842, *p*= .097, 95% CI= [-.0328, 1.4833]. The overall model accounted for 41% of the total variance of parent rated proactive aggression ($F_{(5, 182)}$ = 25.1679, p < .001). Once gender was entered into the model, a three-way interaction between respiratory sinus arrhythmia reactivity, inconsistent discipline, and gender was significant (*B*= 1.6758, *SE*= .0471, *p*< .001, 95% CI= [.3707, .5564]). The

overall model accounted for 46% of the total variance of parent rated proactive aggression ($F_{(8, 179)} = 18.8622$, $p < .001$).

A plot of the model with inconsistent discipline as the sole moderator indicated that respiratory sinus arrhythmia reactivity was positively associated with parent rated proactive aggression in the presence of high and average inconsistent discipline, but negatively associated with parent rated proactive aggression in the presence of low inconsistent discipline (Figure 6). The Johnson-Neyman test indicated no statistically significant transition points. When these relationships were examined within males, there was a negative association between respiratory sinus arrhythmia reactivity and parent rated proactive aggression regardless of the level of inconsistent discipline (Figure 7). However, in females, respiratory sinus arrhythmia reactivity was positively associated with parent rated proactive regardless of the level of inconsistent discipline (Figure 8).

Table 7

Regression Analysis Summary for Respiratory Sinus Arrhythmia Reactivity, Inconsistent Discipline, Gender and their Interaction in Predicting Parent Rated Proactive Aggression (N= 188)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Parent Rated Reactive Aggression	.450	.049	9.234**	---
Gender	-.487	.293	-1.664†	---
Race	.058	.325	.179	---
Respiratory Sinus Arrhythmia Reactivity	.145	.270	.539	---
Inconsistent Discipline	.570	.211	2.698**	---
Inconsistent Discipline Moderation Model				
Parent Rated Reactive Aggression	.4632	.0487	9.5197**	[.3672, .5592]
Gender	-.4967	.2893	-1.7170†	[-1.0675, .0741]
Race	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity	-1.6256	.9743	-1.6684†	[-3.5481, .2968]
Inconsistent Discipline	.5373	.2096	2.5636*	[.1238, .9508]
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline	.7253	.3842	1.8878†	[-.0328, 1.4833]
Full Model with Race and Gender				
Parent Rated Reactive Aggression	.4635	.0471	9.8479**	[.3707, .5564]
Gender	.4323	1.0318	.6757	[-1.6037, 2.4684]
Race	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity	.9954	2.8057	.3548	[-4.5411, 6.5319]
Inconsistent Discipline	1.0232	.5927	1.7263†	[-.1464, 2.1927]
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline	-1.3696	1.1085	-1.2356	[-3.5569, .8178]
Respiratory Sinus Arrhythmia Reactivity x Gender	-2.1685	1.9782	-1.0962	[-6.0720, 1.7351]
Respiratory Sinus Arrhythmia Reactivity x Race	---	---	---	---
Inconsistent Discipline x Gender	-.3709	.3983	-.9311	[-1.1570, .4152]
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline x Gender	1.6758	.7945	2.1092*	[.1080, 3.2436]
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline x Race	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Race x Gender	---	---	---	---

†$p < .10$ *$p < .05$.**$p < .01$

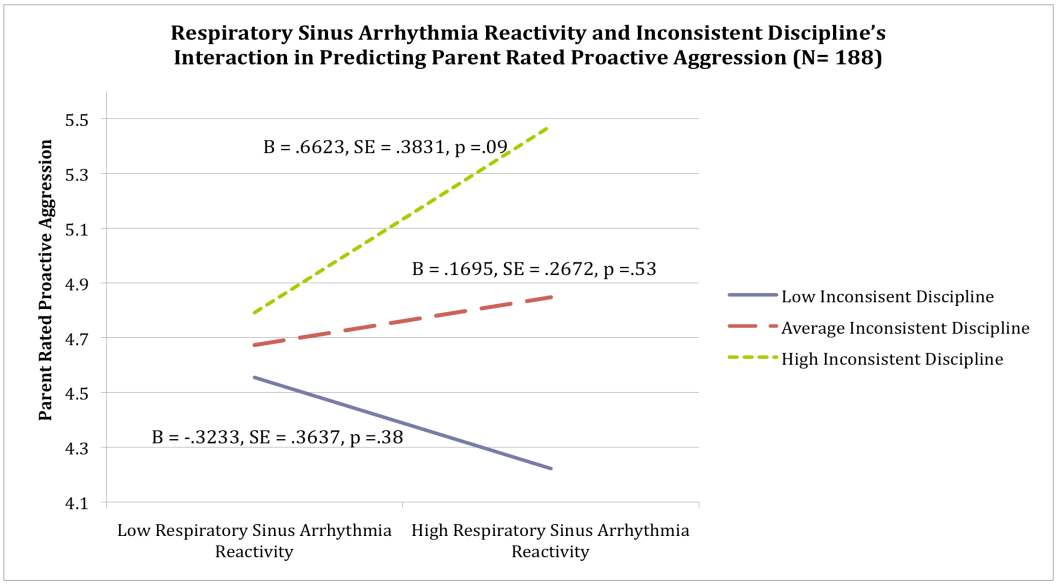

Figure 6: Respiratory sinus arrhythmia reactivity and inconsistent discipline's interaction in predicting parent rated proactive aggression (N= 188)

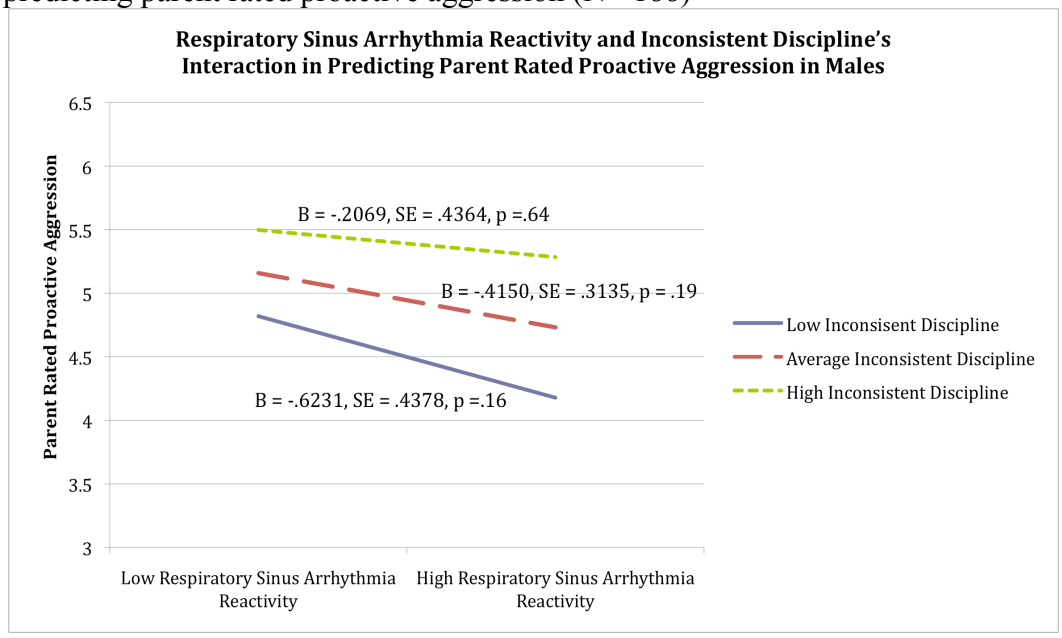

Figure 7: Respiratory sinus arrhythmia reactivity and inconsistent discipline's interaction in predicting parent rated proactive aggression in males (N= 188)

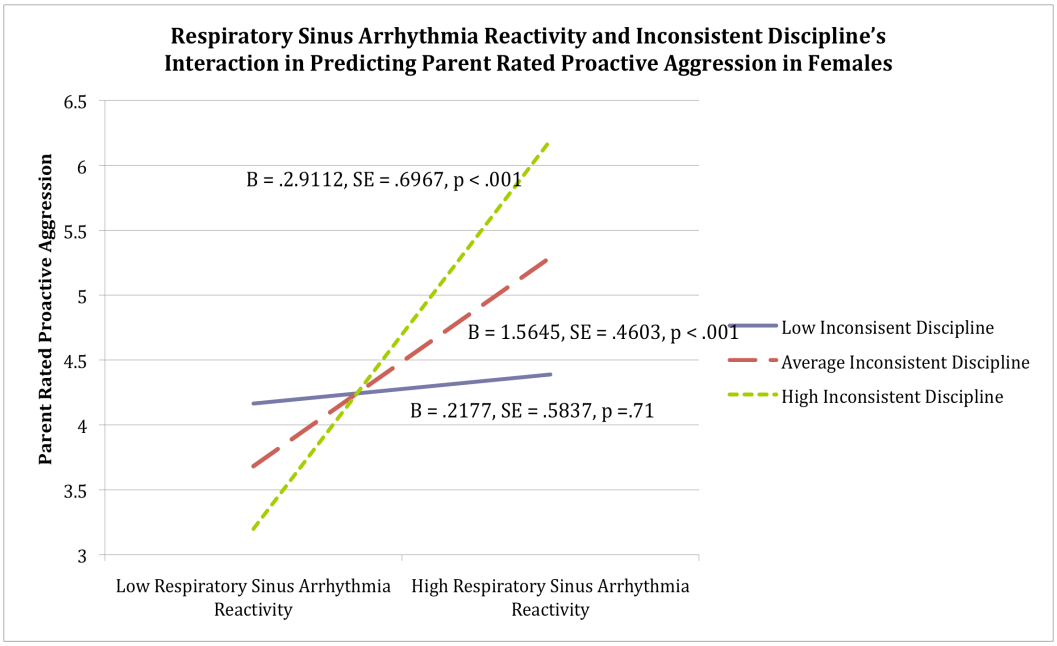

Figure 8: Respiratory sinus arrhythmia reactivity and inconsistent discipline's interaction in predicting parent rated proactive aggression in females (N= 188)

Moderation Analyses: Parent Reported Reactive Aggression

Baseline Skin Conductance. Regression analyses revealed that a model including parent rated proactive aggression, gender, race, baseline skin conductance, and inconsistent discipline significantly predicted parent rated reactive aggression ($F_{(5, 219)} = 21.323$, $R^2 = .32$, $p < .001$; regression results are shown in Table 8). Parent rated proactive aggression and inconsistent discipline were both significant predictors in this model ($B = .648$, $SE\ B = .070$, $p < .001$ and $B = .482$, $SE\ B = .239$, $p = .045$ respectively). After controlling for race, gender, and parent rated proactive aggression the interaction between baseline skin conductance and inconsistent discipline was tested, but was found to be non-significant. Three-way interactions with gender and race were also found to be non-significant.

Table 8

Regression Analysis Summary for Baseline Skin Conductance Predicting Parent Rated Reactive Aggression (N = 224)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Parent Rated Proactive Aggression	.648	.070	9.211**	---
Gender	-.021	.341	-.062	---
Race	.048	.420	.115	---
Baseline Skin Conductance	.026	.032	.810	---
Inconsistent Discipline	.482	.239	2.021*	---
Full Model				
Parent Rated Proactive Aggression	---	---	---	---
Gender	---	---	---	---
Race	---	---	---	---
Baseline Skin Conductance	---	---	---	---
Inconsistent Discipline	---	---	---	---
Baseline Skin Conductance x Inconsistent Discipline	---	---	---	---
Baseline Skin Conductance x Gender	---	---	---	---
Baseline Skin Conductance x Race	---	---	---	---
Baseline Skin Conductance x Inconsistent Discipline x Gender	---	---	---	---
Baseline Skin Conductance x Inconsistent Discipline x Race	---	---	---	---
Baseline Skin Conductance x Race x Gender	---	---	---	---

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

Skin Conductance Reactivity. Regression analyses revealed that a model including parent rated proactive aggression, gender, race, skin conductance reactivity, and inconsistent discipline significantly predicted parent rated reactive aggression ($F_{(5, 217)} = 21.086$, $R^2 = .32$, $p < .001$; regression results are shown in Table 9). Parent rated proactive aggression and inconsistent discipline were both significant predictors in this model ($B = .655$, $SE\ B = .071$, $p < .001$ and $B = .485$, $SE\ B = .240$, $p = .044$ respectively).

After controlling for parent rated proactive aggression, the interaction between skin conductance reactivity and inconsistent discipline was tested, but was found to be non-significant. However, once race was entered into the model, the three-way interaction between skin conductance reactivity, inconsistent discipline, and race was significant ($B = .2318$, $SE =$

.1144, *p*= .044, 95% CI= [.0064, .4573]). The overall model accounted for 35% of the total variance of parent rated reactive aggression ($F_{(8, 214)} = 14.1678$, $p < .001$).

A plot of inconsistent discipline as the sole moderator indicated that skin conductance reactivity was positively associated with parent rated reactive aggression in the presence of high inconsistent discipline, but negatively associated with parent rated reactive aggression in the presence of low inconsistent discipline (Figure 9). When these relationships were examined within African Americans, the direction of the relationships remained the same (Figure 10). However, in Caucasians, the opposite relationships occurred, with skin conductance reactivity being positively associated with parent rated reactive aggression in the presence of low inconsistent discipline, but negatively associated with parent rated reactive aggression in the presence of high inconsistent discipline (Figure 11).

Table 9

Regression Analysis Summary for Skin Conductance Reactivity, Inconsistent Discipline, and Race's Interaction in Predicting Parent Rated Reactive Aggression (N = 223)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Parent Rated Proactive Aggression	.655	.071	9.264**	---
Gender	-.026	.345	-.076	---
Race	-.098	.383	-.256	---
Skin Conductance Reactivity	.011	.029	.377	---
Inconsistent Discipline	.485	.240	2.023*	---
Inconsistent Discipline Moderation Model				
Parent Rated Proactive Aggression	.6541	.0697	9.3830**	[.5167, .7915]
Gender	---	---	---	---
Race	---	---	---	---
Skin Conductance Reactivity	-.1216	.1076	-1.1308	[.3336, .0904]
Inconsistent Discipline	.3286	.2680	1.2261	[-.1996, .8568]
Skin Conductance Reactivity x Inconsistent Discipline	.0538	.0421	1.2785	[-.0291, .1367]
Full Model with Gender and Race				
Parent Rated Proactive Aggression	.6567	.0702	9.3601**	[.5184, .7950]
Gender	---	---	---	---
Race	.9980	1.5062	.6626	[-1.9709, 3.9668]
Skin Conductance Reactivity	.4342	.2801	1.5501	[-.1179, .9864]
Inconsistent Discipline	.6263	.4923	1.2723	[-.3440, 1.5967]
Skin Conductance Reactivity x Inconsistent Discipline	-.1447	.1044	-1.3862	[-.3504, .0610]
Skin Conductance Reactivity x Gender	---	---	---	---
Skin Conductance Reactivity x Race	-.6477	.3037	-2.1326*	[-1.2464, -.0490]
Inconsistent Discipline x Race	-.3764	.5803	-.6486	[-1.5202, .7674]
Skin Conductance Reactivity x Inconsistent Discipline x Gender	---	---	---	---
Skin Conductance Reactivity x Inconsistent Discipline x Race	.2318	.1144	2.0268*	[.0064, .4573]
Skin Conductance Reactivity x Race x Gender	---	---	---	---

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

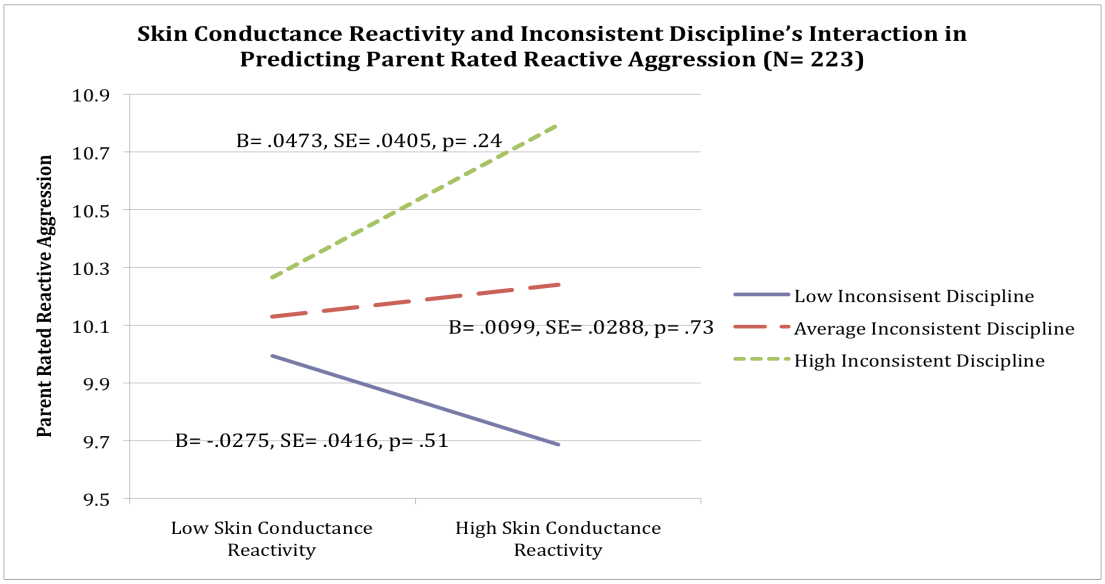

Figure 9: Skin conductance reactivity and inconsistent discipline's interaction in predicting parent rated reactive aggression (N= 223)

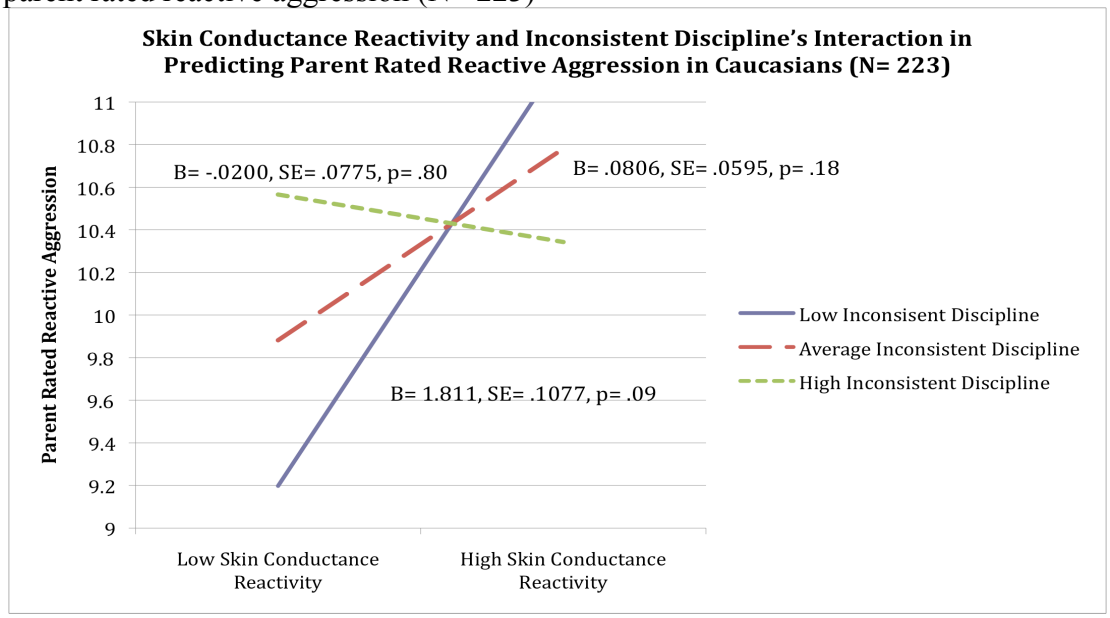

Figure 10: Skin conductance reactivity and inconsistent discipline's interaction in predicting parent rated reactive aggression in Caucasians (N= 223)

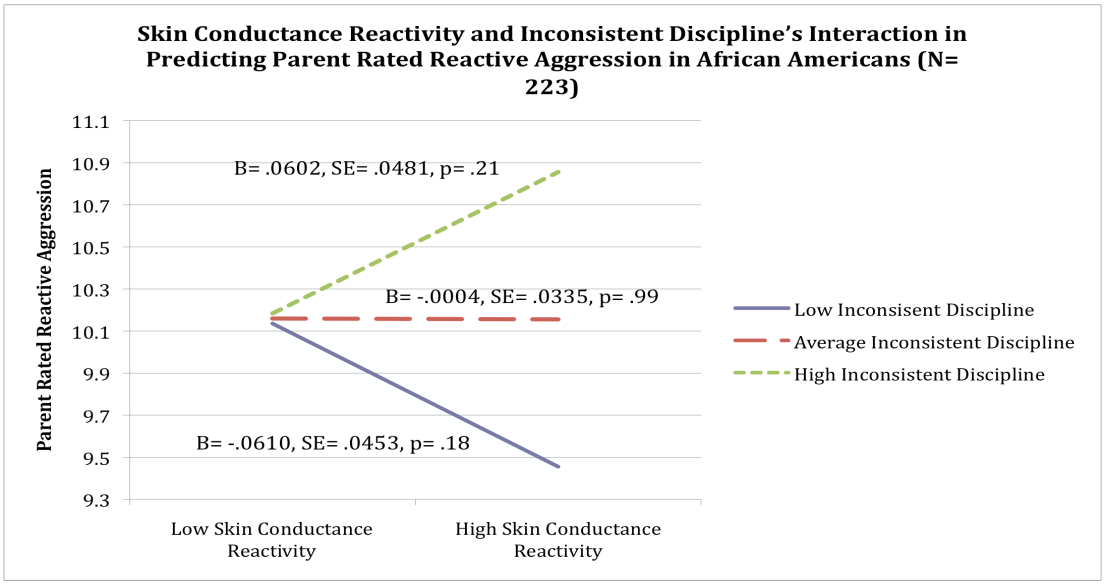

Figure 11: Skin conductance reactivity and inconsistent discipline's interaction in predicting parent rated reactive aggression in African Americans (N= 223)

Baseline Respiratory Sinus Arrhythmia. Regression analyses revealed that a model including parent rated proactive aggression, gender, race, baseline respiratory sinus arrhythmia, and inconsistent discipline significantly predicted parent rated reactive aggression ($F_{(5, 183)}$ = 21.893, R^2 = .37, p < .001; regression results are shown in Table 10). Parent rated proactive aggression was a significant predictor in this model (*B*= .706, *SE B*= .076, *p*< .001).

When inconsistent discipline was examined as a moderator in the relationship between baseline respiratory sinus arrhythmia and parent rated reactive aggression and parent rated proactive aggression was controlled for, the interaction was significant (*B*= .5183, *SE*= .2428, *p*= .03, 95% CI= [.0393, .9974]). The overall model accounted for 39% of the total variance of parent rated reactive aggression ($F_{(4, 184)}$ = 29.1654, p < .001). A plot of the interaction indicated that baseline respiratory sinus arrhythmia was positively associated with parent rated reactive aggression in the presence of high inconsistent discipline, but negatively associated with parent rated reactive aggression in the presence of low inconsistent discipline (Figure 12). The

Johnson-Neyman test indicated significant conditional effects of inconsistent discipline at levels below 1.8695. Three-way interactions with gender and race were found to be non-significant.

Table 10

Regression Analysis Summary for Baseline Respiratory Sinus Arrhythmia and Inconsistent Discipline's Interaction in Predicting Parent Rated Reactive Aggression (N = 210)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Parent Rated Proactive Aggression	.706	.076	9.258**	---
Gender	-.002	.368	-.005	---
Race	.263	.408	.643	---
Baseline Respiratory Sinus Arrhythmia	-.135	.168	-.806	---
Inconsistent Discipline	.374	.268	1.395	---
Inconsistent Discipline Moderation Model				
Parent Rated Proactive Aggression	.7142	.0743	9.6124**	[.5676, .8608]
Gender	---	---	---	---
Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia	-1.4049	.6248	-2.2487*	[-2.6376, -.1723]
Inconsistent Discipline	-3.4938	1.8255	-1.9139†	[-7.0954, .1079]
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline	.5183	.2428	2.1346*	[.0393, .9974]
Full Model				
Parent Rated Proactive Aggression	---	---	---	---
Gender	---	---	---	---
Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia	---	---	---	---
Inconsistent Discipline	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Gender	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline x Gender	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline x Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Race x Gender	---	---	---	---

†$p < .10$ *$p < .05$.**$p < .01$

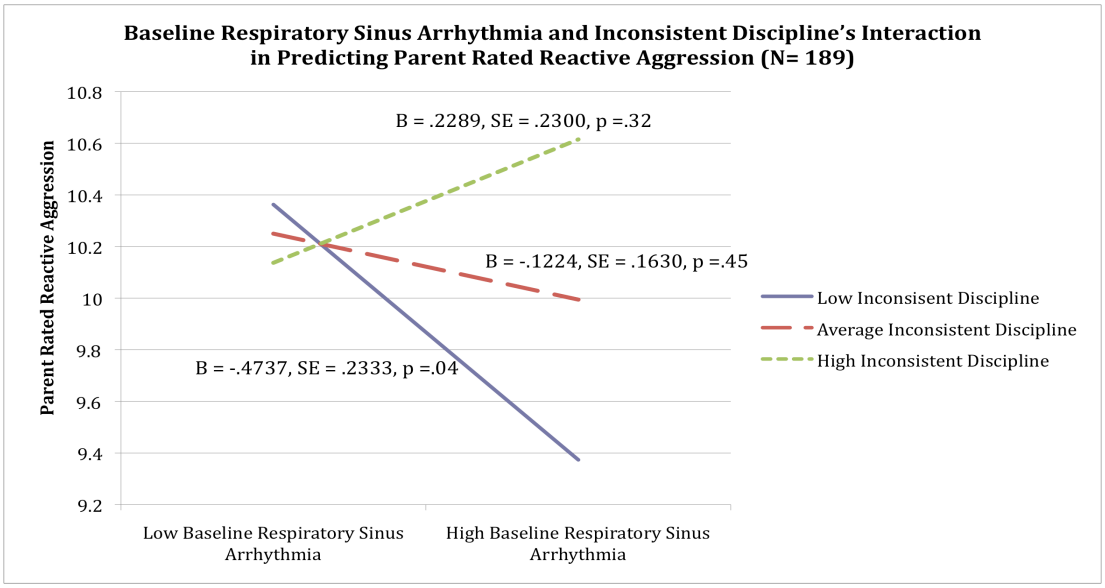

Figure 12: Baseline respiratory sinus arrhythmia and inconsistent discipline's interaction in predicting parent rated reactive aggression (N= 189)

Respiratory Sinus Arrhythmia Reactivity. Regression analyses revealed that a model including parent rated proactive aggression, gender, race, respiratory sinus arrhythmia reactivity, and inconsistent discipline significantly predicted parent rated reactive aggression ($F_{(5, 182)}$ = 21.529, R^2 = .35, p < .001; regression results are shown in Table 11). Parent rated proactive aggression was a significant predictor in this model (*B*= .709, *SE B*= .077, *p*< .001).

When inconsistent discipline was examined as a moderator in the relationship between respiratory sinus arrhythmia reactivity and parent rated reactive aggression and parent rated proactive aggression was controlled for, the interaction was significant (*B*= -1.2533, *SE*= .4724, *p*= .009, 95% CI= [-2.1853, .3214]). The overall model accounted for 39% of the total variance of parent rated reactive aggression ($F_{(4, 183)}$ = 29.7427, p < .001). A plot of the interaction indicated that respiratory sinus arrhythmia reactivity was negatively associated with parent rated reactive aggression in the presence of high inconsistent discipline, but positively associated with parent rated reactive aggression in the presence of low inconsistent discipline (Figure 12). The Johnson-Neyman test indicated significant conditional effects of inconsistent discipline at levels

below 1.6646 and above 3.2235. Three-way interactions with gender and race were found to be non-significant.

Table 11

Regression Analysis Summary for Respiratory Sinus Arrhythmia Reactivity and Inconsistent Discipline's Interaction in Predicting Parent Rated Reactive Aggression (N= 188)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Parent Rated Proactive Aggression	.709	.077	9.234**	---
Gender	-.018	.370	-.049	---
Race	.214	.408	.525	---
Respiratory Sinus Arrhythmia Reactivity	.011	.339	.032	---
Inconsistent Discipline	.371	.269	1.377	---
Inconsistent Discipline Moderation Model				
Parent Rated Proactive Aggression	.7177	.0743	9.6620**	[.5711, .8643]
Gender	---	---	---	---
Race	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity	3.0563	1.1965	2.5544*	[.6956, 5.4170]
Inconsistent Discipline	.3832	.2624	1.4603	[-.1345, .9008]
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline	-1.2533	.4724	-2.6534**	[-2.1853, .3214]
Full Model				
Parent Rated Proactive Aggression	---	---	---	---
Gender	---	---	---	---
Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia	---	---	---	---
Inconsistent Discipline	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Gender	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline x Gender	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline x Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Race x Gender	---	---	---	---

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

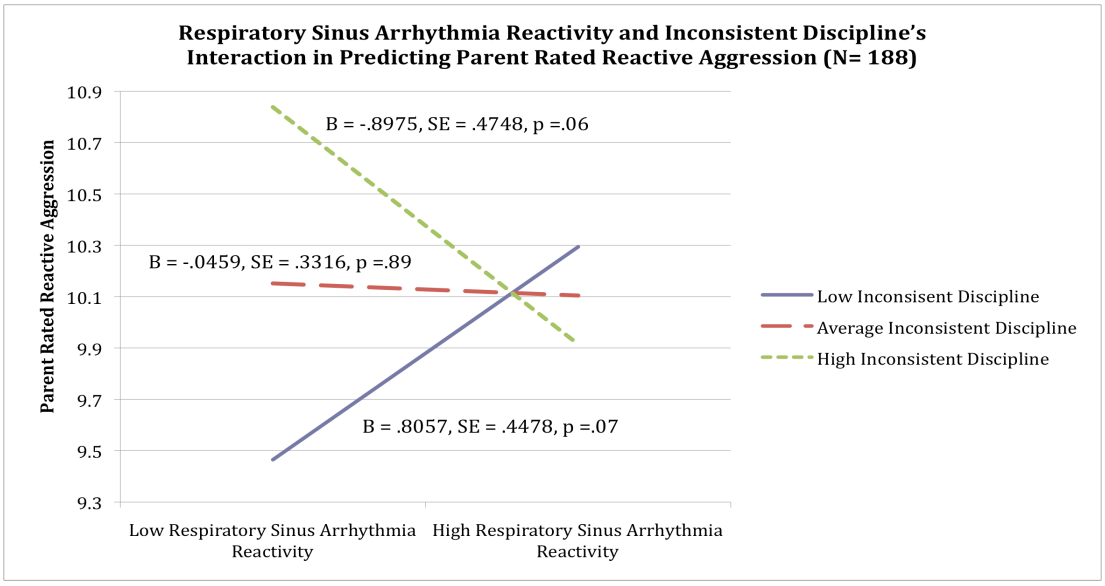

Figure 13: Respiratory sinus arrhythmia reactivity and inconsistent discipline's interaction in predicting parent rated reactive aggression (N= 188)

Moderation Analyses: Teacher Reported Proactive Aggression

Baseline Skin Conductance. Regression analyses revealed that a model including teacher rated reactive aggression, gender, race, baseline skin conductance, and inconsistent discipline significantly predicted teacher rated proactive aggression ($F_{(5, 219)} = 22.354$, $R^2 = .32$, $p < .001$; regression results are shown in Table 12). Teacher rated reactive aggression and gender were significant predictors in this model ($B = .468$, $SE\ B = .048$, $p < .001$ and $B = -.898$, $SE\ B = .325$, $p = .006$ respectively).

After teacher rated reactive aggression and gender were controlled for, inconsistent discipline was tested as a moderator between baseline skin conductance and teacher rated proactive aggression, but was found to be non-significant. However, once gender was entered into the model, a three-way interaction between baseline skin conductance, inconsistent discipline, and gender was significant ($B = -.1834$, $SE = .0755$, $p = .016$, 95% CI= [-.3323, -.0345]). The overall model accounted for 35% of the total variance of teacher rated proactive aggression ($F_{(8, 216)} = 14.6252$, $p < .001$). Additionally, when race was entered into a model

controlling for teacher rated reactive aggression and gender, a three-way interaction between baseline skin conductance, inconsistent discipline, and race was significant (*B*= -.1922, *SE*= .0894, *p*= .033, 95% CI= [-.3683, -.0160]). The overall model accounted for 36% of the total variance of teacher rated proactive aggression ($F_{(9, 215)}$ = 13.3129, p < .001).

A plot of inconsistent discipline as the sole moderator indicated that baseline skin conductance was slightly positively associated with teacher rated proactive aggression in the presence of high inconsistent discipline, but negatively associated with teacher rated proactive aggression in the presence of low and average inconsistent discipline (Figure 14). For males, the direction of these relationships remained the same; however, for females the directions were the opposite, demonstrating a negative relationship between baseline skin conductance and teacher rated proactive aggression in the presence of high inconsistent discipline, but a positive relationship in the presence of low and average inconsistent discipline (Figures 15 and 16). When these relationships were examined within Caucasians, the direction of the relationships reflected those of inconsistent as a sole moderator and of males (Figure 17). However, in African Americans, the opposite relationships occurred (similar to those seen in females), with baseline skin conductance being negatively associated with teacher rated proactive aggression in the presence of high inconsistent discipline, but positively associated with teacher rated proactive aggression in the presence of low inconsistent discipline (Figure 18).

Table 12

Regression Analysis Summary for Baseline Skin Conductance, Inconsistent Discipline, and their Interaction with Gender and Race Predicting Teacher Rated Proactive Aggression (N = 225)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Teacher Rated Reactive Aggression	.468	.048	9.659**	---
Gender	-.898	.325	-2.759**	---
Race	.640	.407	1.572	---
Baseline Skin Conductance	.010	.031	.322	---
Inconsistent Discipline	-.014	.223	-.064	---
Inconsistent Discipline Moderation Model				
Teacher Rated Reactive Aggression	.4810	.0482	9.9728**	[.3859, .5760]
Gender	-.9097	.3270	-2.7815**	[-1.5542, -.2651]
Race	---	---	---	---
Baseline Skin Conductance	-.0571	.0959	-.5949	[-.2462, .1320]
Inconsistent Discipline	-.1855	.3923	-.4729	[-.9587, .5877]
Baseline Skin Conductance x Inconsistent Discipline	.0188	.0379	.4952	[-.0559, .0934]
Three-Way Interaction Model with Gender				
Teacher Rated Reactive Aggression	.4782	.0480	9.9646**	[.3836, .5728]
Gender	-5.1271	1.9691	-2.6038**	[-9.0081, -1.2460]
Race	---	---	---	---
Baseline Skin Conductance	-.8165	.3095	-2.6378**	[-1.4266, -.2064]
Inconsistent Discipline	-2.6205	1.2293	-2.1317*	[-5.0435, -.1975]
Baseline Skin Conductance x Inconsistent Discipline	.3032	.1230	2.4639*	[.0606, .5457]
Baseline Skin Conductance x Gender	.4956	.1917	2.5859*	[.1178, .8733]
Inconsistent Discipline x Gender	1.5943	.7876	2.0242*	[.0419, 3.1466]
Baseline Skin Conductance x Inconsistent Discipline x Gender	-.1834	.0755	-2.4279*	[-.3323, -.0345]
Three-Way Interaction Model with Race				
Teacher Rated Reactive Aggression	.4747	.0484	9.817**	[.3794, .5700]
Gender	-.9358	.3258	-2.8724**	[-1.5780, -.2937]
Race	-6.2204	2.7688	-2.2466*	[-11.6779, -.7629]
Baseline Skin Conductance	-.4229	.1838	-2.3011*	[-.7851, -.0607]
Inconsistent Discipline	-2.3655	.9596	-2.4652*	[-4.2569, -.4742]
Baseline Skin Conductance x Inconsistent Discipline	.1634	.0680	2.4018*	[.0293, .2975]
Baseline Skin Conductance x Race	.5022	.2281	2.2015*	[.0526, .9517]
Inconsistent Discipline x Race	2.6546	1.0689	2.4835*	[.5477, 4.7614]
Baseline Skin Conductance x Inconsistent Discipline x Race	-.1922	.0894	-2.1504*	[-.3683, -.0160]

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

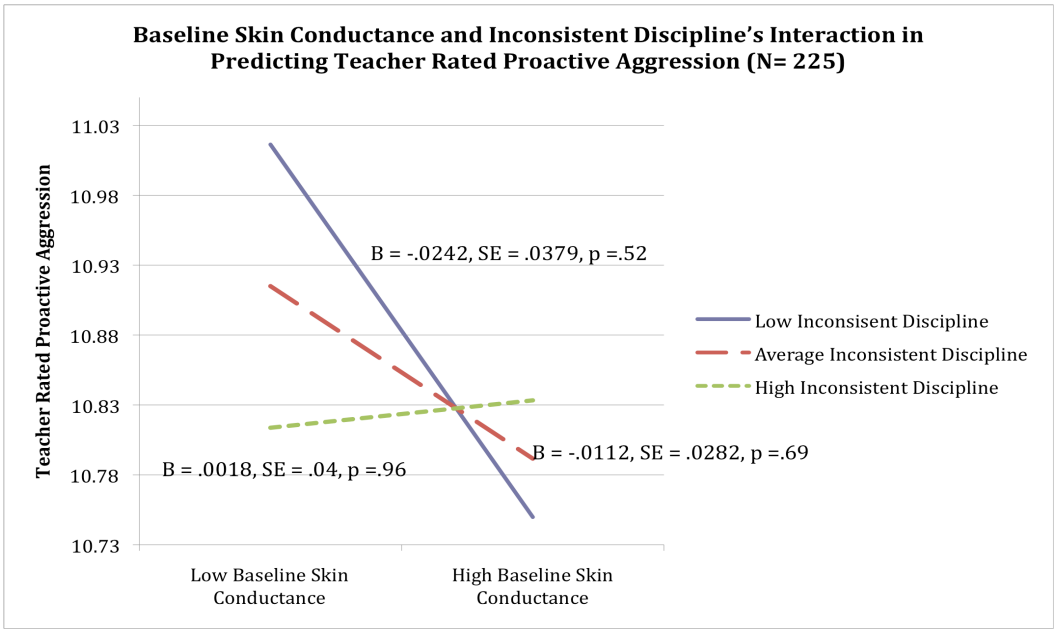

Figure 14: Baseline skin conductance and inconsistent discipline's interaction in predicting teacher rated proactive aggression (N= 225)

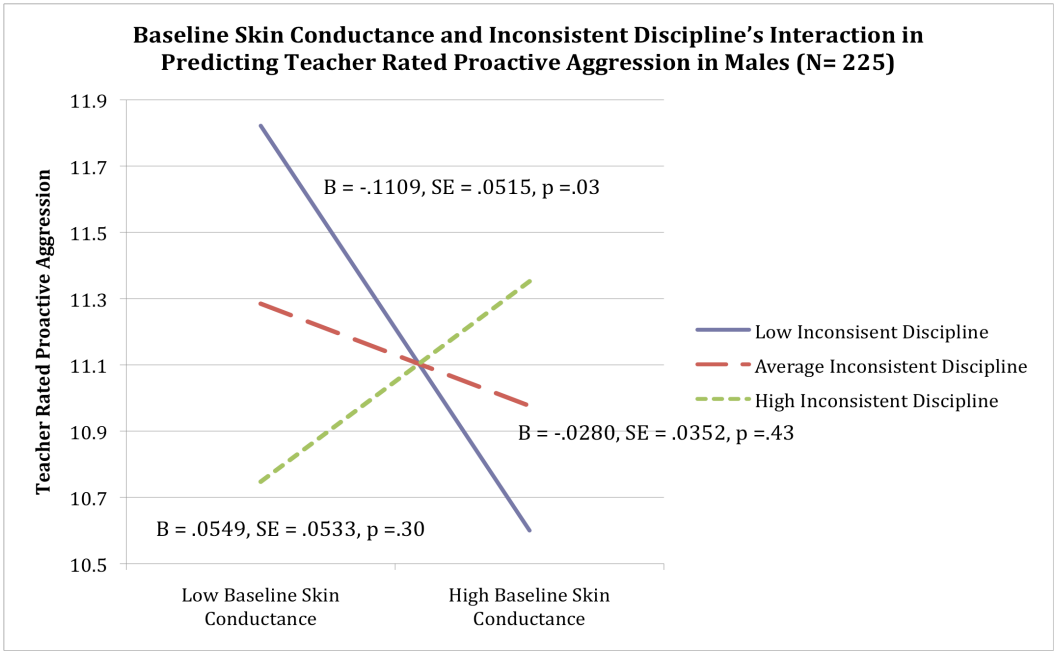

Figure 15: Baseline skin conductance and inconsistent discipline's interaction in predicting teacher rated proactive aggression in males (N= 225)

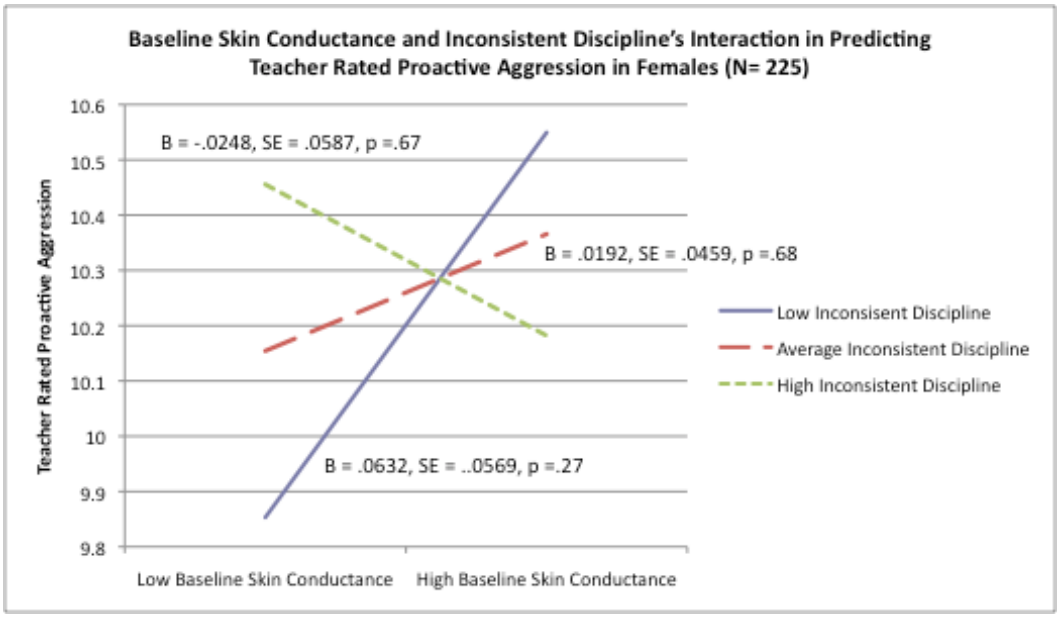

Figure 16: Baseline skin conductance and inconsistent discipline's interaction in predicting teacher rated proactive aggression in females (N= 225)

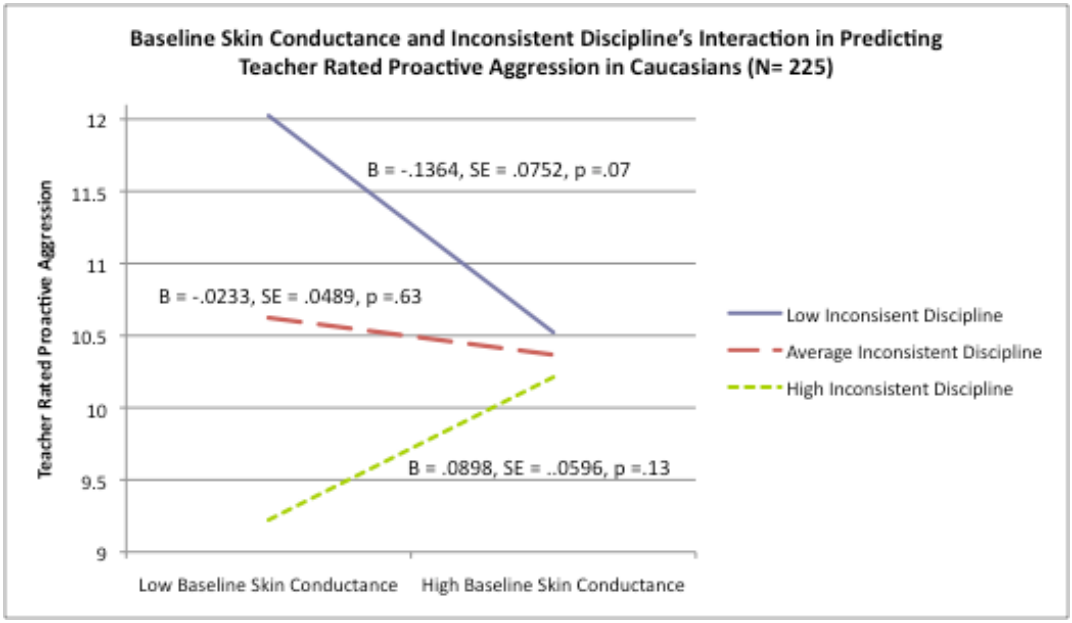

Figure 17: Baseline skin conductance and inconsistent discipline's interaction in predicting teacher rated proactive aggression in Caucasians (N= 225)

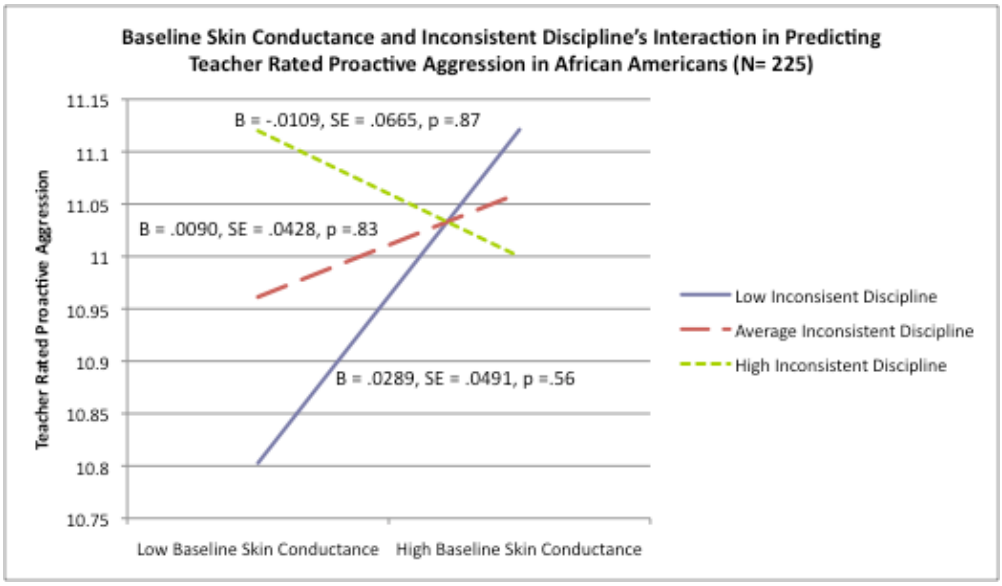

Figure 18: Baseline skin conductance and inconsistent discipline's interaction in predicting teacher rated proactive aggression in African Americans (N= 225)

Skin Conductance Reactivity. Regression analyses revealed that a model including teacher rated reactive aggression, gender, race, skin conductance reactivity, and inconsistent discipline significantly predicted teacher rated proactive aggression ($F_{(5, 217)} = 21.901$, $R^2 = .34$, $p < .001$; regression results are shown in Table 13). Teacher rated reactive aggression and gender were both significant predictors in this model ($B = .465$, $SE\ B = .048$, $p < .001$ and $B = -.978$, $SE\ B = .324$, $p = .003$ respectively).

After controlling for teacher rated reactive aggression and gender the interaction between skin conductance reactivity and inconsistent discipline was tested, but was found to be non-significant. However, once race was entered into the model, the three-way interaction between skin conductance reactivity, inconsistent discipline, and race trended towards significance ($B = -.2050$, $SE = .1102$, $p = .064$, 95% CI= [-.4222, .0123]). The overall model accounted for 35% of the total variance of teacher rated proactive aggression ($F_{(9, 213)} = 12.9644$, $p < .001$).

A plot of inconsistent discipline as the sole moderator indicated that skin conductance reactivity was negatively associated with teacher rated proactive aggression regardless of the

level of inconsistent discipline (Figure 19). When these relationships were examined within Caucasians, the direction of the relationships remained the same, but for individuals with low inconsistent discipline there was a slight positive relationship (Figure 20). In African Americans, the opposite relationships occurred, with skin conductance reactivity being positively associated with teacher rated proactive aggression in the presence of low inconsistent discipline, but negatively associated with teacher rated proactive aggression in the presence of high inconsistent discipline (Figure 21).

Table 13

Regression Analysis Summary for Skin Conductance Reactivity, Inconsistent Discipline, and Race's Interaction in Predicting Teacher Rated Proactive Aggression (N = 223)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Teacher Rated Reactive Aggression	.465	.048	.9611**	---
Gender	-.978	.324	-3.021**	---
Race	.505	.364	1.390	---
Skin Conductance Reactivity	-.018	.028	-.644	---
Inconsistent Discipline	-.006	.221	-.027	---
Inconsistent Discipline Moderation Model				
Teacher Rated Reactive Aggression	.4717	.0483	9.7565**	[.3764, .5670]
Gender	-.9867	.3251	-3.0348**	[-1.6275, -.3459]
Race	---	---	---	---
Skin Conductance Reactivity	-.0332	.1029	-.3230	[-.2360, .1695]
Inconsistent Discipline	-.0458	.2516	-.1819	[-.5417, .4501]
Skin Conductance Reactivity x Inconsistent Discipline	.0070	.0402	.1744	[-.0723, .0863]
Full Model with Gender and Race				
Teacher Rated Reactive Aggression	.4695	.0495	9.4818**	[.3719, .5671]
Gender	-.9140	.3246	-2.8160**	[-1.5538, -.2742]
Race	-1.8924	1.4220	-1.3308	[-4.6955, .9107]
Skin Conductance Reactivity	-.5550	.2673	-2.0762*	[-1.0820, -.0281]
Inconsistent Discipline	-.6714	.4590	-1.4628	[-1.5761, .2333]
Skin Conductance Reactivity x Inconsistent Discipline	.1815	.1000	1.8154†	[-.0156, .3786]
Skin Conductance Reactivity x Gender	---	---	---	---
Skin Conductance Reactivity x Race	.6153	.2911	2.1141*	[.0416, 1.1891]
Inconsistent Discipline x Race	.8555	.5478	1.5617	[-.2243, 1.9352]
Skin Conductance Reactivity x Inconsistent Discipline x Gender	---	---	---	---
Skin Conductance Reactivity x Inconsistent Discipline x Race	-.2050	.1102	-1.8599†	[-.4222, .0123]
Skin Conductance Reactivity x Race x Gender	---	---	---	---

†$p < .10$ *$p < .05$.**$p < .01$

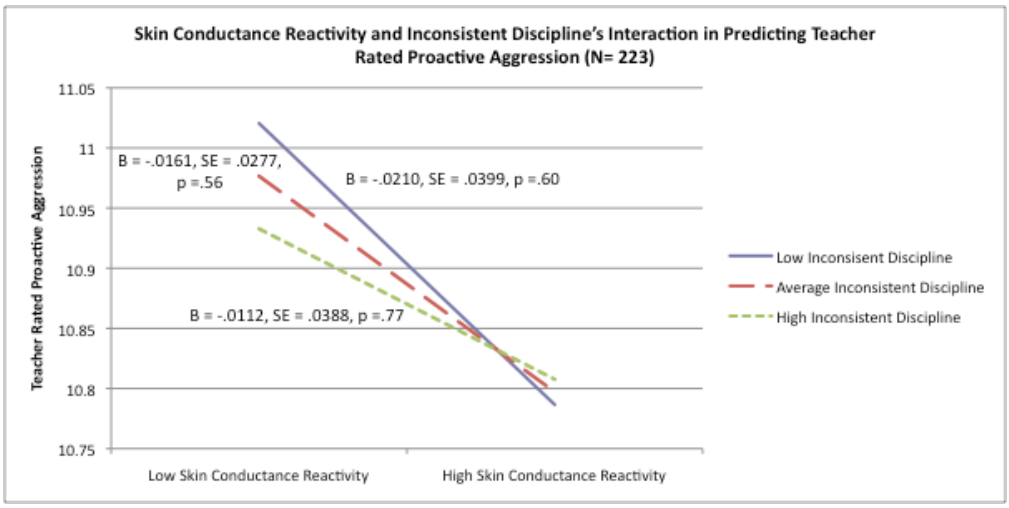

Figure 19: Skin conductance reactivity and inconsistent discipline's interaction in predicting teacher rated proactive aggression (N= 223)

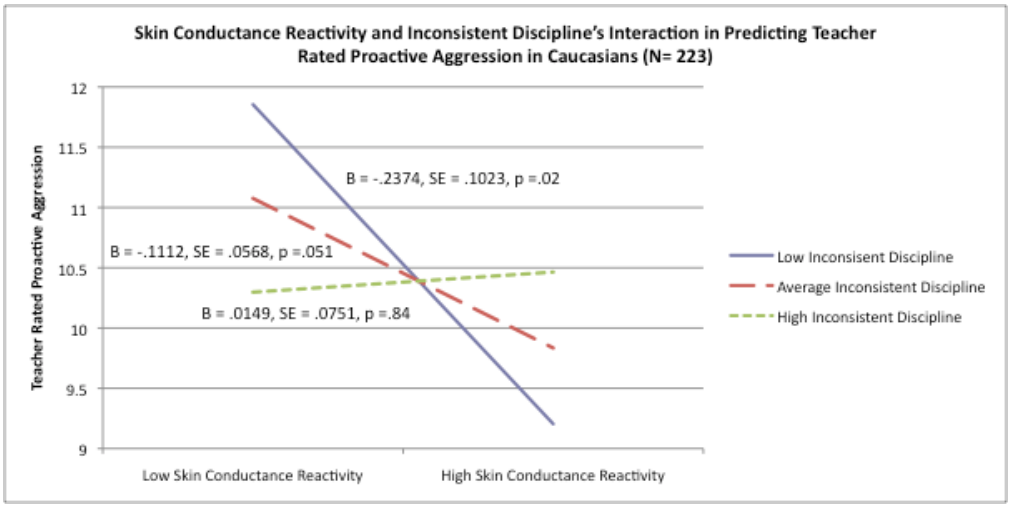

Figure 20: Baseline skin conductance and inconsistent discipline's interaction in predicting teacher rated proactive aggression in Caucasians (N= 223)

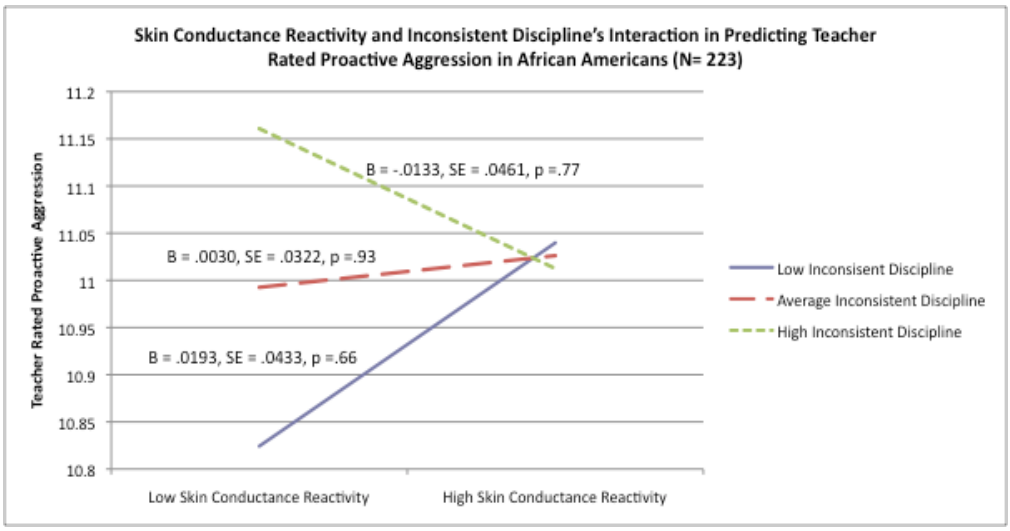

Figure 21: Baseline skin conductance and inconsistent discipline's interaction in predicting teacher rated proactive aggression in African Americans (N= 223)

Baseline Respiratory Sinus Arrhythmia. Regression analyses revealed that a model including teacher rated reactive aggression, gender, race, baseline respiratory sinus arrhythmia, and inconsistent discipline significantly predicted teacher rated proactive aggression ($F_{(5, 183)} =$ 17.826, $R^2 =$ .33, p < .001; regression results are shown in Table 14). Teacher rated reactive aggression and gender were significant predictors in this model (*B*= .461, *SE B*= .056, *p*< .001 and *B*= -1.049, *SE B*= .363, *p*= .004 respectively). After controlling for race, gender, and teacher rated reactive aggression the interaction between baseline respiratory sinus arrhythmia and inconsistent discipline was tested, but was found to be non-significant. Three-way interactions with gender and race were also found to be non-significant.

Table 14

Regression Analysis Summary for Baseline Respiratory Sinus Arrhythmia and Inconsistent Discipline's Interaction in Predicting Teacher Rated Proactive Aggression (N = 210)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Teacher Rated Reactive Aggression	.461	.056	8.168**	---
Gender	-1.049	.363	-2.889**	---
Race	.642	.410	1.565	---
Baseline Respiratory Sinus Arrhythmia	.236	.168	1.408	---
Inconsistent Discipline	0.054	.255	-.212	---
Full Model				
Teacher Rated Reactive Aggression	---	---	---	---
Gender	---	---	---	---
Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia	---	---	---	---
Inconsistent Discipline	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Gender	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline x Gender	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline x Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Race x Gender	---	---	---	---

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

Respiratory Sinus Arrhythmia Reactivity. Regression analyses revealed that a model including teacher rated reactive aggression, gender, race, respiratory sinus arrhythmia reactivity, and inconsistent discipline significantly predicted teacher rated proactive aggression ($F_{(5, 182)} =$ 16.471, $R^2 =$ .31, p < .001; regression results are shown in Table 15). Teacher rated reactive aggression and gender were significant predictors in this model (B= .451, $SE\ B$= .056, p< .001 and B= -1.066, $SE\ B$= .361, p= .004 respectively). After controlling for race, gender, and teacher rated reactive aggression the interaction between respiratory sinus arrhythmia reactivity and inconsistent discipline was tested, but was found to be non-significant. Three-way interactions with gender and race were also found to be non-significant.

Table 15

Regression Analysis Summary for Respiratory Sinus Arrhythmia Reactivity Predicting Teacher Rated Proactive Aggression (N= 187)

Variable	*B*	*SE B*	*t*	95% CI
Main Effects Model				
Teacher Rated Reactive Aggression	.451	.056	8.003**	---
Gender	-1.066	.361	-2.951**	---
Race	.622	.405	1.535	---
Respiratory Sinus Arrhythmia Reactivity	-.055	.334	-.163	---
Inconsistent Discipline	-.066	.253	-.263	---
Full Model				
Teacher Rated Reactive Aggression	---	---	---	---
Gender	---	---	---	---
Race	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity	---	---	---	---
Inconsistent Discipline	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Gender	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Race	---	---	---	---
Inconsistent Discipline x Gender	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline x Gender	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline x Race	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Race x Gender	---	---	---	---

$^{\dagger}p < .10$ $*p < .05$.$**p < .0$

Moderation Analyses: Teacher Reported Reactive Aggression

Baseline Skin Conductance. Regression analyses revealed that a model including teacher rated proactive aggression, gender, race, baseline skin conductance, and inconsistent discipline significantly predicted teacher rated reactive aggression ($F_{(5, 219)} = 20.278$, $R^2 = .32$, p < .001; regression results are shown in Table 16). Teacher rated proactive aggression was a significant predictor in this model ($B = .638$ $SE\ B = .066$, $p < .001$).

After teacher rated proactive aggression was controlled for, inconsistent discipline was tested as a moderator between baseline skin conductance and teacher rated reactive aggression, but was found to be non-significant. However, once race was entered into the model controlling for teacher rated proactive aggression and gender, a three-way interaction between baseline skin

conductance, inconsistent discipline, and race was significant (B= .2128, SE= .1048, p= .044, 95% CI= [.0061, .4194]). The overall model accounted for 33% of the total variance of teacher rated reactive aggression ($F_{(9, 215)}$ = 11.9049, p < .001).

A plot of inconsistent discipline as the sole moderator indicated that baseline skin conductance was positively associated with teacher rated reactive aggression in the presence of low and average inconsistent discipline, but negatively associated with teacher rated reactive aggression in the presence of high inconsistent discipline (Figure 22). When these relationships were examined within Caucasians, the direction of the relationships were the same, but more robust for low inconsistent discipline (Figure 23). However, in African Americans, baseline skin conductance was positively associated with teacher rated reactive aggression regardless of the level of inconsistent discipline (Figure 24).

Table 16

Regression Analysis Summary for Baseline Skin Conductance, Inconsistent Discipline, and Race's Interaction in Predicting Teacher Rated Reactive Aggression ($N = 225$)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Teacher Rated Proactive Aggression	.638	.066	9.659**	---
Gender	.504	.385	1.309	---
Race	.481	.477	1.009	---
Baseline Skin Conductance	.040	.036	1.112	---
Inconsistent Discipline	.078	.261	.301	---
Inconsistent Discipline Moderation Model				
Teacher Rated Proactive Aggression	.6356	.0643	9.8843**	[.5089, .7623]
Gender	---	---	---	---
Race	---	---	---	---
Baseline Skin Conductance	.1377	.1113	1.2372	[-.0817, .3572]
Inconsistent Discipline	.4882	.4551	1.0727	[-.4087, 1.3851]
Baseline Skin Conductance x Inconsistent Discipline	-.0473	.0440	-1.0743	[-.1339, .0394]
Full Model with Gender and Race				
Teacher Rated Proactive Aggression	.6520	.0664	9.8174**	[.5211, .7829]
Gender	.5749	.3871	1.4853	[-.1880, 1.3379]
Race	6.4699	3.2529	1.9890*	[.0582, 12.8816]
Baseline Skin Conductance	.4926	.2154	2.2869*	[.0680, .9171]
Inconsistent Discipline	2.2565	1.1299	1.9971*	[.0294, 4.4836]
Baseline Skin Conductance x Inconsistent Discipline	-.1762	.0799	-2.2052*	[-.3337, -.0187]
Baseline Skin Conductance x Gender	---	---	---	---
Baseline Skin Conductance x Race	-.5289	.2679	-1.9744*	[-1.0569, -.0009]
Inconsistent Discipline x Race	-2.4044	1.2599	-1.9084†	[-4.8877, .0789]
Baseline Skin Conductance x Inconsistent Discipline x Gender	---	---	---	---
Baseline Skin Conductance x Inconsistent Discipline x Race	.2128	.1048	2.0293*	[.0061, .4194]
Baseline Skin Conductance x Race x Gender	---	---	---	---

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

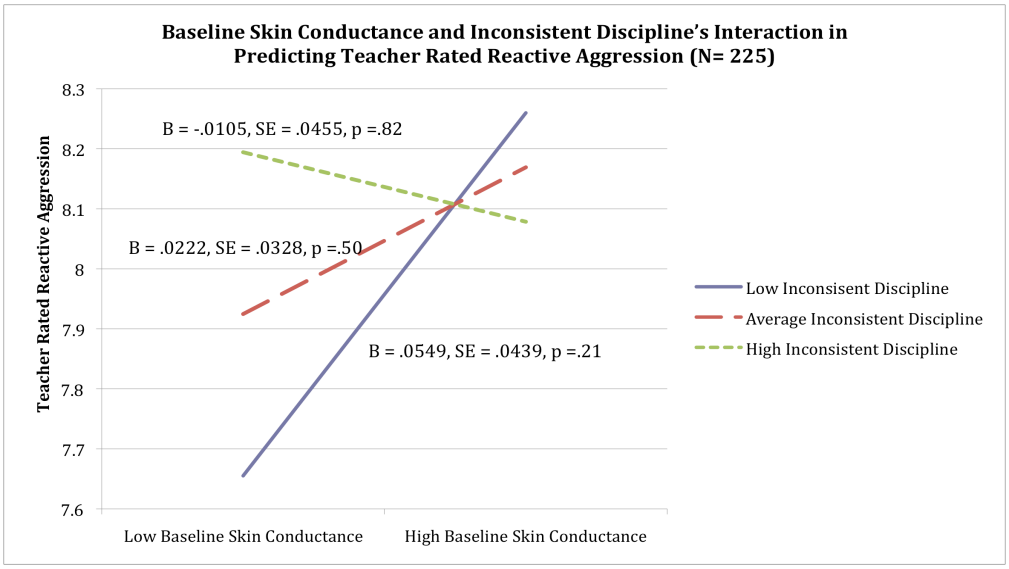

Figure 22: Baseline skin conductance and inconsistent discipline's interaction in predicting teacher rated reactive aggression (N= 225)

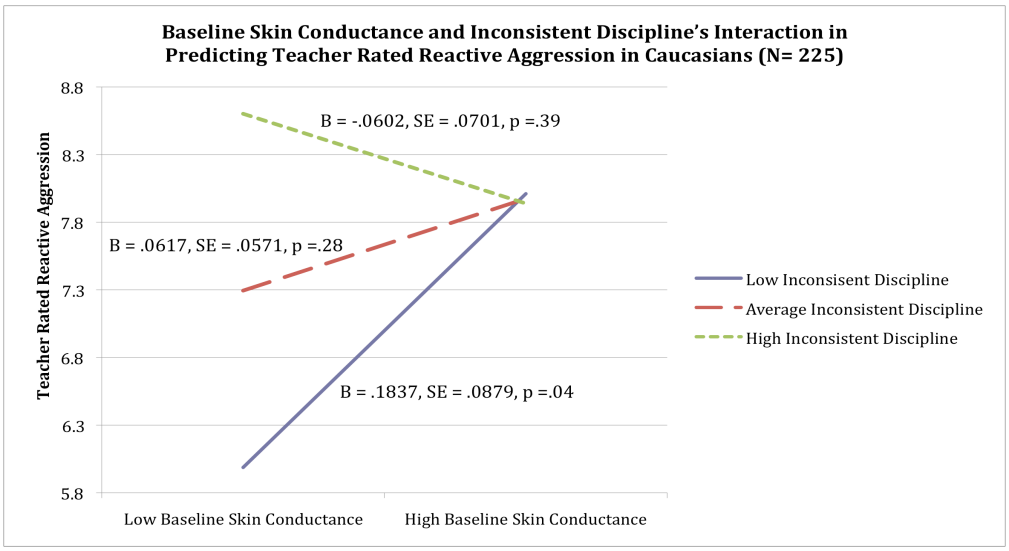

Figure 23: Baseline skin conductance and inconsistent discipline's interaction in predicting teacher rated reactive aggression in Caucasians (N= 225)

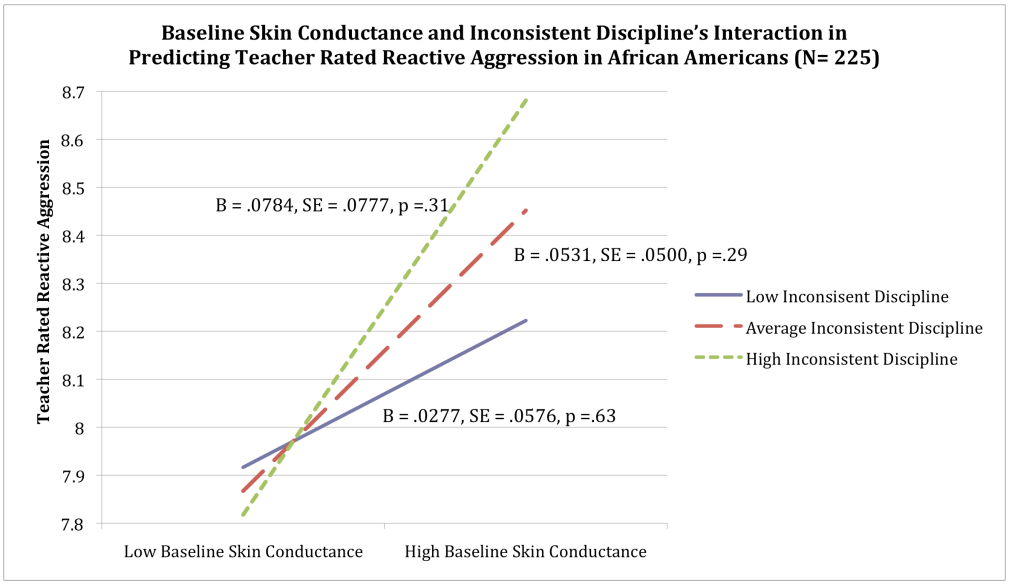

Figure 24: Baseline skin conductance and inconsistent discipline's interaction in predicting teacher rated reactive aggression in African Americans (N= 225)

Skin Conductance Reactivity. Regression analyses revealed that a model including teacher rated proactive aggression, gender, race, skin conductance reactivity, and inconsistent discipline significantly predicted teacher rated reactive aggression ($F_{(5, 217)} = 19.346$, $R^2 = .31$, p < .001; regression results are shown in Table 17). Teacher rated proactive aggression was a significant predictor in this model (*B*= .642 *SE B*= .067, *p*< .001).

After teacher rated proactive aggression was controlled for, inconsistent discipline was tested as a moderator between skin conductance reactivity and teacher rated reactive aggression, but was found to be non-significant. However, once gender was entered into the model controlling for teacher rated proactive aggression, a three-way interaction between skin conductance reactivity, inconsistent discipline, and gender was significant (*B*= .2058, *SE*= .0989, *p*= .039, 95% CI= [.0108, .4007]). The overall model accounted for 32% of the total variance of teacher rated reactive aggression ($F_{(8, 214)} = 12.8667$, p < .001). Additionally, when race was entered into a model controlling for teacher rated proactive aggression, a three-way interaction between skin conductance reactivity, inconsistent discipline, and race was significant (*B*= .4084,

SE= .1262, *p*= .001, 95% CI= [.1597, .6572]). The overall model accounted for 34% of the total variance of teacher rated reactive aggression ($F_{(8, 214)} = 13.6551$, $p < .001$).

A plot of inconsistent discipline as the sole moderator indicated that skin conductance reactivity was negatively associated with teacher rated reactive aggression regardless of the level of inconsistent discipline (Figure 25). For males, skin conductance reactivity was still negatively associated with teacher rated reactivity in the presence of high inconsistent discipline, but was positively associated with teacher rated reactive aggression in the presence of low inconsistent discipline (Figure 26). For females the directions were the opposite, demonstrating a negative relationship between skin conductance reactivity and teacher rated reactive aggression in the presence of low inconsistent discipline, but a positive relationship in the presence of high inconsistent discipline (Figures 27). When these relationships were examined within Caucasians, the direction of the relationships reflected those of males, but the associations were more robust (Figure 28). However, in African Americans, the opposite relationships occurred (similar to those seen in females), with skin conductance reactivity being negatively associated with teacher rated reactive aggression in the presence of low inconsistent discipline, but positively associated with teacher rated reactive aggression in the presence of high inconsistent discipline (Figure 29).

Table 17

Regression Analysis Summary for Skin Conductance Reactivity, Inconsistent Discipline, and Race's Interaction in Predicting Teacher Rated Reactive Aggression (N = 223)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Teacher Rated Proactive Aggression	.642	.067	9.611**	---
Gender	.527	.387	1.364	---
Race	.226	.429	.528	---
Skin Conductance Reactivity	-.010	.032	-.319	---
Inconsistent Discipline	.080	.259	.307	---
Inconsistent Discipline Moderation Model				
Teacher Rated Proactive Aggression	.6300	.0653	9.6506**	[.5013, .7587]
Gender	---	---	---	---
Race	---	---	---	---
Skin Conductance Reactivity	-.0480	.1206	-.3980	[-.2857, .1897]
Inconsistent Discipline	.0497	.2948	.1685	[-.5314, .6307]
Skin Conductance Reactivity x Inconsistent Discipline	.0137	.0472	.2905	[-.0793, .1067]
Three Way Interaction Model with Gender				
Teacher Rated Proactive Aggression	.6502	.0663	9.8126**	[.5196, .7809]
Gender	3.1418	1.5036	2.0895*	[.1780, 6.1056]
Race	---	---	---	---
Skin Conductance Reactivity	.6786	.3727	1.8205†	[-.0561, 1.4132]
Inconsistent Discipline	1.6665	.9188	1.8137†	[-.1446, 3.4775]
Skin Conductance Reactivity x Inconsistent Discipline	-.2817	.1457	-1.9337†	[-.5689, .0054]
Skin Conductance Reactivity x Gender	-.4948	.2472	-2.0019*	[-.9820, -.0076]
Inconsistent Discipline x Gender	-1.0829	.5914	-1.8310†	[-2.2486, .0828]
Skin Conductance Reactivity x Inconsistent Discipline x Gender	.2058	.0989	2.0800*	[.0108, .4007]
Three Way Interaction Model with Race				
Teacher Rated Proactive Aggression	.6163	.0660	9.3420**	[.4863, .7463]
Gender	---	---	---	---
Race	2.3527	1.6531	1.4232	[-.9059, 5.6112]
Skin Conductance Reactivity	.7765	.3096	2.5079*	[.1662, 1.3868]
Inconsistent Discipline	.7172	.5340	1.3429	[-.3355, 1.7698]
Skin Conductance Reactivity x Inconsistent Discipline	-.3198	.1152	-2.7768**	[-.5468, -.0928]
Skin Conductance Reactivity x Race	-.9875	.3355	-2.9436**	[-1.6487, -.3262]
Inconsistent Discipline x Race	-.9106	.6379	-1.4275	[-2.1679, .3468]
Skin Conductance Reactivity x Inconsistent Discipline x Race	.4084	.1262	3.2369**	[.1597, .6572]

†$p < .10$ *$p < .05$.**$p < .01$

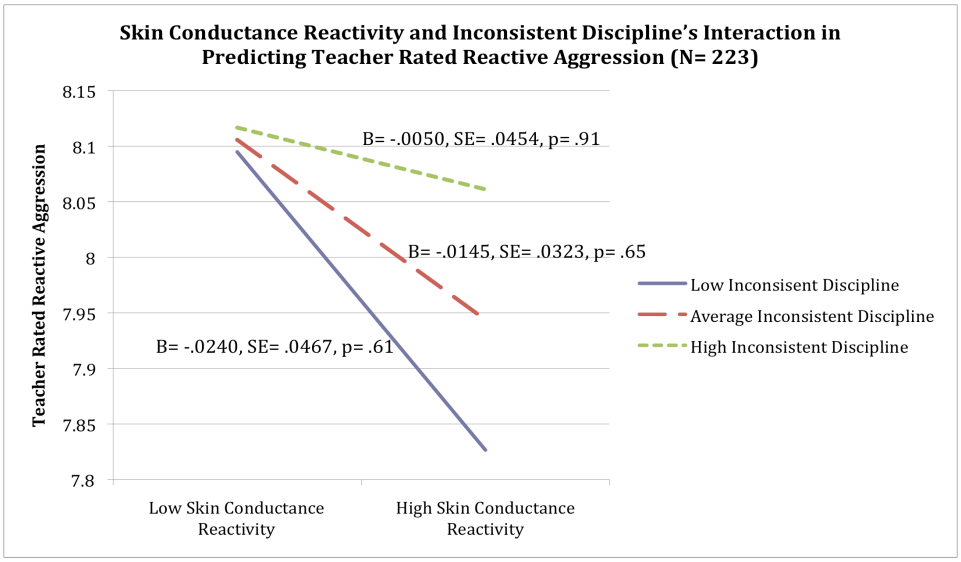

Figure 25: Skin conductance reactivity and inconsistent discipline's interaction in predicting teacher rated reactive aggression (N= 223)

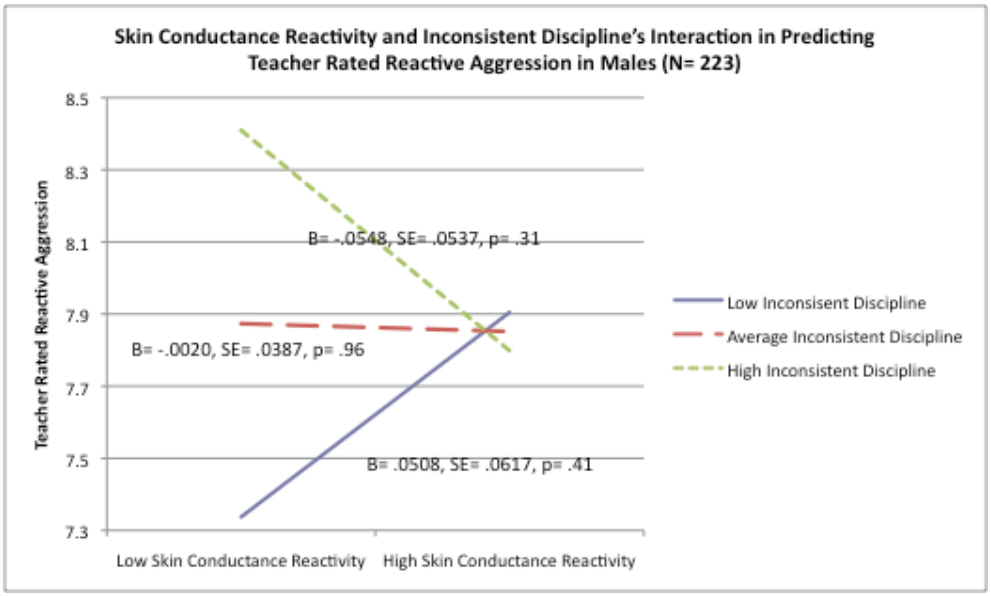

Figure 26: Skin conductance reactivity and inconsistent discipline's interaction in predicting teacher rated reactive aggression in males (N= 223)

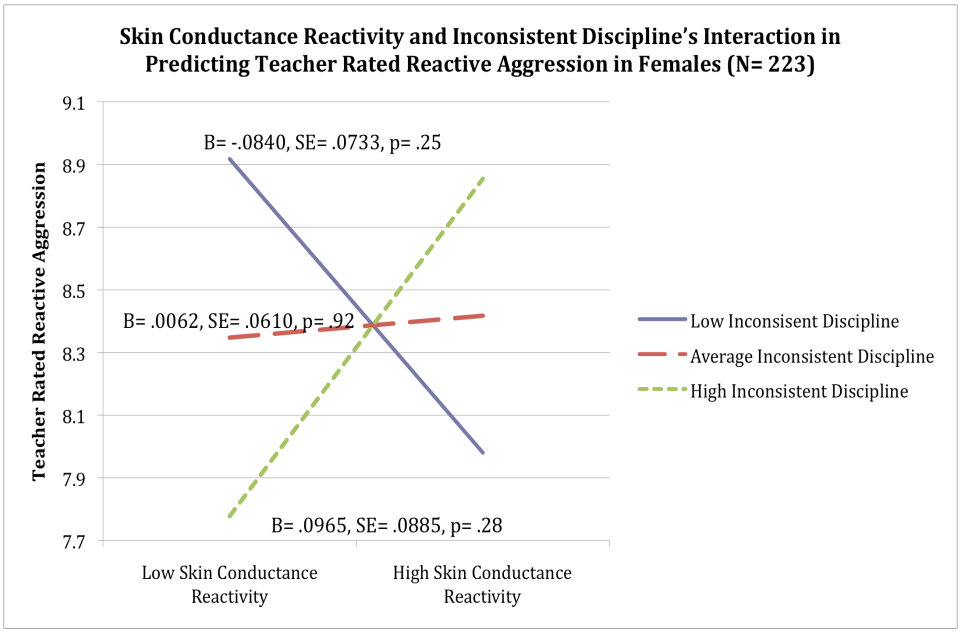

Figure 27: Skin conductance reactivity and inconsistent discipline's interaction in predicting teacher rated reactive aggression in females (N= 223)

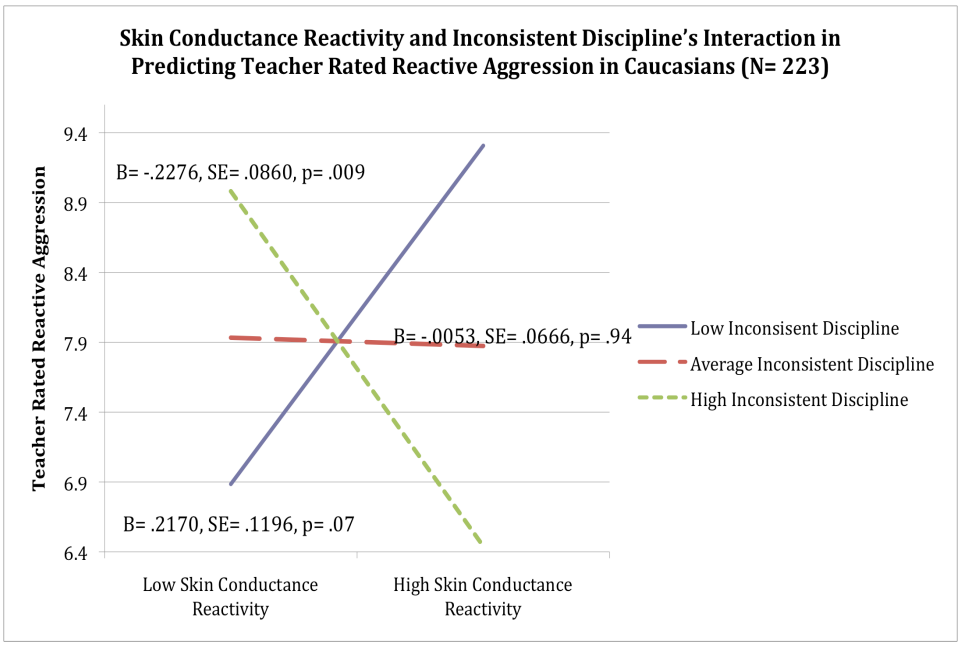

Figure 28: Skin conductance reactivity and inconsistent discipline's interaction in predicting teacher rated reactive aggression in Caucasians(N= 223)

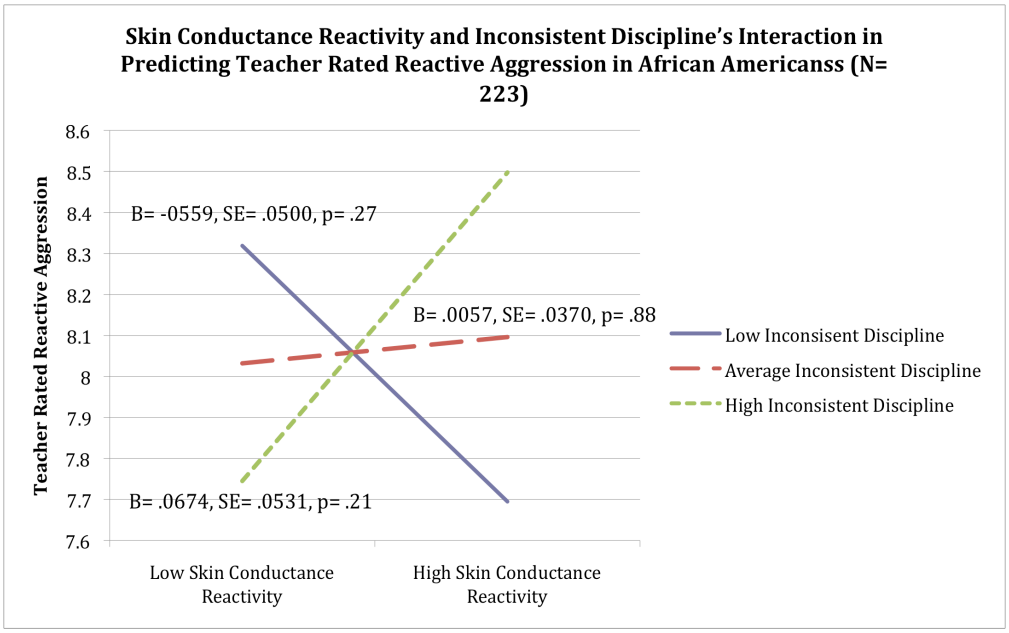

Figure 29: Skin conductance reactivity and inconsistent discipline's interaction in predicting teacher rated reactive aggression in African Americans (N= 223)

Baseline Respiratory Sinus Arrhythmia. Regression analyses revealed that a model including teacher rated proactive aggression, gender, race, baseline respiratory sinus arrhythmia, and inconsistent discipline significantly predicted teacher rated reactive aggression ($F_{(5, 183)}$ = 14.637, R^2 = .29, p < .001; regression results are shown in Table 18). Teacher rated proactive aggression was a significant predictor in this model (*B*= .580, *SE B*= .071, *p*< .001). After controlling for race, gender, and teacher rated proactive aggression the interaction between baseline respiratory sinus arrhythmia and inconsistent discipline was tested, but was found to be non-significant. Three-way interactions with gender and race were also found to be non-significant.

Table 18

Regression Analysis Summary for Baseline Respiratory Sinus Arrhythmia Predicting Teacher Rated Reactive Aggression (N = 188)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Teacher Rated Proactive Aggression	.580	.071	8.168**	---
Gender	.520	.415	1.252	---
Race	.316	.463	.683	---
Baseline Respiratory Sinus Arrhythmia	-.042	.189	-.221	---
Inconsistent Discipline	-.151	.286	-.529	---
Full Model				
Teacher Rated Proactive Aggression	---	---	---	---
Gender	---	---	---	---
Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia	---	---	---	---
Inconsistent Discipline	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Gender	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline x Gender	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Inconsistent Discipline x Race	---	---	---	---
Baseline Respiratory Sinus Arrhythmia x Race x Gender	---	---	---	---

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

Respiratory Sinus Arrhythmia Reactivity. Regression analyses revealed that a model including teacher rated proactive aggression, gender, race, respiratory sinus arrhythmia reactivity, and inconsistent discipline significantly predicted teacher rated reactive aggression ($F_{(5, 182)} = 13.872$, $R^2 = .28$, p < .001; regression results are shown in Table 19). Teacher rated proactive aggression was a significant predictor in this model ($B = .578$, $SE\ B = .072$, $p < .001$). After controlling for race, gender, and teacher rated proactive aggression the interaction between respiratory sinus arrhythmia reactivity and inconsistent discipline was tested, but was found to be non-significant. Three-way interactions with gender and race were also found to be non-significant.

Table 19

Regression Analysis Summary for Respiratory Sinus Arrhythmia Reactivity, Inconsistent Discipline, Gender and their Interaction in Predicting Teacher Rated Reactive Aggression (N= 188)

Variable	***B***	***SE B***	***t***	**95% CI**
Main Effects Model				
Teacher Rated Proactive Aggression	.578	.072	8.003**	---
Gender	.520	.417	1.248	---
Race	.307	.461	.665	---
Respiratory Sinus Arrhythmia Reactivity	.160	.378	.424	---
Inconsistent Discipline	-.152	.287	-.531	---
Full Model				
Teacher Rated Proactive Aggression	---	---	---	---
Gender	---	---	---	---
Race	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity	---	---	---	---
Inconsistent Discipline	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Gender	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Race	---	---	---	---
Inconsistent Discipline x Gender	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline x Gender	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Inconsistent Discipline x Race	---	---	---	---
Respiratory Sinus Arrhythmia Reactivity x Race x Gender	---	---	---	---

$^{\dagger}p < .10$ $*p < .05.**p < .0$

A summary table of moderation analyses is included below (see Table 20). Bolded text indicates results from two-way interactions with inconsistent discipline as the sole moderator. All other text indicates results from three-way interactions with gender, race, or both. All reported interactions were significant at the p < .05 level with the exception of baseline respiratory sinus arrhythmia for parent rated proactive aggression (which was a model 2 analysis) and skin conductance reactivity for teacher rated proactive aggression. These analyses were significant at the p < .10 level and are italicized for reference.

Table 20

Summary of Moderation Results

	Parent Proactive	Parent Reactive	Teacher Proactive	Teacher Reactive
Baseline Skin Conductance	**High baseline SC with high ID†** **Low baseline SC for low ID†**	NA	Males/Caucasians: High baseline SC with high ID Low baseline SC with low ID*(for males) †(for Caucasians) Females/AAs: Low baseline SC with high ID High baseline SC with low ID	Caucasians: Low baseline SC with high ID High baseline SC with low ID*(for Caucasians) AA: high baseline SC for all
Skin Conductance Reactivity	NA	Caucasians: Low SC reactivity for high ID* High SC reactivity for low ID African Americans: High SC reactivity for high ID Low SC reactivity for low ID	***Total: low SC reactivity for all*** *Caucasians:* *High SC reactivity for high ID* *Low SC reactivity for low ID*** *AA:* *Low SC reactivity for high ID* *High SC reactivity for low ID*	Males/Caucasians: Low SC reactivity for high ID†(for Caucasians) High SC reactivity for low ID**(for Caucasians) Females/AA: High SC reactivity for high ID Low SC reactivity for low ID
Baseline Respiratory Sinus Arrhythmia	*Males:* *Low baseline RSA for high ID* *High baseline RSA for low ID** *Females: low baseline RSA for all*(for high ID)*	**High baseline RSA for high ID** **Low baseline RSA for low ID***	NA	NA
Respiratory Sinus Arrhythmia Reactivity	**Total:** **High RSA reactivity for high ID†** **Low RSA reactivity for low ID** Males: low RSA reactivity for all Females: high RSA reactivity for all**(for high ID)	**Low RSA reactivity for high ID†** **High RSA reactivity for low ID†**	NA	NA

Note: SC = Skin Conductance; RSA = Respiratory Sinus Arrhythmia, ID= Inconsistent Discipline
†significant slope at $p < .10$, *significant slope at $p < .05$

CHAPTER 4

DISCUSSION

Regression analyses supported the hypothesis of a biosocial interaction with inconsistent discipline acting as a moderator between autonomic arousal and parent reported reactive and proactive aggression. Unexpectedly, inconsistent discipline also moderated the relationship between autonomic arousal and teacher reported reactive and proactive aggression. As hypothesized, models including gender and race as second moderators also predicted both reported forms of aggression. Both reactive and proactive aggression were predicted by patterns of over- and underarousal under certain contextual conditions, but demonstrated opposite patterns from one another in all significant models. Parental involvement was not supported as a moderator in the relationship between autonomic arousal and either form of aggression.

Inconsistent Discipline as a Moderator

Ten moderation analyses found inconsistent discipline to be a significant moderator (at the $p < .05$ level) in the relationship between autonomic arousal and both teacher and parent reported aggression. Three of the interactions were two-way interactions between autonomic arousal and inconsistent discipline. Two of these indicated a positive relationship between baseline autonomic arousal and parent rated aggression under high levels of inconsistent discipline and the third indicated a negative relationship between autonomic reactivity and aggression under high levels of inconsistent discipline. The other seven significant models

included either race or gender as an additional moderating variable, and will be discussed in depth later in the discussion section.

Results from the significant two-way interactions supported the hypotheses for reactive aggression, but not for proactive aggression. It was expected that children with underarousal during a task, hyperarousal at rest, and high exposure to inconsistent discipline would exhibit higher levels of reactive aggression. Moderation analyses supported this prediction. These results reflect previous research finding high levels of reactive aggression in children with both baseline parasympathetic overarousal and exposure to community violence (Scarpa et al., 2008). It is possible that children who grow up with highly inconsistent parents are forced to remain reactive to situations as a product of the unpredictability of their home environment. It is unclear why baseline parasympathetic hyperarousal would place children at higher risk for developing reactively aggressive behaviors in this environment, but Scarpa et al. (2008) hypothesized that high levels of parasympathic arousal may reflect disinhibited temperament, increasing impulsivity and risk-taking.

It was expected that children with underarousal at rest, but hyperarousal during a task, and high levels of inconsistent discipline exposure would exhibit higher levels of proactive aggression; however, moderation analyses did not support this. Instead, results indicated that children with increased baseline sympathetic arousal who are exposed to high levels of inconsistent discipline display higher levels of proactive aggression. These results are surprising given past research finding underarousal patterns in individuals high in proactive aggression (Raine et al., 2014; Scarpa et al., 2008). However, these results are supported by some research finding a positive relationship between baseline sympathetic arousal and proactive aggression (Scarpa et al., 2010). It is possible that children who naturally have higher skin conductance

levels are generally more emotionally aroused and therefore elicit harsher, more inconsistent punishment from their parents providing a learning environment for proactively aggressive behavior.

Inverse relationships were found between autonomic variables and aggression depending on level of inconsistent discipline and demographic characteristics, meaning that findings from all cited studies may be matched with the reported results, just not in the hypothesized context. For example, previous research findings that sympathetic hyper-reactivity is associated with higher levels of reactive aggression (Hubbard et al., 2002) is supported by these findings, but only in the context of low inconsistent discipline. It is possible that some individuals begin by exhibiting reactive aggression in response to perceived threat, but that over time, these behaviors become more proactive. As children learn the instrumental value of aggression they may move towards proactive aggression as a means to obtain rewards. This developmental trajectory may help explain the overlap between arousal patterns in reactive versus proactive aggression.

Overall these results indicate that inconsistent discipline moderates the relationship between certain autonomic variables and the two types of aggression and that this relationship may additionally depend on demographic characteristics. These findings are particularly important given that no significant main effects were found for autonomic variables predicting either form of aggression. These results highlight how important environmental factors (particularly parenting styles) may be in the development and maintenance of aggressive behaviors in children.

Reactive and Proactive Aggression Differences

Given the three-way interactions between autonomic arousal variables, inconsistent discipline, and demographic characteristics, it is difficult to definitively conclude that differences

exist between these relationships in reactive versus proactive aggression for all four measures of autonomic arousal. However, for respiratory sinus arrhythmia (RSA) reactivity, opposite arousal patterns were observed for parent reported proactive and reactive aggression. In the presence of low inconsistent discipline, children high in proactive aggression presented with reduced RSA reactivity, while children high in reactive aggression presented with increased RSA reactivity. When this relationship was observed in the presence of high inconsistent discipline, the opposite patterns emerged.

These results suggest that without the negative influence of inconsistent discipline, children high in proactive aggression typically exhibit reduced parasympathetic reactivity while children high in reactive aggression typically exhibit increased parasympathetic reactivity. This is consistent with the general hypothesis of proactive and reactive aggression being characterized by under- and overarousal respectively (Scarpa et al., 2008). However, under the influence of high inconsistent discipline, these relationships reverse and children high in proactive aggression exhibit heightened parasympathetic reactivity, while children high in reactive aggression exhibit reduced parasympathetic reactivity. Additionally, these results imply that parasympathetic reactivity may act as a protective factor for different functions of aggression depending on the presence of inconsistent discipline. For example, in the context of high inconsistent discipline, heightened parasympathetic reactivity may protect against the development of reactive aggression, but reduced parasympathetic reactivity may protect against the development of proactive aggression.

These results conflict with Scarpa et al.'s study (2008), which found that in the context of community violence, individuals high in proactive aggression exhibited lower resting heart rate (an indicator of overall autonomic arousal) and individuals high in reactive aggression exhibited

higher heart rate variability (an indicator of parasympathetic arousal). While one may expect to see similar influences of community violence and parenting styles on the relationship between autonomic arousal and aggression, the differing results are unsurprising given that the studies assessed different contextual moderating factors. However, the Scarpa et al. (2008) study did also find an inverse relationship between victimization and aggression at differing levels of arousal, implicating high resting heart rate and low heart rate variability as protective factors against aggressive behaviors in the context of community violence. This mirrors the present study's findings that parasympathetic arousal may be implicated as a risk and protective factor for aggression under certain environmental conditions.

While it was not possible to compare reactive and proactive aggression at all four possible levels of autonomic arousal, in those in which comparison was possible (baseline skin conductance and RSA reactivity), the patterns of arousal were reversed between the types of aggression. In other words, present data support that reactive and proactive aggression are characterized by opposite patterns of autonomic arousal as has been shown in previous studies (Scarpa et al., 2010, 2008).

While differences in autonomic arousal were found between children demonstrating proactive versus reactive aggression, it is important to note that most aggressive children exhibit *both* proactive and reactive behaviors (Bobadilla, Wampler, & Taylor, 2012). As a result, while children typically demonstrate a diverse range of aggressive behaviors, the behaviors themselves may still be characterized as either proactive or reactive. By examining these "pure" forms of reactive and proactive behaviors, one may better understand the unique motivations and risk factors for these types of behaviors.

Gender as a Moderator

Three models included gender as a significant moderator between autonomic arousal and inconsistent discipline in predicting aggression. When examining teacher reported aggression in the context of high inconsistent discipline, males exhibited a positive relationship between baseline skin conductance and proactive aggression and a negative relationship between skin conductance reactivity and reactive aggression. Females on the other hand, exhibited the opposite and hypothesized patterns. In addition, when considering parent reported aggression, males exhibited a negative relationship between RSA reactivity and proactive aggression at all levels of inconsistent discipline. Females exhibited a positive relationship between RSA reactivity and proactive aggression at all levels of inconsistent discipline, but this relationship was strongest at high levels. Males and females demonstrated opposite arousal pattern for both parent and teacher reported reactive and proactive aggression, highlighting the importance of gender differences in these relationships.

Research has shown that males typically demonstrate more dominant sympathetic arousal, while females demonstrate more dominant parasympathetic arousal (Evans et al., 2001; Kuo et al., 1999). The present study's results support a dominant parasympathetic branch for females, but only support a dominant sympathetic branch for males under high levels of inconsistent discipline. Therefore, while typically developing males and females may consistently exhibit certain patterns of autonomic arousal, the current study suggests that these patterns are not consistent in at-risk children exposed to differing levels of parental discipline.

Research has also shown that gender moderates the relationship between parenting and conduct problems (Tung et al., 2012). The current study supports these findings and furthers the literature by implicating both parenting and gender as moderators in the relationship between

autonomic arousal and aggressive behavior. These results emphasize the importance of taking the interaction between environmental and child-specific demographic factors into account when considering how autonomic arousal may relate to different functions of aggression.

Race as a Moderator

Three models included race as a significant moderator between autonomic arousal and inconsistent discipline in predicting aggression. When examining teacher reported aggression in the context of high inconsistent discipline, like males, Caucasians exhibited a positive relationship between baseline skin conductance/skin conductance reactivity and proactive aggression and a negative relationship between baseline skin conductance/skin conductance reactivity and reactive aggression. Like females, African Americans exhibited the opposite and hypothesized patterns. These results for skin conductance reactivity match what was found based on parent reported aggression. Caucasians exhibited a negative relationship between skin conductance reactivity and proactive aggression in the context of high inconsistent discipline and African Americans exhibited the opposite pattern. Caucasians and African Americans demonstrated opposite arousal pattern for both parent and teacher reported reactive and proactive aggression, highlighting the importance of race differences in these relationships.

It is interesting that Caucasians and males exhibited similar autonomic arousal patterns, while African Americans and females exhibited similar autonomic arousal patterns. In addition, females and African Americans demonstrated patterns of arousal that matched this study's hypotheses. Given that previous studies have also used predominately African American samples, it is unsurprising that African Americans in particular mirrored predicted patterns. However, it is less clear why females would demonstrate this same pattern, given the use of predominately male samples in the current study and previous studies. It is possible that African

Americans and females are more prone to victimization in the broader culture making them hypervigilant to possible provocation. Following continued exposure to threat, these individuals may be primed to respond in a certain way and may develop a higher arousal threshold.

Parent and Teacher Data Agreement

It was also difficult to conclusively determine the level of agreement between parent and teacher reported aggression given the three-way interactions and non-significant interactions; however, comparison was possible for the relationship between skin conductance and teacher versus parent reported reactive aggression. For both teacher and parent reported reactive aggression, Caucasians exhibited high skin conductance reactivity in the presence of low inconsistent discipline and low skin conductance reactivity in the presence of high inconsistent discipline, while African Americans displayed the opposite patterns for both teacher and parent reports. Despite the low correlations between parent and teacher reported aggression, similar patterns emerged for both types.

RSA variables seemed to be more predictive of parent reported data given that three of the four models were significant for parent reported data (based on $p < .05$) versus none for teacher reported data. Conversely, skin conductance variables seemed to be predictive of both teacher and parent reported data. At school and in the home, children may be exposed to threatening stimuli (e.g. bullying at school, harsh parenting at home), which may influence the activation of their fight or flight response (influenced by the sympathetic nervous system). This may explain why skin conductance was found to be predictive of both sources of reported aggressive behaviors. More often in the home environment however, children may be faced with emotionally charged family conflict and may perceive harsh responses from their parents. This is likely exacerbated in emerging adolescents as they begin seeking independence and testing

boundaries. In this type of home environment, it is possible that children are experiencing heightened arousal, but having difficulty regulating this arousal, which may explain why RSA was found to be more predictive of parent reported aggressive behaviors.

In addition, more three-way interactions with gender and race were found for teacher reported aggression (5 significant models) than for parent reported aggression (2 significant models). Therefore, it appears as though there is something unique about school-based aggressive behaviors that are more affected by demographic characteristics (i.e. gender, race). It is possible that elementary school-aged children deal with more gender and race specific teasing and conflict at school than at home and therefore their aggressive behaviors may be more influenced by these characteristics in a school environment.

Limitations and Future Recommendations

The primary limitations of this study include generalizability, reliance on self-reported parenting data, and a cross-sectional design. Given that the present study's sample was drawn from identified aggressive children, it is unclear how these results would generalize to a low-risk or more variable sample. Given that the sample was predominately from low socioeconomic backgrounds, it is also possible that living in these at-risk environments affected emotional arousal and even parenting practices. Worries about finances and other stressors may contribute uniquely to relationships among emotional arousal, parenting, and aggression in an at-risk sample. Assessing these relationships in an aggressive sample aids in the understanding of the development of aggressive behaviors in at-risk youth, however, this comes at the cost of generalizing these findings. In addition, the present sample was primarily composed of African Americans and Caucasians, limiting the ability to extend findings beyond these two racial groups.

The Alabama Parenting Questionnaire was a self-reported measure completed by parents on their own behaviors. Self-reported data may be somewhat inaccurate due to poor recall and a desire to be viewed in a positive light. However, the present study attempted to compensate for this limitation by utilizing different sources of information for the independent, moderating, and dependent variables. Autonomic arousal was measured directly from the child and required no subjective reporting from the participants, the parent reported on parenting, and both the parent and teacher reported on aggression. By including three sources of data (child, parent, and teacher) the present study avoided relying solely on self-reported data or data from only one source.

The cross-sectional design of this study prevents any causal inferences from being made regarding the relationships between autonomic arousal, parenting, and aggression. Given that all measures were taken at the same time point, direction may not be determined. It is possible, for example, that aggressive children elicit harsher or more inconsistent parenting which in turn leads to the development of different patterns of emotional arousal. It is likely that all three variables act in a reciprocal manner and that direction would be difficult to determine even in a longitudinal study.

While it was expected that parental involvement would also moderate the relationship between autonomic arousal and aggressive behavior, parental involvement was not found to be a significant moderator in any of the tested models. One possible explanation could be the unintentional inclusion of two subtypes of "involved" parents in the sample. For example, some parents who score highly on the parental involvement subscale may be overbearing and refuse to let their children leave the house, while other parents scoring high on the same subscale may bring their children to extracurricular activities and participate in school functions. While both

types of parents may score high on the parental involvement subscale, having such variability may confound results and account for the lack of findings.

Finally, the present study only measured overt forms of aggression and did not consider relational or more covert aggressive behaviors. Future research may wish to explore these relationships in the context of covert aggression, especially with regards to gender differences.

Future research should work to determine whether these results may be replicated in other populations (e.g. community samples, more diverse samples, other developmentally significant age groups). It may also be interesting to explore whether these relationships hold when examining different parent-child interaction factors (such as security of attachment) as well as other externalizing behavior outcomes. It is also important for future research to explain the directionality of these relationships, given that the current study could not address this in the present design.

Implications and Conclusions

Overall, these results reveal that children exhibiting both proactive and reactive aggression may demonstrate heighted or diminished autonomic arousal patterns, but that the level of arousal depends on contextual and demographic factors (specifically, level of inconsistent discipline, gender, and race). This may help to explain the mixed findings that previous research has found with regards to autonomic arousal in reactive versus proactive aggression. These results suggest that while reactive and proactive aggression are related, they are distinct constructs that are predicted by opposite combinations of arousal and inconsistent discipline. In addition, arousal patterns in aggressive children appear to be more complex than originally suggested, as aggressive behavior may not be universally characterized by one pattern of autonomic arousal (e.g. underarousal). Continuing to consider the different functions of

aggression in children in future research will likely aid in the development and implementation of prevention strategies, especially if different interventions may be more appropriate for each function of aggression.

More generally, these results confirm the influence of biosocial interactions on externalizing behavior. Understanding how biological and environmental factors work together to predict aggressive behaviors allows for focus on multiple targets for prevention and intervention strategies. For example, treatment may concentrate on parent training to increase consistency of effective discipline strategies, reducing risk and increasing protection against the development of both reactive and proactive aggression. Treatment may also focus on increasing emotion regulation strategies within at-risk youth; however, the most effective interventions will likely need to address both environmental and child-specific issues.

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APPENDIX: IRB APPROVAL

Office for Research

Institutional Review Board for the
Protection of Human Subjects

THE UNIVERSITY OF
ALABAMA
RESEARCH

March 30, 2015

Francesca Kassing
Department of Psychology
College of Arts & Sciences
Box 870348

Re: IRB: EX-15-CM-056, "The Influence of Parental Factors on the Relationship between Autonomic Arousal and Aggressive Behavior in Children"

Dear Ms. Kassing:

The University of Alabama Institutional Review Board has granted approval for your proposed research.

Your application has been given exempt approval according to 45 CFR part 46.101(b)(4) as outlined below:

(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

This approval expires on March 29, 2016. If the study continues beyond that date, you must complete the appropriate portion of the IRB Renewal Application. If you modify the application, please complete the Modification of an Approved Protocol Form. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants. When the study closes, please complete the IRB Study Closure Form.

Should you need to submit any further correspondence regarding this application, please include the assigned IRB application number.

Good luck with your research.

Si[redacted]

Carpantato T. Myles, MSM, CIM, CIP
Director & Research Compliance Officer

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IRB Project #:

UNIVERSITY OF ALABAMA
INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN SUBJECTS
REQUEST FOR APPROVAL OF RESEARCH INVOLVING HUMAN SUBJECTS

I. Identifying information

	Principal Investigator	Second Investigator	Third Investigator
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Title of Research Project: The Influence of Parental Factors on the Relationship between Autonomic Arousal and Aggressive Behavior in Children

Date Submitted:

Funding Source: None

Type of Proposal	☒ New	☐ Revision	☐ Renewal Please attach a renewal application	☐ Completed	☑ Exempt
			Please attach a continuing review of studies form		
		Please enter the original IRB # at the top of the page			

UA faculty or staff member signatu[redacted]

II. NOTIFICATION OF IRB ACTION (to be completed by IRB):

Type of Review: _____ Full board _____ Expedited

IRB Action:

___ Rejected Date: _____
___ Tabled Pending Revisions Date: _____
___ Approved Pending Revisions Date: _____
___Approved-this proposal complies with University and federal regulations for the protection of human subjects.

Approval is effective until the following date:

Items approved: ___ Research protocol (dated_____)
___ Informed consent (dated_____)
[redacted]ed_____)
[redacted]ed_____)

Approv[redacted] Date 3/30/2015