Autism Spectrum Disorder Traits and Parental Stress: The Moderating Role of Parental Self-Efficacy

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ABSTRACT

Previous research has established that caregivers of children with Autism Spectrum Disorder (ASD) experience greater levels of parenting stress as a result of unique parenting demands and child problem behavior (Davis & Carter, 2008; Estes et al., 2013). Positive self-concepts, specifically parental self-efficacy (PSE), have been implicated as a buffer to stress in a number of contexts (Cieslak, Benight, & Lehman, 2008). While many studies examine parenting stress in relation to ASD, they often use parent self-report rather than objective measures in a laboratory setting. The present study aimed to further explore the role of PSE in the relationship of parental stress and ASD traits through a biological measure of stress, as well as a parent self-report within a controlled laboratory environment.

Forty-two mother and child dyads participated in a validated parent-child interaction task designed to elicit a stressful experience. Mother's heart rate (HR) and heart rate variability (HRV) were monitored as the physiological measure of stress reactivity. Mothers also self-reported on ASD traits, perceived stress-reactivity, and PSE. Results demonstrated a significant positive main effect for ASD traits on HRV reactivity, and an interaction such that the relationship between ASD traits and HRV reactivity (i.e., more emotional flexibility) was stronger in those with lower PSE. Given the low sample size and subsequent low power, results should be viewed with caution. Considerations of the context of HRV as well as implications for treatment targets and studying parental stress are explored.

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GENERAL AUDIENCE ABSTRACT

Previous research has found that caregivers of children with Autism Spectrum Disorder (ASD) experience greater levels of parenting stress as a result of parenting demands and child problem behavior (Davis & Carter, 2008; Estes et al., 2013). Positive self-concepts, specifically parental self-efficacy (PSE), have been suggested to protect the individual against stress (Cieslak, Benight, & Lehman, 2008). While many studies examine parenting stress in relation to ASD, they often use parent self-report rather than more objective measures (i.e., physiological measures). The present study aimed to further explore the role of PSE in the relationship of parental stress and ASD traits through a biological measure of stress, as well as a parent self-report within a controlled laboratory environment.

Forty-two mothers and children participated in a parent-child interaction task designed to create a stressful experience. Mother's heart rate (HR) and heart rate variability (HRV) were monitored as the physiological measure of stress reactivity. Mothers also self-reported on ASD traits, perceived stress-reactivity, and PSE. Results demonstrated a significant relationship for ASD traits on HRV reactivity, and an interaction such that the relationship between ASD traits and HRV reactivity (i.e., more emotional flexibility) was stronger in those with lower PSE. Given the low sample size, results should be viewed with caution. Considerations of the context of HRV as well as implications for treatment and studying parental stress are explored.

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Introduction

The relationship between parenting stress and child behavior is a complex and bi-directional process (Baker et al., 2003). That is, this circular system involves child problem behaviors which increase parental stress, and this increase in stress manifests in decreased interaction or irritable mood from parents that in turn can exacerbate and perpetuate the behavior (Rezendes & Scarpa, 2011). The distress experienced by parents can be conceptualized as involving the external demands of parenting (i.e., providing basic necessities such as food and shelter), quality of the parent child relationship (i.e., synchrony) and emotional and social well-being of parent and child independently. Parenting distress has been shown to contribute to strained parent-child relationships as well as the development of adult and child psychopathology (Deater-Deckard, 1998). Therefore, it is important to study parent stress in the context of the parent-child relationship.

Parenting Stress and Autism Spectrum Disorder

Previous research has established that caregivers of children with Autism Spectrum Disorder (ASD) experience greater levels of parenting stress (Davis & Carter, 2008; Estes et al., 2013). Distress related to ASD usually begins before a formal diagnosis, as early concerns about development, social behavior, and communication are typically present in the early life of a child (Karst & Van Hecke, 2012). These concerns are reported by the majority of parents when their child is around 18 months of age (Bolton et al., 2012). Therefore, the parent is faced with a number of stressors early in the child's life, in addition to general parental concerns. The nature of this stress and factors contributing to it has been explored in numerous reports. For example, previous research has indicated that the amount of parental involvement with one's child has

been correlated with parenting stress, such that greater involvement may lead to greater stress (Tehee, Honan, & Hevey, 2008). Others expand upon these findings, showing that increased parental stress is not simply a function of cognitive deficits or level of ASD impairment, but appears to be accounted for by other factors (Davis & Carter, 2008; Rao & Beidel, 2009). For example, social support for parents can partially mediate the relationship between the child's symptom severity and parenting stress (Ingersoll & Hambrick, 2011). Many parents of children with ASD often feel isolated and do not have a secure social support system in dealing with their child, as they are faced with unique challenges in comparison to parents of typically developing children (Karst & Van Hecke, 2012). In addition, these increased levels of stress in parents of children with ASD have been found to be highly correlated with child problem behavior (Davis & Carter, 2008), such that one study found that behavior problems were associated with stress ratings by both parents and teachers above adaptive functioning deficits (Lecavelier, Leone, & Wiltz, 2006). Other results revealed that delays and deficits in social skills as well as behavior problems were the most salient predictors of parenting stress (Davis & Carter, 2008). Interestingly, in this study there were differences between mothers and fathers in the behavioral domains, such that the greatest predictor of stress in mothers was deficits in self-regulation, while for fathers externalizing behaviors were the greatest predictor.

Physiological Measures of Stress

Although self-report measures of stress are informative, physiological measures of stress provide objective information in studying stress reactivity. Multiple automatic physiological reactions to social stressors have been studied to assess emotional response, such as heart rate (HR; Kudielka, Buske-Kirschbaum, Hellhammer, & Kirschbaum, 2004), heart rate variability (HRV; Appelhans & Luecken, 2006), blood pressure (Smith & Allred, 1989), and cortisol levels

(Kirschbaum, Pirke, & Helhammer, 1993). In particular, cardiovascular measures such as HR and HRV are often used to index emotional responding as well as specific individual differences in these patterns of responding (Appelhans & Luecken, 2006).

While HR is a function of both sympathetic and parasympathetic influences of the autonomic nervous system on the heart, high-frequency HRV is a more specific way to examine autonomic functioning, as it is only mediated by parasympathetic nervous system activity (Berntson, Cacioppo, Quigley, & Fabro, 1994). HRV has been used to indicate emotional responding and flexibility, as well as psychopathological features and processes in a number of studies (Thayer & Lane, 2000; Kreibig, 2010). Specifically, higher HRV may reflect a greater capacity for regulated emotional responses. For example, higher baseline levels of respiratory sinus arrhythmia (RSA), one measurement of HRV, are associated with flexible emotional responding (Porges, 2001). However, in examining changes in RSA from baseline, the context may alter the interpretation of the response. For instance, in stressful situations, decreases in RSA from baseline might reflect effective coping strategies; however, in nonthreatening situations, increases in RSA may demonstrate successful emotion regulation (Huffman et al., 1998; Hastings et al., 2008).

Fabes and Eisenberg (1997) found that lower RSA indicated a greater negative emotional arousal in response to stress. Therefore, this interfered with one's ability to implement adaptive coping strategies. While some research has looked at HRV in children in response to parental behavior in clinical populations (Allen, Kuppens, & Sheeber, 2012), to date, no research (to our knowledge) has examined parental HRV in response to child ASD traits. Using both HR and HRV as measures of stress may give unique insights into stress responses and coping in parents related to ASD traits.

Additional Measures of Stress

In addition to the physiological measures of stress previously mentioned, there are other methods and mechanisms for assessing parental stress. For example, parent self-report allows parents to report on their own level of stress as they perceive it. Different measures tap into specific aspects of stress. The Parenting Stress Index (Abidin, 2012) measures the amount of stress parents experience related to their role as a parent. Additionally, the Perceived Stress Reactivity Scale (Schlotz, Yim, Zoccola, Jansen, & Schulz, 2011) addresses an individual's perception of their intensity of response for a number of daily stressful situations.

Behavioral observations of parental stress allow for another method of measurement. Coding systems exist examining parental-child relationships, such as the Marschak Interaction Method (Theraplay Institute, 2005). Though there have been a number of studies employing one of these methods of measuring stress, to our knowledge, there have not been other studies to use a multimethod approach to stress measurement.

Parental Self-Efficacy

In considering the complex nature of parental stress, positive self-concepts have been implicated as a buffer to stress in a number of contexts (Cieslak, Benight, & Lehman, 2008). Parental self-efficacy (PSE) is a notion that has begun to be researched in examining parental stress. Defined as a caregiver's belief in their ability to parent their child (Karst & Van Hecke, 2012), PSE was found to predict the level of parenting competence, such that higher PSE led to more effective parenting, even when dealing with challenging behavior, in a sample of typically developing children and their parents (Jones & Prinz, 2005). Further, low levels of PSE may lead to poor persistence, depression, and less satisfaction as a parent (Johnston & Mash, 1989). This is an especially important concept to examine in parents of children with ASD or high ASD

traits, since children often do not receive a diagnosis until later in their development (4-5 years of age), even though ASD can be diagnosed as early as 2 years old (CDC, 2014). This could mean that parents have been employing ineffective parenting techniques for a number of years, which may have made them feel both inept and frustrated as parents (Karst & Van Hecke, 2012). Further, due to the lack of reciprocal social communication, they may feel less able to meet the emotional needs of their children and may also feel more of a lifelong burden since their children may never live independently (Karst & Van Hecke, 2012). This may decrease optimism about their future and the future of their child, thus lowering PSE.

Broad Autism Phenotype

Another factor to examine in the parent-child relationship when considering ASD is the presence of Broad Autism Phenotype (BAP) in parents. BAP is defined as a subclinical set of features found in relatives of individuals with ASD, which presents evidence for a genetic component in ASD (Piven, Palmer, Jacobi, Childress, & Arndt, 1997). With the presence of these characteristics, parents might lack confidence in helping their child and may in fact experience some difficulties themselves, such as social anxiety and communication issues (Karst & Van Hecke, 2012). Parents who demonstrate these characteristics have been found to be more likely to utilize ineffective coping strategies for stress and as a result, may face decreases in PSE (Ingersoll & Hambrick, 2011). Both child symptom severity and parent BAP were found to be positively correlated with elevated stress and depression in parents of children with ASD (Ingersoll & Hambrick, 2011). As such, BAP characteristics may need to be accounted for when examining ASD-related parental stress.

Parental Self-Efficacy, Stress, and ASD

Previous research has indicated that PSE, parenting stress, and ASD are related in a

complex and transactional nature. In one study, parenting stress was found to mediate the relationship between child behavior problems and decreased PSE in a sample of parents of children with ASD (Rezendes & Scarpa, 2011). Further, lower PSE also partially mediated parenting stress and increased depression and anxiety in parents (Rezendes & Scarpa, 2011). This suggests both the importance of PSE on parent pathology as well as the role that child behavior problems, as related to ASD traits, have on parental stress. Similarly, Hastings and Brown (2002) revealed that PSE mediated the relationship between child problem behaviors and maternal anxiety and depression, and that stress was associated with decreased PSE. Thus, more positive self-efficacy was associated with psychological well-being and less psychological distress (Hastings & Brown, 2002). Notably, there were differences in the relationship between these variables seen in fathers. Paternal PSE was found to moderate the effect of child behavior problems on anxiety; however, in children with low levels of behavior problems, the father's self-efficacy had no effect on their anxiety (Hastings & Brown, 2002). This suggests that PSE might serve as a protective factor for fathers, only activated in situations of high levels of stress, but is more of a compensatory or coping mechanism for mothers, directly impacting depression and anxiety (Hastings & Brown, 2002). Finally, Kuhn and Carter (2006) found that PSE served as a mediator for misbehavior and maternal anxiety and depression, and that decreased agency and increased guilt in parents were correlated with lower PSE. This highlights the complex and multifaceted nature of PSE, as well as other factors that contribute to the interplay between PSE, behaviors related to ASD, and parental stress.

Parental coping in response to their child's ASD diagnosis has also been studied, such that parents with better adjustment had higher PSE (Pakenham, Sofronoff, & Samios, 2004). There is evidence that coping in parents of children with ASD is different from parents of other

developmental disabilities (Hastings et al., 2005), which may impact the stress and PSE parents experience. Four main coping strategies were identified for parents of preschoolers with ASD, which included active avoidance coping, problem-focused coping, positive coping, and religious/denial coping (Hastings et al., 2005). Active avoidance coping was related to more stress and mental health problems in both mothers and fathers, while positive reframing of stressful events may be an especially beneficial coping strategy for parents of children with ASD (Hastings et al., 2005). Hastings and Taunt (2002) suggest that positive perceptions of children with disabilities may serve as an adaptive mechanism to help cope with high stress levels.

Interventions targeting PSE have proven to have success in both increasing PSE and decreasing child behavior problems. Sofronoff and Farbotko (2002) examined the importance of targeting PSE in parents of children with ASD in Parent Management Training (PMT). Results indicated increased PSE in comparison to control groups, and these parents also reported fewer child problem behaviors post intervention. Therefore, increasing PSE may have an impact not only directly on the parent, but also on the child. Further, in another study, mothers with higher PSE reported being more active in their children's development, which may indicate more involvement and benefits for their child (Hastings et al., 2005).

Currently, many treatment programs for children with ASD focus on the child and often require the parent to perform time intensive protocols. In turn, this may add increased stress in the family system, which often affects family relationships, psychological well-being, and the child's treatment success (Gulsrud, Jaromi, & Kasari, 2010). While child outcomes are important focuses of interventions, parent and family outcomes play a large role in maintenance and generalization of gains made by the child. These factors not only include parent stress, but also family functioning, parent child relationships, and PSE (Karst & Van Hecke, 2012). Ignoring the

parent component can have deleterious effects (e.g., poor mental health), which outweigh any gains made by the child during a treatment program.

Although parental stress has been widely studied, there is a paucity in the literature related to PSE, and especially in examining the relationship between PSE, parental stress, and ASD traits; even though it has been determined to be an important factor in examining parent-child relationships. While many studies examine the relationship between stress and independent variables, they often utilize solely parent self-report, which is subject to reporter bias. Therefore, this study adds to the literature by including physiological measures of responsivity to stress as well as self-report measures. Further, by including an in-lab task, this enhances the current methodology in this area of research and examines stress in a quantifiable way, which has not been done before. Overall, parents of children with ASD have repeatedly reported increased levels of parenting stress. Since this can impact physical health, this is an important inclusion. By measuring ASD trait levels and examining how these traits are associated with PSE and stress, this study provides important information that can influence treatment options. Therefore, careful analysis to the contributions and maintenance factors through the combination of biological markers of stress in addition to self-report can provide rich information that may help guide future interventions for parents of children with ASD. The present study aimed to further explore the role of PSE in the relationship of parental stress and child ASD traits. By utilizing both a biological level of stress, as well as self-report within a controlled laboratory environment, this allowed for the examination of more robust outcomes in studying the converging patterns of physiological and perceived stress to truly capture the experiences of parents.

Hypotheses

In considering the relationship between ASD traits, parental stress, and PSE described

above, there is a need to further explore these interactions with mothers and their children, as previously discussed. Employing both objective and subjective measures of stress in the context of a controlled lab experiment will allow for further analysis of these relationships and the role that PSE plays in this relationship. Based on this, it was hypothesized that PSE would act as a moderator between child ASD traits and parental stress, such that higher levels of PSE would buffer the relationship between ASD traits and parental stress. This would be indicated by lower endorsement of stress on self-reports and, since the physiological measures of stress are change scores, buffering would be indicated by attenuated reactivity in HR (less of an increase from baseline to response after interaction task) and HRV (less of a decrease from the baseline to the post-interaction task). Specifically, during a mildly stressful parent-child interaction task, it was predicted that there would be a main effect between ASD traits and parental stress, such that more ASD traits would be related to higher parental stress levels (both self-reported and change in HR/HRV). There would also be a main effect of PSE on stress, such that parents with higher PSE would have lower stress levels on self-reports and lower HR/HRV stress reactivity. Finally, there would be an interaction between PSE and parental stress, such that the positive relationship between ASD traits and stress reactivity would be attenuated by higher PSE. Further, BAPQ characteristics would serve as a covariate to control for its potential effects on maternal stress.

Method

Participants

Participants included 42 mother-child dyads who were recruited as part of a larger study on parent-child interactions. Mothers were between the ages of 31 and 51 (M = 39.59, SD = 5.26). Mothers were chosen as the parent of interest because previous research suggests that fathers vary significantly more than mothers in their interaction

style with their son and/or daughter (McBride, Schoppe, & Rane, 2002). Therefore, in order to keep a more homogeneous sample, only mothers were used for this study. Further inclusionary criteria for mothers involved English speaking and no history of cardiovascular disease. The sample of mothers was 76.42% Caucasian and 14.3% Asian American/Asian origin (9.5% did not report race). For children, they were required to be between the ages of 7-12 (M = 8.87, SD = 1.47) and both males and females were recruited (64.3% male). This age range was selected due to the fact that Hudson and Rapee (2001) validated the parent-child interaction task with this population age range. The sample of children consisted of 66.7% Caucasian, 16.7% Asian American/Asian origin, 2.4% African American, and 2.4% Latino/Hispanic (11.9% did not report race). Both typically developing children and children with clinical diagnoses were included, such that individuals with an ASD diagnosis were not excluded, as the study focused on ASD traits. As previously defined, we aimed to recruit at least one quarter of the sample with high ASD trait scores. The current sample consisted of 35.7% of children with a previous ASD diagnosis, and 61.9% without a diagnosis. Children were also not excluded based on IQ, but IQ (as determined by the Wechsler Abbreviated Scale of Intelligence; WASI-II; Wechsler, 2011) was measured and examined as a potential covariate in analyses to ensure that the parent's response to task performance was not a function of the child's intellectual ability.

Reactivity to a social conflict stress response was measured via HR in mothers. Complete data were collected from 32 mothers. Ten participants were excluded because the psychophysiology equipment malfunctioned or event markers were not properly obtained. Analyses indicated that the individuals with and without HR data did not

significantly differ on demographic, ASD, parental stress, or IQ variables (t-values ranged from -.788 to .803). Five other participants did not complete all of the measures used for the moderation analyses. Therefore, the final analyses for HR and HRV reactivity will be based on the 27 mothers for whom physiological data were collected as well as completed all measures. Additionally, behavioral information was recorded to reflect any incidents reported that would affect the physiological data, such as excessive movement by the mother or issues with the equipment. This information was used in examining outliers and removing data that were invalid.

The Social Responsiveness Scale, 2nd Edition (SRS-2; Constantino & Gruber, 2012) and WASI-II (Wechsler, 2011) were used to characterize the sample for the current study. The overall sample experienced a mild degree of social deficits, which is between 60 and 65 (M = 60.64, SD = 14.433), based on mean SRS-2 scores. These scores differed depending upon ASD diagnosis. SRS-2 scores indicated no social difficulties in those without ASD (M = 53.00, SD = 10.144) and moderate social difficulties in the ASD group (M = 75.45, SD = 9.802).

Regarding the WASI-II, mean IQ scores for the overall sample fell in the average IQ range (M = 108.46, SD = 15.711). Of note, some children (n = 2) were unable to complete the WASI-II due to behavioral issues, while others (n = 10) did not have a cognitive assessment completed due to time constraints or other variables (i.e., administration errors, protocol changes). The children who did and did not complete IQ assessments were compared on all demographic, IQ, ASD, parental stress, and physiological data and did not significantly differ (t-values ranged from -1.317 to 1.479). IQ scores were also calculated for the non-ASD group (M = 111.55, SD = 14.770) and the ASD group (M = 100.75, SD = 16.272). These scores did not significantly differ between the ASD and non-ASD groups ($t(26)$ = 1.700, p =.101).

Power

A moderation analysis was proposed using multiple regression analyses with two predictor variables and an interaction term (Cohen, Cohen, West, & Aiken, 2003). Power analyses were conducted to determine the sample size needed to detect small (Cohens f^2 =.02), medium (Cohens f^2 = .15), or large (Cohens f^2 = .35) effects, with a power of .8 and alpha of .10. Based on this analysis, a sample size of n = 444 would be required to detect a small effect, n = 62 to detect a medium effect, and n = 29 to detect a large effect. Given this information and recruitment considerations, researchers initially aimed to collect information from 62 mother-child dyads; however, due to difficulties with recruitment, 42 families were included in the current sample (32 for the HR and HRV data), which was sufficient to detect a large effect. Thus, it is noted that this sample size is underpowered to detect small effects, which are typical of interactions; however, this study will focus on main effects for primary analyses, and the moderation analysis will examine trends in the predicted direction.

Background information

Demographic Form (Appendix A): This questionnaire involved questions about the participants' background including age, race, ASD diagnosis, and socioeconomic status. Only mothers with a child between the ages of 7 and 12 were included in the current study.

Medical History Questionnaire (Appendix B): This self-report questionnaire was used to identify potential confounds to the measurement of HR/HRV, such as alcohol and caffeine consumption, exercise, and medication use.

Parental Self-Report Stress Measures

Perceived Stress Reactivity Scale (PSRS; Appendix C): The PSRS (Schlotz, Yim, Zoccola, Jansen, & Schulz, 2011) is a 23 question self-report adapted from the German validated Stress Reactivity Scale (SRS; Schulz, Jansen, & Schlotz, 2005). This measure aims to address an individual's perception of their intensity of response for a number of daily stressful situations. Each question contains a statement that describes a potentially stressful situation and three choices describing potential responses. The PSRS produces a composite score for overall stress reactivity as well as five subscales (i.e., Reactivity to Work Overload, Reactivity to Social Conflicts, Reactivity to Social Evaluation, Reactivity to Failure, and Prolonged Reactivity). Good internal consistency across scales was found in the original study (.71 to .91), and the English-version also demonstrated good internal consistency for total score (α = .87) and moderate internal consistency for the subscales (.62 to .87). The subscale score for reactivity to social conflicts, becoming emotionally affected or upset in response to social conflict or criticism, was compared to the autonomic responses of stress reactivity in the current study. Therefore, it will be used as the measure of parent-reported stress. In the current study, the Cronbach's alpha for the social conflict subscale was .69 and .90 for total stress reactivity. The remaining subscales ranged from .68 to .77.

***Parenting Stress Index (PSI-4-SF; Appendix I)*:** The PSI-4-SF (Abidin, 2012) is a 36 item self-report checklist, abbreviated from the full 120 item checklist, that measures the amount of stress parents experience related to their role as a parent. The scale leads to a total stress score and three separate domain scores that reflect the amount of stress attributable to child characteristics (Difficult Child), parent characteristics (Parental Distress), and the dyadic relationship (Parent-Child Dysfunctional Interaction). Internal

consistency was found to be satisfactory for each scale, with alphas all above .90. The total score was used as another way to check the validity of the PSRS-RSC scale as a measure of parental self-reported stress. In the current study, the Cronbach's alpha for the total score was .89.

ASD Trait Measures

The Autism Spectrum Quotient – Children's Version (AQ-Child; Appendix D)

The AQ-Child (Auyeung, Baron-Cohen, Wheelwright, & Allison, 2007) consists of 50 statements, each with the rating of "definitely agree," "slightly agree," "slightly disagree," or "definitely disagree." The questions cover five different domains associated with the autism spectrum: social skills, communication skills, imagination, attention to detail, and attention switching/tolerance of change. This parent-report questionnaire quantifies ASD traits in children 4-11 years old. Due to the fact that the original sample was 7-10 year olds and there were only two 12 year olds in the current sample, we used this version for all participants. Scores range from 0-150. A score of 76 was determined as the cut-off for ASD traits (Auyeung et al., 2007). The measure has high internal consistency, with Cronbach's alpha for the five scales ranging from .83 to .93. The total score was used for the analyses as the independent variable of ASD traits. In the current study, the Cronbach's alpha for the total score was .92. The subscales ranged from .75 to .90.

Social Responsiveness Scale, 2nd Edition (SRS-2; Appendix E): The SRS-2 (Constantino & Gruber, 2012) is a 65 item questionnaire that provides a measure of traits and symptoms that distinguish behavior indicative of ASD from other variations in behavior. This quantitative measure of the severity of ASD traits gives a rating from normal to autistic disorder. Each question is rated from 1 to 4, with 1 meaning "not true"

and 4 indicating "almost always true." Scores go up to 195 and the questions focus on the child's behavior in the last 6 months. The original measure was designed for 4-18 year olds, but it has been extended into adulthood. One recent study conducting exploratory and confirmatory factor analysis examining how the SRS-2 maps onto the two main domains in the DSM-5, social communicative impairment and restricted repetitive behaviors, found a number of subdomains that do not clearly map onto these two areas (Frazier et al., 2013). These include emotion recognition, social avoidance, interpersonal relatedness, insistence on sameness, and repetitive mannerisms (Frazier et al., 2013).

Validity has been shown to be good for the SRS (which is the same as SRS-2). Internal consistency was calculated separately for males and females and was found to be .93 and .94, respectively. For the current study, total scores were used to determine the severity of social deficits in this sample of children as a way to characterize the sample and also to check the validity of the AQ. For this sample, the Cronbach's alpha for the total score is .97. The subscales ranged from .86 to .93.

Broad Autism Phenotype Questionnaire (BAPQ; Appendix F): The BAPQ (Hurley, Losh, Parlier, Reznick, & Piven, 2006) is a 36 item questionnaire designed to measure BAP characteristics in relatives of individuals with ASD. The subscales include pragmatic language, aloofness, and rigidity, which map onto the three core features of the BAP. Each question is rated on a 6 point scale, ranging from 1 (i.e., very rarely) to 6 (i.e., very often) as to how often the individual experiences each item. Summary scores for each subscale are computed by reverse scoring appropriate items, averaging across 12 items of each subscale. Therefore, summary scores range from 1 to 6 on subscales. A composite diagnosis of BAP was defined as the presence of at least two of three directly assessed BAP characteristics and composite scores were

computed by the sum of the dichotomized scores for each of the three main characteristics. The total score is calculated by averaging all 36 items. Previous research has indicated that there is internal consistency for the total BAPQ score and subscales. Cronbach's alpha ranged from .94 - .86 for each subscale (aloof, rigid, pragmatic language), and the overall alpha was .95 across all 36 items (Ingersoll & Hambrick, 2011). Validity has also been indicated, especially face validity in measuring the BAP, from previous research. Mothers' total scores on the BAPQ were used in the present study to determine maternal BAP characteristics that need to be controlled in analyses. In the current study, the Cronbach's alpha for the total score was .93. Subscale scores ranged from .79 to .92.

Parental Self-Efficacy Measures

***Parental Sense of Competence Scale (PSOC; Appendix G)*:** Parental self-efficacy was measured by the PSOC Scale (Johnston & Mash, 1989). This test includes two subscales, efficacy and satisfaction, which have been found to measure two different components of PSE (Ohan, Leung, & Johnston, 2000). Reliability has been established from previous studies, with a Cronbach's alpha of .70, test-retest for the scales on the PSOC ranging from .46 to .82, and the internal reliability of .72 (Johnston & Mash, 1989). Validity has also been established from these studies (Johnston & Mash, 1989). This scale was used to determine each mother's PSE and as such, the total score was applied to capture this construct for the current study. In the current study, the Cronbach's alpha for the total PSOC score was .87.

***Parental Self-Efficacy in the Management of Asperger Syndrome (PSEMAS; Appendix H)*:** The PSEMAS scale (Sofronoff &Farbotko, 2002) is a 15 item questionnaire that was developed to assess parental self-efficacy in a study of PMT with children with Asperger

Syndrome. This questionnaire assesses the behaviors children display and the extent to which parents feel they can handle them. The total self-efficacy score is determined by the total confidence score for behaviors that do occur divided by the total number of behaviors. The measure was only used in the original study and reliability and validity were not determined. The total score was used as another measure of PSE in the various moderation models herein. This second measure of PSE was chosen because it is specific to efficacy in parents of children with ASD. In the current study, the Cronbach's alpha for the total score was .923.

Physiological Stress Reactivity Measurement

HR and HRV were used to determine physiological reactivity to a stress-inducing task, using the Polar Heart Rate Monitors, Model RS800sd (i.e., Polar monitors; Polar Electro, USA). This monitor provides wireless, continuous, and valid recordings of HR and R-R variability (i.e., HRV), similar to an electrocardiogram during both stationary tasks and physical exercise (Gamelin, Berthoin, & Bosquet, 2006; Goodie, Larkin, & Schauss, 2000). The Polar monitor uses a combined sensor and transmitter that was strapped across the participants' chests and the receivers were worn on the non-dominant wrist. Cardiac electrical impulses were measured by the monitor, which were then transmitted to the receivers. From this information, the receiver calculated the interbeat interval (IBI), which was converted into a HR recording. This was then displayed on the receiver and the data were stored and uploaded to a computer using the Polar computer interface unit and Polar HR Analysis Software (Polar Electro, USA). R-R intervals were detected with a resolution of 1 millisecond and converted into HR (measured in beats per minute; bpm) and HRV (measured in root mean squared successive differences; RMSSD).

Since both the sympathetic and parasympathetic branches influence HR, it was necessary to include HRV to clarify the parasympathetic influences. In the present study, the mean baseline

HR (bpm) was calculated while viewing a 3-minute neutral video. In order to control for the individual differences of mothers' HR response at baseline, we calculated individual change scores for HR by subtracting the average resting HR value in bpm during the 3 minutes of baseline from the average HR values recorded during the entire task. This method has been used in previous research to determine HR reactivity (e.g. Matthews, Manuck, & Saab, 1986; Larson, Ader & Moynihan, 2001). In order to account for any floor or ceiling effects, which would indicate biased measures of stress, the Law of Initial Values will be employed. This was calculated by following the procedures specified by Geenan and Van de Vijver (1993), who stated that if the Law of Initial Values applies, then a correction was implemented to the change scores. Specific analyses include taking the logarithmic value of the fraction of variance of average HR from baseline over variance of HR from task period.

To get these measurements, the mother's HR was measured and assessed over the 3-minute baseline video ($M = 70.827$, $SD = 8.359$) and 5-minute mother-child interaction task ($M = 75.376$, $SD = 9.932$). For HRV, baseline values were also assessed during the 3-minute video ($M = 41.702$, $SD = 18.166$) and task HRV was determined from the interaction task ($M = 33.994$, $SD = 15.607$). The data were analyzed in sequential 30-second epochs, then averaged to determine baseline and task epochs. Task minus baseline HR/HRV was used as the measure of stress reactivity. Increased stress was indicated by increases in HR (i.e., bpm) from baseline to task (i.e., positive change scores), and decreases in HRV (i.e., RMSSD) from baseline to task (i.e., negative change scores). This determination of stress response is consistent with previous literature on HR reactivity (e.g. Matthews, Manuck, & Saab, 1986; Larson, Ader & Moynihan, 2001). The SD of average baseline HR was compared to SD of average task HR in a paired-sample t test to

test for Law of Initial Values; results demonstrated that the standard deviations were not statistically different from one another (p = .191), suggesting that a change score in averages of HR could be used as an unbiased predictor.

Behavioral Measures

Wechsler Abbreviated Scale of Intelligence (WASI-II): The WASI-II (Wechsler, 2011) measures verbal and nonverbal IQ with two verbal (vocabulary and similarities) and two nonverbal (block design and matrices) subtests. This has been proven to have good reliability for children and adults, and has been validated against other tests of intelligence, such as the Wechsler Intelligence Scale for Children (WISC). Internal consistency scores on subtests ranged from .87 to .91, showing good internal consistency (Ryan & Brown, 2005). Test-retest reliability was found to range from .70 to .90 for subtests and from .87 to .95 for composite scores (Ryan & Brown, 2005). Both internal and concurrent validity have also been established based on previous research. The child's score was used to determine their overall intelligence and characterize the sample, as well as a potential covariate in the data analyses to account for the effect of child intellectual ability.

***Parent-Child Interaction*:** The 5 minute parent-child interaction task was designed to present the child with difficult tasks while interacting with their parent, thus increasing the frequency of problem behavior (Hudson & Rapee, 2001), and is used as an ecologically valid laboratory task that may elicit parental stress. The task involved a set of difficult puzzles, or tangrams, designed so the child was unable to complete them in the allotted 5 minutes. The mother remained in the room with the child and she was supplied with the solutions to the puzzles. She was also instructed to let the child work on

the puzzle; however, she could help if she thought it is necessary. The interaction tasks were videotaped and any behavioral issues were recorded.

As part of this task in the present study, the mother completed a short questionnaire rating four domains as a manipulation check to the task: her level of stress, sense of controllability, sense of helplessness, and sense of pleasantness in being with her child. Each question was on an 8 point Likert scale from 1 being the lowest level of the construct to 8 being significant experience of the construct. She completed this before the interaction task as a baseline, as well as afterwards in reference to how she was feeling during the task.

Procedure

Participants were recruited through widespread email, flyers, and word of mouth solicitation to multiple locations for distribution to anyone who might be interested, such as the Montgomery County Parent Resource Center, NRV Community Services, Virginia Tech Center for Autism Research, Virginia Tech Autism Clinic, Virginia Tech Child Study Center, Virginia Tech Daily News, Psychological Services Center, and other local service agencies, public posting locations (e.g., grocery stores, recreational centers), and school/community groups.

Interested mothers were contacted by a research assistant who conducted a phone screen, provided information about the study, answered any initial questions, and scheduled an appointment. Initially, a packet with a demographics form, medical history form, the SRS-2 and the AQ-Child was mailed home for the mother to complete and she would complete the rest upon her visit to the lab. However, for the majority of the participants, REDCap (Research Electronic Data Capture; Harris, Taylor, Thielke, Payne, Gonzalez, & Conde, 2009), a secure, web-based application designed to support data capture for research studies, was used to allow the mother to

complete the assessments online at her leisure. Prior to the visit, the research assistant instructed mothers to abstain from smoking, drinking caffeinated beverages, and strenuous exercising for 4 hours before the visit, as these activities may impact the physiological measurements of HR and HRV (Allen, Chambers, & Towers, 2007). These behaviors were also assessed when the mother came into the lab.

Mother-child dyads were scheduled to meet a trained research assistant at one of three locations: Virginia Tech Autism Clinic (Blacksburg, VA; $n = 35$), Higher Education Center (Roanoke, VA; $n = 2$), and Children's Hospital (Boston, MA; $n = 5$). Participants were told that they were to participate in a study examining parent and child interactions based on an in-lab task. A script was prepared to obtain verbal assent from the child and the mother completed the consent and permission forms. After obtaining informed consent, parent permission, and assent from the child, the research assistant administered the WASI-II to the child. At the same time, the mother completed the additional measures, which varied based on whether or not she had completed the measures prior. These measures often included the PSOC, PSEMAS, the BAPQ, the PSRS, and the PSI-4-SF. The mother also completed paper versions of a demographics and medical history form.

After the assessment with the child was completed, the research assistant instructed the mother on procedures for attaching the HR monitor. The mother was asked to attach the monitor while the research assistant stepped out of the room. Once the device was in place and checked for proper functioning, the mother watched a 3-minute baseline video, *National Geographic's Animal Holiday,* to achieve a "vanilla" baseline (Jennings, Kamarck, Stewart, Eddy, & Johnson, 1992). Previous research has indicated this provides a more robust baseline for measuring autonomic activity than simply sitting still (Jennings et al., 1992). Mothers were then instructed

to rate their current level of stress, sense of controllability, sense of helplessness, and sense of pleasantness in being with their child. After this, the child joined the mother in a testing room to engage in a 5-minute parent-child interaction task (Hudson & Rapee, 2001).

According to the original task from Hudson and Rapee (2001), the research assistant administered the following instructions:

"This is a test of your child's ability. We want to see how good he/she is at thinking. Mom, you are going to sit there for support and you will have the answers for interest. Most kids can do it but some find it a bit hard to get going. You can help if you think he/she really needs it (p. 1416)."

Based on the age of the sample, we used the set of tangrams for 7-12 year olds (Hudson & Rapee, 2001). We did not include the scrabble section, which is also a component of the task developed by Hudson and Rapee, due to varying reading levels at this age. After the task, the mother was asked to again rate her level of perceived stress, helplessness, controllability, and pleasantness in reference to her experience during the interaction task.

The mother then watched a post-task video, while the child was free to play with the research assistant and select their prize for participation. Finally, the research assistant debriefed the mother and child and answered any questions. The mother was asked to remove the HR monitor and the participants were thanked for their time and efforts with $10 compensation.

Analytic Plan

Preliminary Analyses

Data were first analyzed to determine that the necessary assumptions of normality, linearity, and homoscedasticity were met before proceeding. Next, descriptive statistics including

the means, standard deviations, and ranges were determined for the variables of interest (Table 1). Further, Pearson correlations between all variables were explored to determine if there were covariates to include, other than BAPQ which has been identified previously as a covariate of consideration. Some possible additional covariates were IQ, race, health concerns, maternal age, and age of child. Also, correlations were calculated among change scores in HR/HRV, average HR/HRV scores at baseline and during the task, maternal health behavior (i.e., caffeine intake, alcohol consumption, exercise), and maternal physical characteristics (i.e., height and weight), and any correlations were used as covariates in the analyses. In addition, correlations between methods of data collection (i.e., self-report and physiological measures of stress) were examined.

Hypothesis Testing

To test the hypotheses outlined regarding the main effects and moderating effect of PSE on the relationship between ASD traits and parental stress, multiple regression analyses were conducted (with appropriate covariates as noted above). These regressions included combinations of using the self-report stress measure or physiological stress measures as an outcome and PSE as the moderator. Since we had two measures of PSE (i.e., the PSOC and the PSEMAS), stress measures were first examined using the PSOC in the moderation analyses, and then repeated using the PSEMAS. Main effects as well as interaction effects were determined.

The first set of analyses tested the relationship between ASD traits and self-reported stress as moderated by PSE. Two regressions were conducted, once using the PSOC and once using the PSEMAS as the measure of PSE. For the first regression, therefore, the independent variables were ASD traits (via total AQ score), PSE (via total PSOC score), and their interaction term, and the dependent variable was parent self-reported stress reactivity (via PSRS-RSC

score). The second regression included the same independent variables and dependent variable, and PSEMAS as the measure of PSE.

The second set of analyses tested the relationship between ASD traits and physiological stress (i.e., HR reactivity or HRV reactivity) as moderated by PSE. Four regressions were conducted in total. Two regressions were conducted for HR reactivity and HRV reactivity using PSOC score as the measure of PSE. An additional two regressions were then conducted for HR reactivity and HRV reactivity using the PSEMAS as the measure of PSE. In all cases, continuous predictors were mean-centered.

The first two hypotheses examined the main effects of ASD traits and PSE on parental stress as the primary analyses of this study, while the third hypothesis examined the effect of the interaction term as the secondary analysis. If the interaction effect is significant, post-hoc probing analyses were conducted to further test the interaction and determine the direction of effects. Effect sizes were calculated for main effect and interactions. Since the analyses included regressions, the unstandardized coefficient was used to determine the effect size and the cutoffs laid out by Cohen were used (i.e., small =.1, medium = .3, and large = .5; Cohen, 1988, 1992). The procedures used for interaction testing followed the guidelines specified by Aiken and West (1991) in mean centering variables and screening variables for normality, linearity, homogeneity and multicollinearity.

Results

Preliminary Analyses

Covariates. After examining the correlations among the variables (Tables 3 and 4), different covariates emerged for the dependent variables. Self-report of stress, as measured by PSRS total score, was significantly correlated with the previously determined covariate, BAPQ

scores. Specifically, the correlation suggested that higher levels of parent stress were positively correlated with higher BAPQ scores (r = .408, p = .028). BAPQ was also significantly positively correlated with AQ scores (r = .381, p = .038), which indicates that more ASD traits in a child is correlated with a higher BAPQ score in the parent. Additionally, child age was significantly negatively correlated with PSRS-RSC score (r = -.460, p = .005), such that having a child who is older was correlated with lower parental stress levels. As such, these were the only covariates used in self-report analyses.

For the physiological data, maternal height was significantly negatively correlated with HRV change (r = -.372, p = .039) and HRV mean baseline scores (r = -.461, p = .009). Additionally, caffeine intake the day of the lab visit was significantly positively associated with HR change (r = .391, p = .033). These variables were used as covariates in the respective models.

Manipulation Test of In-Lab Stressful Task. Approximately the same number of mothers reported elevated stress levels (n = 16) versus no change (n = 20) after the task, and a small proportion (n = 3) indicated reduced stress levels. A within-subject paired-sample t-test indicated that there was a significant difference in stress rating before (M = 2.243, SD = 2.712) and after the interaction task (M = 2.946, SD = 2.549; $t(36)$ = -2.594, p = .014), such that there was a significant increase in reported stress overall in the current sample. In addition, t-tests from pre to post task were conducted on the three manipulation check scales (i.e., controllability, helplessness, pleasure). There were no significant changes from pre to post on the controllability ($t(31)$ = -1.063, p = .295), helplessness ($t(31)$ = -1.000, p = .325), and pleasure ($t(31)$ = -1.094, p = .282) domains.

Correlations of Self-Report with Observation Measures

See Table 3 and Table 4 for a full list of correlations among all continuous variables of interest. Several correlations are of note considering the constructs of interest. Neither baseline HR nor change in HR was correlated to self-report levels of stress (r = .064, p = .736; r = -.279, p = .142) as measured by the PSRS-RSC. Similarly, there were no significant correlations for baseline HRV nor change in HRV (r = .112, p = .555; r = -.021, p = .910) with self-reported stress on the PSRC-RSC. In sum, results yielded no significant correlations between self-report and lab measures of similar constructs.

Correlations of ASD Measures and Self-report Stress Measures

In cross-validating the ASD trait measure (i.e., AQ score), a correlation was conducted with SRS-2 scores. This correlation was significant (r = .785, p = .000). Additionally, an independent samples t-test between AQ score and ASD diagnosis indicated a significant difference ($t(27)$ = -11.518, p = .000) in AQ score between those with ASD (M = 33.36, SD = 6.990) and those without ASD (M = 17.72, SD = 8.956), which is to be expected, and confirms that it is a valid measure of ASD symptomology.

To cross-validate the PSRS-RSC, a correlation was conducted with the PSI-4-SF score. The two were significantly correlated (r = .431, p = .008), validating the measurement of parent stress. Measures of PSE were also correlated. Results indicated a correlation between the PSOC overall score and the PSEMAS total score and (r = .479, p = .005). In sum, these correlations validate the use of these measures to capture ASD traits and parental stress, respectively.

Hypothesis Testing

Examination of the Relationships between ASD traits and Self-reported Stress as moderated by PSE.

Autism Traits and Self-Report Stress, Moderated by Parental Self-Efficacy (PSOC).

The first regression tested the hypothesis of ASD traits (AQ), PSE (PSOC) and their interaction with the dependent variable of self-reported parental stress (PSRS-RSC). BAPQ and child age were the only identified covariates. The full model accounted for 14.2% of the variance in PSRS-RSC scores. As shown in Table 5, child age was significantly and negatively related to PSRS-RSC in Step 1, Step 2, and Step 3 (β = -.506, p = .009; β = -.531, p = .010; β = -.533, p = .016). In all instances an older child was associated with decreased parent stress. These effect sizes were all large. Additionally, no significant main effects emerged for AQ score (β = -.195, p = .387) or parenting efficacy (β = .023, p = .922). The interaction effect was also non-significant (β = -.006, p = .979).

Autism Traits and Self-Report Stress, Moderated by Parental Self-Efficacy (PSEMAS).

A secondary regression was conducted using the PSEMAS scale as the moderator in the relationship between ASD traits (AQ) and self-reported parental stress (PSRS-RSC). Again, BAPQ and child age were used as covariates, as previously identified. The full model accounted for 27.6% of variance in PSRS-RSC scores. Child age was significantly and negatively related to PSRS-RSC in Step 1, Step 2, and Step 3 (β = -.500, p = .012; β = -.506, p = .010; β = -.499, p = .011). These were all large effect sizes. As shown in Table 6, no significant main effects emerged for AQ scores (β = -.182, p = .410) or PSEMAS score (β = -.338, p = .077). The interaction term was also not significant (β = -.186, p = .308). The main effect size for PSEMAS was medium, in the direction of lower PSE associated with greater self-reported stress. Additionally, the interaction effect size was small.

Examination of the Relationship between ASD Traits and Physiological Stress as Moderated by PSE

Autism Traits and Physiological Stress, Moderated by Parental Self-Efficacy (PSOC).

The second set of analyses tested the relationship of ASD traits (AQ), PSE (PSOC) and their interaction with physiological outcome measures of stress, measured by HR reactivity and HRV reactivity to the task. In these models caffeine intake was used as a covariate for HR reactivity, mother height was a covariate for HRV reactivity, and BAPQ scores were used as covariates in both.

For the dependent variable of HR reactivity, the full model accounted for 47.4% of the variance. BAPQ was negatively related to HR reactivity in Step 1 (β = -.561, p = .009) and caffeine intake was positively related to HR reactivity in Step 1 (β = .405 p = .048). These effect sizes were both large. As shown in Table 7, there was no significant main effect for AQ score (β = -.271, p = .392) nor for PSOC score (β = -.123, p = .646) for the dependent variable of HR reactivity. The interaction effect was also non-significant (β = .009, p = .973). There were small effect sizes for the main effect of AQ on HR change and PSOC on HR reactivity.

For the dependent variable of HRV reactivity, the full model accounted for 47.7% of the variance. In Step 2, there was a unique and significant negative relation between BAPQ and HRV (β = -.615, p = .017). There was a large effect size for this correlation. Additionally, there was a significant main effect for AQ on HRV change score (β = .687, p =.011), suggesting that higher ASD traits were associated with larger increases in HRV from baseline in the mother. There was no significant main effect for PSOC on HRV change (β = .058, p = .803). The interaction effect was also non-significant (β = -.178, p = .473). There was a large effect size for the main effect of AQ on HRV change and a small interaction effect.

Autism Traits and Physiological Stress, Moderated by Parental Self-Efficacy (PSEMAS***).*** Secondary analyses tested the prediction of ASD traits (AQ), PSE (PSEMAS) and their interaction with a physiological stress measure, measured by HR reactivity and HRV

reactivity. In these models caffeine intake was used as a covariate for HR reactivity, mother height was a covariate for HRV reactivity, and BAPQ score was used as a covariate in both.

In looking at HR change score, the full model accounted for 53.8% of the variance. BAPQ was significantly negatively related to HR reactivity in Step 1 (β = -.572, p = .010), which is considered it be a large effect size. As shown in Table 9, HR reactivity was not significantly related to AQ score (β = -.083, p = .755) nor was it significantly related to PSEMAS score (β = .163, p = .457). The interaction effect was also non-significant for this model (β = .254, p = .243). There was a small effect size for the main effect of PSEMAS on HR change, in the direction of lower self-efficacy related to decreased maternal HR reactivity from baseline. There was also a small interaction effect size.

In looking at HRV change score, the full model accounted for 67.20% of variance. As shown in Table 10, BAPQ was significantly and negatively related to HRV change score in Step 2 and Step 3 (β = -.619, p = .018; β = -.603, p = .009), such that higher BAPQ scores were associated with lower HRV reactivity. Both of these correlations suggest large effect sizes. Further, HRV reactivity was significantly positively related to AQ score (β = .549, p = .017), but no significant main effect emerged for PSE (β = -.254, p = .153). The significant main effect for AQ on HRV change score suggested that higher ASD traits were associated with larger increases in HRV from baseline in the mother. The main effect of ASD traits remained significant with the inclusion of the interaction term, which was also significant (β = -.405, p = .0275). In looking at the direction of the interaction, results indicated that there was a significant relationship between heightened ASD traits and increased HRV reactivity for those with low PSE (β = 1.05, p = .002), but not high PSE (β = .1309, p = .670). There was a large effect size for the main effect of AQ on HRV change, and a medium effect size for the main effect of parental efficacy on HRV change.

The medium effect size for PSE was in the direction of lower self-efficacy associated with greater increases in maternal HRV from baseline.

Discussion

This study adds to the growing literature on parental stress unique to parents of children with ASD. As such, the results shed light on potential targets of treatment, as well as the utility of using physiological measures of stress. The current study utilized a methodology that examined both physiological and self-report measures of stress, which approaches this topic from a nascent perspective. Though some findings are consistent with previous literature, others are slightly different than hypothesized, and the implications as well as future directions are discussed here. The primary findings indicated that PSE may act as a moderator between ASD traits and parental stress when using a physiological measure of parental stress, specifically HRV. This conclusion is qualified by the fact that the finding held for one measure of PSE, the PSEMAS. This interaction suggested that with lower PSE scores, there is a positive relationship between ASD and HRV reactivity. A significant positive main effect also indicated that ASD traits were related to increased HRV reactivity. Notably, there were no significant results found with HR reactivity or with parent self-report. These results were found after controlling for covariates for the specified models (i.e., child age, BAPQ score, mother height, and caffeine intake). It should be restated that this study was underpowered to detect small or medium effects. This is evident in that some of the regression coefficients were medium or large; however, they were not significant. Therefore, all results need to be further explored with a larger sample size, and medium to large effect sizes will be discussed with due caution herein.

In the first set of analyses using PSOC scores and self-reported stress, there were no significant interactions or main effects, and all effect sizes were negligible. This is somewhat

contrary to previous literature that has found that caregivers of children with ASD experience greater levels of parenting stress (Davis & Carter, 2008; Estes et al., 2013), due to the additional demands of parenting a child with special needs. One possible explanation is that parents often employ positive appraisal of a situation as a coping strategy (Holroyd & Ladaruz, 1982). Therefore, parents might perceive that they are experiencing less stress as a means to help themselves handle difficult situations, though that might not actually be the case. One study found that locus of control, similar to PSE, did not moderate the relationship between stressors and negative outcomes, and in fact coping styles and strategies were more predictive of the outcome than parental confidence or even social support (Dunn, Burbine, Bowers, & Tanlteff-Dunn, 2001). Therefore, the results in this study might further support the notion that coping strategies, such as cognitive appraisal, might be accounting for the self-report results.

Similar results were found with the other set of analyses using self-reported stress and a different measure of PSE (PSEMAS), namely there were no significant main effects nor a significant interaction. This provides evidence of not only consistency in the results across self-report measures, but also intimates that both measures of PSE are capturing a similar construct of PSE. This consistency across measures was also supported by the significant correlation between the two measures of PSE. Despite statistical non-significance, however, the effect size of the PSEMAS main effect was medium, indicating that lower PSE may be associated with greater self-reported stress. This result should be interpreted very cautiously, due to the low power; however, the direction of this finding is consistent with what was hypothesized.

In the models using physiological data, HRV stress reactivity was found to have a relationship with ASD traits. Here, results revealed that higher ASD traits were positively related to HRV change. A positive change reveals higher HRV in the task relative to baseline. Since

HRV has been used to indicate emotional responding and flexibility, as well as psychopathological features and processes in a number of studies (Thayer & Lane, 2000; Kreibig, 2010), there are a few possible interpretations of the present finding. If context is not considered, however, a potential interpretation is that parents of children with higher ASD traits have developed more flexible and adept regulation skills in stressful situations. Specifically, higher HRV may reflect a greater capacity for regulated emotional responses. These results may illustrate the fact that parents whose children have more severe ASD traits might have developed more adaptive coping mechanisms. To date, there are no studies to our knowledge looking specifically at HRV in parents of children with ASD. However, research on general stress and other clinical populations, such as individuals with PTSD, indicate that decreased HRV may indicate lack of the ability to respond flexibly to stressful situations even if they are not exposed to a stressful reminder during a task, and may also reveal more rigidity and more vulnerability to psychological distress (Cohen et al., 1998).

Additionally, previous research has suggested the importance of considering HRV reactivity in the context of the situation. Hastings et al. (2008) indicated that RSA (another index of HRV) changes depending on the situation. More specifically, it was found that lower RSA in threatening situations might reflect effective coping strategies, whereas increased RSA in non-threatening situations might reflect emotion regulation. If this finding is applied to the current study, this suggests that an increase in HRV during the parent-child stressor actually may reflect poorer coping. Therefore, the positive relationship between ASD traits and HRV reactivity may indicate that higher ASD traits are related to an atypical coping response during a stressful situation. This is consistent with previous literature indicating greater stress levels for parents of children with ASD. Since manipulation checks found that the task was stressful, the pattern of

responding might highlight effective coping that parents of children with less severe ASD traits might possess in comparison to those with more severe deficits. Further, HRV is a more specific way to examine autonomic functioning, as it is only mediated by parasympathetic nervous system activity (Berntson, Cacioppo, Quigley, & Fabro, 1994). Therefore, it seems HRV might be a better index of parental stress than HR, as it isolates the parasympathetic nervous system activity and provides a measure of emotional responding and flexibility.

The analysis using PSEMAS was the only overall model that was significant for the interaction, such that mothers with low PSE demonstrated a stronger relationship between ASD traits and increased HRV change. Interpreting this finding without consideration of context, this is contrary to the initial hypothesis. However, this is in line with research indicating more flexible coping in parents of children with more severe ASD traits. Though most research is on the positive effects of self-efficacy, recently there has been research exploring negative effects of self-efficacy (Vancouver, Thompson, Tischner, & Putka, 2002). While some researchers looked at the effect of self-efficacy in longitudinal data on performance, other work has found that higher self-efficacy can lead to overconfidence in one's abilities and this resulted in the individual being less active in completing a given task (Stone, 1994). Based on this information, an alternate possible explanation for the findings from the present study may be that with higher self-efficacy, these parents might be overconfident in their abilities, and therefore display greater stress when they feel they cannot handle a situation or should have more control. Therefore, with lower self-efficacy, parents might not be as invested or as concerned with their performance. Instead, they are reacting to the situation, rather than considering their own ability to influence the situation. As found in the Dunn et al. article (2001), coping strategies were determined to be the greatest predictor of parental response. Thus, coping strategies beyond PSE may be

employed by parents, accounting for the results in the present study. Specifically, researchers indicate that escape-avoidance coping corresponds to increased depression and other negative outcomes, while distancing (i.e., making light of a situation) can also lead to negative results; however, some degree of distancing was found to be positive (Dunn et al, 2011).

In considering this in the context of the situation, this finding suggests that mothers with lower PSE are less adept at responding to stress (Huffman et al., 1998; Hastings et al., 2008). Therefore, mothers with lower PSE could have more difficulty coping with stressful tasks, whereas parents with higher PSE might rise to the challenge. This finding is consistent with previous work highlighting the protective nature of PSE, especially in parents of children with ASD. Further, lower PSE has been found to be related to stress (Hastings & Brown, 2002), to partially mediate parenting stress and increase depression and anxiety in parents (Rezendes & Scarpa, 2011), and mediate the relationship between child problem behaviors and maternal anxiety and depression (Hastings & Brown, 2002). Therefore, mothers with lower PSE might be responding inappropriately and have less strategies for coping with a stressful situation. For them, there is no buffer to their child's ASD symptoms, as their low PSE might lead them to feel more stress and they are left without useful coping strategies. It is important to note again that the study was underpowered to detect interactions as well as medium or small effect sizes. Therefore, the results should be interpreted with caution and this could be another reason why the results are not in the direction that was hypothesized.

Looking at the various methods of report, the results provide support for using physiological data, especially HRV, in looking at stress. Additionally, it seems that maternal report of stress and HRV were not related, which indicates physiological measures might tap into the stress mothers are experiencing beyond what is reported on a survey or paper measure.

Further, the fact that the PSEMAS was the only self-report measure that moderated the model may be due to the fact that this measure is designed specifically for parents of children with ASD, and this sample included a high number of individuals with this diagnosis. Therefore, this measure might have measured PSE in a way more specific to the parents in the current sample than the PSOC does. Future studies can work to validate this measure, as a specific measure of PSE in parents of children with ASD may be useful in answering a number of research questions.

Additionally, the BAPQ was a significant covariate in a number of the analyses and likely accounted for a significant amount of the variance. As previously mentioned, BAP traits have been linked to social anxiety and communication problems in parents (Karst & Van Hecke, 2012), which might impact their interaction with their child. Research has also found that parents with BAP characteristics employ ineffective coping strategies for stress as well as show elevated stress levels and rates of depression (Ingersoll & Hambrick, 2011). Therefore, the presence of BAP features may dictate the amount and type of stress a parent experiences in interacting with their child. The nature of the relationship of BAP traits to stress was not explicitly studied and therefore, future studies should examine this in more detail and explore these moderation models of parental stress without BAPQ score.

The results of this study have potential implications for treatment. There has been a push to include parents in treatments for children with ASD and a number of different treatment models currently exist. These manualized parent-implemented interventions can be complex and require extensive training, expertise, and high fidelity (Rogers et al., 2012). Interventions targeting PSE have proven to be successful in both increasing PSE and decreasing child behavior problems. The results of the present study, indicating lower PSE might lead to poorer coping with stress, suggests that targeting PSE in interventions might be beneficial. This was also

underscored by the finding that lower PSE was related to heightened self-reported stress. Though this was not a significant finding, the effect size was medium, and this effect might have been significant with greater power. Therefore, it may be that low PSE is related to increased self-reported stress and an unusual physiological stress response, and low PSE moderates the relationship between ASD traits and poor coping (as reflected in increased HRV during the stressor task). Regarding PSE in the context of PMT, Sofronoff and Farbotko (2002) found increased PSE in comparison to control groups, and these parents also reported fewer child problem behaviors post intervention. Therefore, increasing PSE may impact parental stress; however, as the results show, there might be the need to teach other coping strategies as well.

Parent training programs may teach parents how to employ strategies for dealing with disruptive behavior, and these interventions have been found to enhance psychopharmacological treatment as well as foster improvements in child behavior (Bearss, Johnson, Handen, Smith, & Schaill, 2012). Based on the current results, teaching specific strategies for managing a child's behavior or eliciting certain skills might be even more beneficial than just focusing on PSE. Finally, psychoeducation outlines core information regarding ASD without giving specific strategies and hands on training. All of these have been found to be efficacious; however, often the parent mediated interventions as well as parent training lead to the most salient results. This outcome might emerge due to the fact that increasing skills increases PSE and as a result could also decrease stress levels.

Considering parent stress in treatment design as well as outcomes should also be considered (Luiselli, 2000). One finding indicates that parental stress decreases with low-intensity treatment (Brookman-Frazee & Koegel, 2004) and may also lead to decreased child outcomes. Therefore, implementing an intervention with a balance between education, resources,

and respect of the parents' time is necessary. Further, higher initial parent stress is associated with less adaptive behavior outcomes in staff-provided interventions, even if the parent is not the main person responsible for the implementation of treatment (Shine & Perry, 2010). Thus, targeting parent stress seems necessary for both the parent and child in making significant gains. Additionally, results from this study indicate that while PSE should be a component addressed in treatment, there is a need for additional strategies to be included in training to enhance parents' repertoire of responding to their child.

Limitations

Multiple limitations exist within the current study. Primarily, difficulties in recruitment led to a number of limitations. First, the sample size did not allow for us to detect significance from medium or small effect sizes, and the results of non-large effects, therefore, should be interpreted with caution. To ensure the accuracy of results as well as expand on the moderation analyses, the specified models should be tested in a larger sample. Additionally, the racial make up of the sample was not diverse, which could impact the response patterns found in the current sample. Parent stress and response patterns have not been specifically studied in looking at race and ASD features, however further examination of these variables can shed light on potential cultural differences. Although we attempted to recruit fathers to fill out additional surveys, we did not have a promising response rate and stopped this component of the study. This did not impact the present analyses; however, it would have allowed for another layer of analyses to consider. Additional research should look at fathers' or other caregivers' responses in order to get a more complete idea of other environmental variables. Finally, the examination of the questions on the manipulation check did not demonstrate significant differences on helplessness, controllability, or pleasure, though the overall stress ratings did indicate significant increases

after the task. Therefore, there is some ambiguity as to whether the task elicited the specific aspects of stress we aimed to target.

Finally, while measures of PSE and the mother's perception of their child's social functioning were included, child behavior factors were not included in the present analysis. Specifically, a child's problematic behavior could serve as an important antecedent and reinforcer of parenting behaviors.

Future Directions

Future directions could expand on the work looking at parental stress. Researchers might include additional diagnoses in order to compare the maternal stress response in mothers of children with ASD to those with other diagnoses. Further, analyzing parent stress response via other physiological measurements including electro-dermal activity (EDA), cortisol, and pupillometry during eye tracking could allow greater insight into the sympathetic, parasympathetic, and HPA influence during stressful situations. Many researchers have studied the role cortisol plays in the HPA axis and its relationship to psychological stressors (Young et al., 2004), combining this measurement with salivary alpha-amylase (sAA). It may also be helpful to measure stress responses in multiple contexts beyond just the interaction with the child, to examine the importance of differentiating state and trait features of a stress response. Including a non-stressful task in order to compare HRV reactivity in a stressful and non-stressful context might also be beneficial and an additional component to add in future studies. Moreover, looking at other factors that may influence parental stress can also shed light on this concept. For example, past studies have focused on parent's levels of stress (i.e., self report and cortisol) in relation to time spent with children, negative and positive affect, and types of stressors encountered (Smith et al., 2010). Additionally, future studies could look at a behavioral measure

of stress as well as specific subscales and components of PSE, to tease apart what might be accounting for the interaction of ASD traits, PSE, and parental stress. Mediation analyses might reveal different interactions of these factors. Future work assessing parental BAPQ characteristics more in depth, used as a covariate here, might also add a layer to the stress literature. Examining the accuracy of performance on the tangram task might also be interesting as it relates to stress reactivity in parents. Additionally, comparing state stress responses versus trait stress response might also elucidate more information regarding this area of research.

In sum, this study continues to elucidate topics related to the stress parents of children with ASD experience and the way in which PSE moderates the impact ASD traits have on this stress. By including a physiological measure of stress, results were not only based on an additional measure of stress, looking at the mother's physiological response, but also demonstrate how parental stress can impact parents' general health. The study results highlight the potential importance of conveying a range of specific strategies and targets of treatment to improve parental coping, in addition to PSE in parent training and intervention, to add to positive outcomes for both the children and their parents.

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Table 1
Descriptive Statistics for Continuous Variables of Interest

Measure	n	Minimum	Maximum	*M*	*SD*	Skewness	Kurtosis
Demographics							
Mother Age (years)	34	31.00	51.00	39.590	5.263	.475	-.772
Child Age (years)	38	7.00	12.00	8.870	1.474	.346	-.690
Mother Height (in cm)	39	155.00	174.00	164.679	5.383	-.042	-.273
Mother Weight (pounds)	39	103.00	257.00	152.308	32.860	1.131	1.647
Mean Baseline HR	32	52.296	91.455	70.827	8.359	.099	.142
Mean Task HR	32	55.337	93.054	75.376	9.932	-.138	-.691
Change in HR	32	-5.07	13.85	4.463	3.956	.080	1.067
Mean Baseline HRV	32	4.945	83.673	41.702	18.166	.039	.028
Mean Task HRV	32	5.698	79.457	33.994	15.607	1.033	1.543
Change in HRV	32	-57.92	44.56	-7.707	18.487	.005	2.305
Primary Measures							
AQ	30	5.00	44.00	23.570	11.032	-.022	-1.157
PSRS-Total	39	3.00	40.00	22.330	8.480	-.290	-.266
PSRS-RSC	39	1.00	10.00	5.920	2.070	-.399	.232
PSOC-Total	34	40.00	95.00	71.910	11.702	-.396	.638
PSEMAS-Total	33	1.182	5.00	3.089	.921	-.075	-.498
Secondary Measures/Confounds							
BAPQ	33	51.00	139.00	97.970	21.412	-.350	-.212
IQ (FSIQ-4)	30	70.00	129.00	108.46	15.711	-.991	.617
PSI-4-SF	38	41.00	142.00	85.50	23.581	.258	.239
SRS-2	33	39.00	87.00	60.640	14.433	.343	-.937

Note. AQ = Autism Quotient total score; PSRS-Total = Perceived Stress Reactivity Scale total score; PSRS-RSC = Perceived Stress Reactivity Scale Social Conflict subscale; PSOC = Parental Sense of Competence total score; PSEMAS = Parental Self-Efficacy in the Management of Asperger Syndrome total score; BAPQ = Broad Autism Phenotype Questionnaire; IQ = FSIQ-4; PSI_4 = Parental Stress Index total score; SRS-2 = Social Responsiveness Scale, second edition

Table 2
Descriptive Statistics for Categorical Variables of Interest

Variable	Percentage (*n*)
Child Gender	
Male	64.3 (27)
Female	31.0 (13)
Location	
Blacksburg	83.3 (35)
Roanoke	4.8 (2)
Boston	11.9 (5)
Child ASD Dx	
Yes	35.7 (15)
No	61.9 (26)
Mother Ethnicity	
Asian	14.3 (6)
Caucasian	76.42 (32)
Child Ethnicity	
African American	2.4 (1)
Asian	16.7 (7)
Caucasian	66.7 (28)
Hispanic	2.4 (1)
Approximate Yearly Household Income	
$10,000-$25,000	9.5 (4)
$25,000-$50,000	23.8 (10)
$50,000-$75,000	21.4 (9)
$75,000-$100,000	14.3 (6)
$100,000-$200,000	19.0 (8)
$200,000+	7.1 (3)
Did not report	4.8 (2)
Marital Status	
Divorced	11.9 (5)
Married	71.4 (30)
Remarried	4.8 (2)
Separated	2.4 (1)
Unmarried/In a relationship	2.4 (1)
Single	2.4 (1)
Did not report	4.8 (2)
Highest Level of Schooling Completed	
Some college	23.8 (10)
Bachelors/4-year degree	31.0 (13)
Graduate School	40.5 (17)
Did not report	4.8 (2)
Manipulation Check (Stress of Task)	
-3 (decrease)	7.0 (3)
-2 (decrease)	14.0 (6)
-1 (decrease)	14.0 (6)
0 (no change)	37.2 (16)
+1 (increase)	9.3 (4)
+2 (increase)	4.7 (2)

Table 3
Correlations Among HR Variables and Possible Covariates

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Change in HRV	1													
2. Baseline HRV	-	1												
3. Task HRV	.443**	.999***	1											
4. Change in HR	.023*	.057	-.449**	1										
5. Baseline HR	.071	.999***	.999***	.269	1									
6. Task HR	-.121	.999***	.999***	.612***	1.00***	1								
7. Mother Age	-.043	-.064	-.066	-.022	-.70	-.071	1							
8. Mother Height (cm)	-.372*	-.461**	.155	-,208	,161	.160	-.137	1						
9. Mother Weight (lbs)	.187	-.146	-.138	-.062	-.132	-.133	-.273	.452**	1					
10. Current Medication (Y/N)	.319	-.222	-.208	-.254	-.219	-.222	.001	-.079	-.069	1				
11. Current Dx (Y/N)	-.047	-.178	-.179	.120	-.182	-.182	.257	.191	-.098	-	1			
12. Caffeine Today? (Y/N)	-.076	-.235	-.238	.391*	-.236	-.232	.078	.014	.194	-.102	-	1		
13. Exercise Today? (Y/N)	-.051	-.084	.082	-.023	.075	.075	.079	.088	-.122	-.066	.210	-.053	1	
14. BMI	-.071	-.205	-.208	.221	-.213	-.211	-.187	-.33	-	-.120	-	.264	.053	1

Note. HR = heart rate; HRV= heart rate variability, BMI = body mass index; **p* < .05, ***p* < .01, ****p* < .001

Table 4
Pearson Correlations for All Variables of Interest

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Demographic Variables	1. Mother Age (years)	1									
	2. Child Age (years)	.359*	1								
	3. Child Gender	.188	.451**	1							
	4. ASD Child Dx	.177	.110	.014	1						
Parent Stress Reactivity Measures (Physiological Measures)	5. Mean Baseline HR	-.070	-.099	-.046	-.127	1					
	6. Mean Task HR	-.071	-.099	-.046	-.126	1***	1				
	7. Change in HR	-.022	.045	.079	-.254	.269	.612***	1			
	8. Mean Baseline	-.064	-.111	-.060	.130	.99***	.99***	.057	1		
	9. Mean Task HRV	-.066	-.112	-.050	.130	.99***	.99***	-.449	. 99**	1	
	10. Change in HRV	-.043	-.016	.249	-.009	.071	-.121	-.415*	-.638***	.334**	1
ASD Measure	11. AQ	.107	-.037	-.103	.689***	.124	.122	-.310	.124	.130	.313
Parent Stress Self-Report	12. PSRS-Total	-.348*	-.41	-.128	-.028	-107	-.109	-.340	-.101	-.100	-.004
	13. PSRS-RSC	.-.302	-.460**	-.146	-.089	.064	-.001	-.279	.112	.005	-.021
Self-Efficacy Measures	14. PSOC-Total	-.104	.167	-.150	-.175	.072	.073	.097	.063	.063	.0000
	15. PSEMAS-Total	.151	.029	.033	-.175	.044	.045	.084	.047	.042	-.177
Covariates	16. BAPQ	-.003	.176	-.115	.446*	-.027	-.030	-.483*	-.021	-.027	-.197
	17. IQ (FSIQ-4)	-.216	-.231	-.067	-.320	.193	.190	-.342	.186	.189	.070
	18. PSI-4-SF	.036	-.327	-.169	.394	.025	.022	-.325	.028	.032	.102
	19. SRS-2 1	-.043	-.119	-.005	.739***	.206	.206	-.096	.209	.210	.033

Note. AQ = Autism Quotient total score; PSRS-Total = Perceived Stress Reactivity Scale total score; PSRS-RSC = Perceived Stress Reactivity Scale Social Conflict subscale; PSOC = Parental Sense of Competence total score; PSEMAS = Parental Self-Efficacy in the Management of Asperger Syndrome total score; BAPQ = Broad Autism Phenotype Questionnaire; IQ = FSIQ-4; PSI_4 = Parental Stress Index total score; SRS-2 = Social Responsiveness Scale, second edition

Table 4 (cont.)
Pearson Correlations for All Variables of Interest

		11.	12.	13.	14.	15.	16.	17.	18.	19.
Demographic Variables	1. Mother Age (years)									
	2. Child Age (years)									
	3. Child Gender									
	4. ASD Child Dx									
	5. Mean Baseline HR									
Parent Stress Reactivity Measures (Physiological Measures)	6. Mean Task HR									
	7. Change in HR									
	8. Mean Baseline HRV									
	9. Mean Task HRV									
	10. Change in HRV									
ASD Measure	11. AQ	1								
Parent Stress Self-Report	12. PSRS-Total	-.004	1							
	13. PSRS-RSC	.014	.820***	1						
Self-Efficacy Measures	14. PSOC-Total	-.234	-.503**	-.082	1					
	15. PSEMAS-Total	-.165	-.473**	-.231	.479**	1				
Covariates	16. BAPQ	.381*	.223	-.057	-.408 *	-.153	1			
	17. IQ (FSIQ-4)	-.197	.166	.220	.028	-.177	.050	1		
	18. PSI-4-SF	.656***	.456**	.431***	..544***	-.545**	.408*	.062	1	
	19. SRS-2	.785**	.166	.199	-.141	-.080	.381*	-.476*	.590*	1

Note. AQ = Autism Quotient total score; PSRS-Total = Perceived Stress Reactivity Scale Total Score; PSRS-RSC = Perceived Stress Reactivity Scale Social Conflict subscale; PSOC = Parental Sense of Competence total score; PSEMAS = Parental Self-Efficacy in the Management of Asperger Syndrome total score; BAPQ = Broad Autism Phenotype Questionnaire; IQ = FSIQ-4; PSI-4-SF = Parental Stress Index total score; SRS-2 = Social Responsiveness Scale, second edition

Table 5
Autism Traits and Self-Report Stress, Moderated by Parental Self-Efficacy (PSOC) (*N*=27)

Variable	*B*	*SE*	Beta	R^2 Change	*F* Change
Outcome: PSRS-RSC					
Step 1				.284	4.569*
BAPQ	.019	.016	.222		
Child Age	-.589		-.506**		
Step 2				.029	.449
BAPQ	.028	.020	.332		
Child Age	-.619	.218	-.531**		
AQ	-.029	.031	-.192		
PSOC	.003	.033	.022		
Step 3				.000	.001
BAPQ	.029	.022	.335		
Child Age	-.621	.236	-.533*		
AQ	-.029	.033	-.195		
PSOC	-.003	.034	.023		
AQ-TotalxPSOC	.000	.004	-.006		

Note. AQ = Autism Quotient total score; PSRS-RSC = Perceived Stress Reactivity Scale Social Conflict subscale; PSOC = Parental Sense of Competence total score; BAPQ = Broad Autism Phenotype Questionnaire
; *$p < .05$, **$p < .01$, ***$p < .001$

Table 6
Autism Traits and Self-Report Stress, Moderated by Parental Self-Efficacy (PSEMAS) (*n*= 27)

Variable	*B*	*SE*	Beta	R^2 Change	*F* Change
Outcome: PSRS-RSC					
Step 1				.279	4.259*
BAPQ	.018	.015	.225		
Child Age	-.550	.200	-.500*		
Step 2				.114	1.886
BAPQ	.020	.017	.250		
Child Age	-.555	.196	-.506**		
AQ	-.023	.032	-.152		
PSEMAS	-.636	.332	-.346		
Step 3				.033	1.098
BAPQ	.019	.019	.241		
Child Age	-.548	.196	-.499*		
AQ	-.027	.032	-.182		
PSEMAS	-.620	.331	-.338		
AQ-Totalx PSEMAS	-.359	.034	-.186		

Note. AQ = Autism Quotient total score; PSRS-RSC = Perceived Stress Reactivity Scale Social Conflict subscale; PSOC = Parental Sense of Competence total score; BAPQ = Broad Autism Phenotype Questionnaire; PSEMAS = Parental Self-Efficacy in the Management of Asperger Syndrome total score; *$p < .05$, **$p < .01$, ***$p < .001$

Table 7
Autism Traits and Physiological Stress (HR), Moderated by Parental Self-Efficacy (PSOC) (*n* = 27)

Variable	*B*	*SE*	Beta	R^2 Change	*F* Change
Outcome: HR Change					
Step 1				.434	6.138
BAPQ	-.103	.035	-.561*		
Caffeine Intake	3.339	1.557	.405*		
Step 2				.040	.531
BAPQ	-.095	.046	-.520		
Caffeine Intake	3.424	1.769	.415		
AQ	-.072	.078	-.215		
PSOC	-.043	.083	-.126		
Step 3				.000	.001***
BAPQ	-.096	.049	-.522		
Caffeine Intake	3.432	1.849	.416		
AQ	-.073	.082	-.217		
PSOC	-.042	.090	-.123		
AQ-TotalxPSOC	.0004	.011	.009		

Note. AQ = Autism Quotient total score; HR Change = Heart Rate change; PSOC = Parental Sense of Competence total score; BAPQ = Broad Autism Phenotype Questionnaire
; *$p < .05$, **$p < .01$, ***$p < .001$

Table 8
Autism Traits and Physiological Stress (HRV), Moderated by Parental Self-Efficacy (PSOC) *(n* = 27)

Variable	*B*	*SE*	Beta	R^2 Change	*F* Change
Outcome: HRV Change					
Step 1				.153	1.541
BAPQ	-.157	.119	-.294		
Maternal Height	.599	.519	.257		
Step 2				.303	.4175
BAPQ	-.328	.122	-.615*		
Maternal Height	.421	.482	.181		
AQ	.690	.240	-.660*		
PSOC	.077	.231	.074		
Step 3				.020	.545
BAPQ	-.284	.138	-.533		
Maternal Height	.428	.489	.184		
AQ	.719	.247	.687**		
PSOC	.060	.236	.058		
AQ-TotalxPSOC	-.023	.031	-.178		

Note. AQ = Autism Quotient total score; HRV Change = Heart Rate Variability Change; PSOC = Parental Sense of Competence total score; BAPQ = Broad Autism Phenotype Questionnaire
; *$p < .05$, **$p < .01$, ***$p < .001$

Table 9
Autism Traits and Physiological Stress (HR), Moderated by Parental Self-Efficacy (PSEMAS) *(n* = 27)

Variable	*B*	*SE*	Beta	R^2 Change	*F* Change
Outcome: HR Change					
Step 1				.434	5.762
BAPQ	-.103	.035	-.572*		
Caffeine Intake	3.160	1.602	.385		
Step 2				.045	.563
BAPQ	-.089	.044	-.491		
Caffeine Intake	4.035	1.862	.491		
AQ	-.047	.093	-.131		
PSEMAS	.812	.936	.187		
Step 3				.058	1.507
BAPQ	-.085	.043	-.469		
Caffeine Intake	3.415	1.895	.416		
AQ	-.029	.092	-.083		
PSEMAS	.708	.923	.163		
AQ-TotalxPSEMAS	.104	.085	.254		

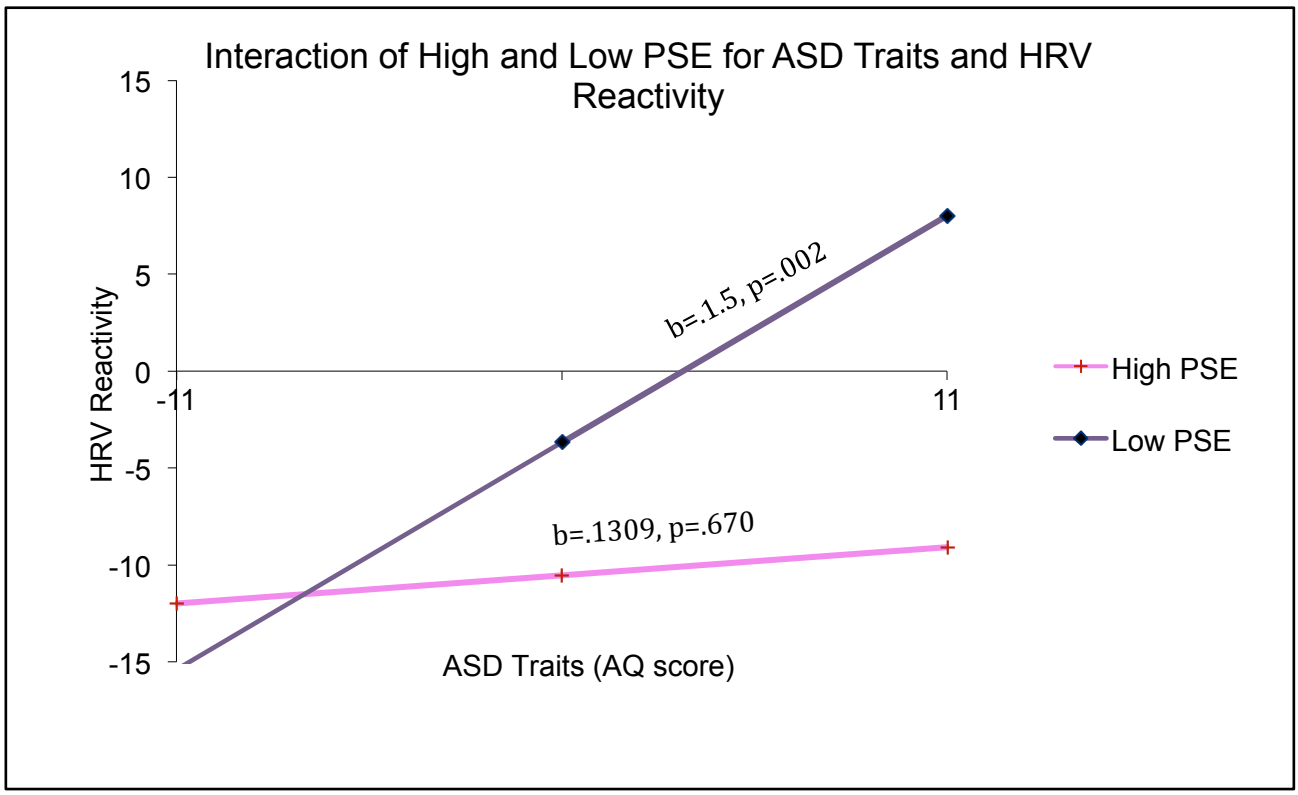
Note. AQ = Autism Quotient total score; HR Change = Heart Rate Change ; PSEMAS = Parental Self-Efficacy in the Management of Asperger Syndrome total score; BAPQ = Broad Autism Phenotype Questionnaire
; **p* < .05, ***p* < .01, ****p* < .001

Table 10
Autism Traits and Physiological Stress (HRV), Moderated by Parental Self-Efficacy (PSEMAS) *(n* = 27)

Variable	*B*	*SE*	Beta	R^2 Change	*F* Change
Outcome: HRV Change					
Step 1				.123	1.126
BAPQ	-.156	.121	-.301		
Maternal Height	.446	.581	.180		
Step 2				.393	5.695
BAPQ	-.320	.119	-.619*		
Maternal Height	.485	.470	.196		
AQ	.640	.257	.585		
PSEMAS	-3.889	2.476	-.305		
Step 3				.155	6.160
BAPQ	-.312	.102	-.603*		
Maternal Height	.333	.406	.134		
AQ	.600	.220	.549*		
PSEMAS	-3.240	2.132	.-254		
AQ-TotalxPSEMAS	-.486	.196	-.405*		

Note. AQ = Autism Quotient total score; HRV Change = Heart Rate Variability Change; PSEMAS = Parental Self-Efficacy in the Management of Asperger Syndrome total score; BAPQ = Broad Autism Phenotype Questionnaire
; *$p < .05$, **$p < .01$, ***$p < .001$

Figure 1
Graphical Representation of Interaction of HRV and ASD Traits moderated by PSE (PSEMAS)



Appendix A

DEMOGRAPHICS QUESTIONNAIRE

1. Today's date (mm/dd/yyyy): _____

2. What is your age? _____ years

3. What is your child's month and year of birth? _____

4. Which of the following best describes your ethnicity/ race?
___Caucasian
___African-American
___Hispanic
___Asian
___Other (please specify): _____

5. Marital Status:
____Married
____Long-term relationship
____Divorced or Separated
____Single or Never married
____Widowed

6. What is your approximate yearly household income?
____ less than $10,000
____ $10,000- $25, 000
____ $25,000 - $50000
____ $50,000 - $75,000
____ $75,000 - $99,999
____ $100,000 - $199,999
____ $200,000 or more

7. How many total persons live in your household? _____

8. Please complete the following table and STAR the child who will be participating in today's study:

	Relationship to you	**Gender**	**Age**
Example	*Son (biological)**	*Male*	*7*
1			
2			
3			
4			
5			
6			

9. Which of the following best describes your child's ethnicity/ race?
___Caucasian
___African-American
___Hispanic
___Asian
___Other (please specify): _____

10. What level of education has your child completed?
____None
____Preschool
____Elementary School
____Middle School

11. Specify last grade completed: _____

12. Does your child have any other symptoms or diagnoses? (check all that apply)
____Anxiety Disorder
____Autism Spectrum Disorder
____Attention Deficit Hyperactive Disorder
____Obsessive Compulsive Disorder
____Central Auditory Processing Disorder
____Depression
____Schizophrenia
____Hearing Impairment
____Vision Impairment
____'Tunnel Vision Syndrome' (peripheral vision, vision perception impairment)
____Mental Retardation
____Seizures
____Dietary Allergies
____Digestive Problems (constipation, diarrhea, bloating, or abdominal pain)
____None
____Other (please specify): _____

Appendix B

MEDICAL HISTORY QUESTIONNAIRE

1) Have you eaten today? □ No □Yes

1a) If yes, what have you eaten today?

_____

_____

1b) If yes, what time did you last eat? _____

2) Have you consume caffeinated beverages today? □ No □Yes

2a) If yes, what caffeinated beverages did you have today?

_____

_____

2b) If yes, what time did you have these beverages? _____

3) Have you consume any alcoholic beverages today? □ No □Yes

3a) If yes, what alcoholic beverages did you have today?

_____

_____

3b) If yes, what time did you have these beverages?_____

4) Have you smoked cigarettes or another tobacco product today? □ No □Yes

4a) If yes, what tobacco product did you use?

_____

4b) If yes, what time did you last use the tobacco product? _____

5) Have you exercised today? □ No □Yes

5a) If yes, what exercise activities did you do today?

_____

_____

5b) If yes, what time did you exercise? _____

6) Do you regularly engage in exercise? □ No □Yes

6a) If yes, how much and how often do you exercise?

_____

6b) If yes, what types of activities do you engage in?

_____
_____

7) Do you currently participate in meditation? □ No □Yes

7a) If yes, how much and how often do you meditate?

_____
_____

8) What time did you fall asleep last night? _____

9) What time did you wake up this morning? _____

10) Do you have any of the following medical conditions?

- Heart condition? □ No □Yes
- Low blood pressure □ No □Yes
- High blood pressure □ No □Yes
- Fainting spells or dizziness □ No □Yes
- Diabetes □ No □Yes
- Asthma □ No □Yes
- Neurological disorders □ No □Yes
- Other condition (s) _____

10a) If yes to any of the items in #10, please explain and describe in more detail:

_____
_____
_____

11) Are you currently taking any medications? □ No □Yes

12a) If yes, what? How much? Why?

_____
_____
_____

12) Do you have any known allergies? □ No □Yes

12a) If yes, what allergies do you have? Please be specific.

_____
_____

13) Are you allergic to any food? □ No □Yes

13a) If yes, what food are you allergic to? Please be specific.

_____

_____

14) Have you ever had a head injury? □ No □Yes

14a) If yes, please explain.

_____

_____

15) Have you ever been knocked unconscious for longer than 5 minutes? □ No □Yes

15a) If yes, please explain.

_____

Appendix C

PERCEIVED STRESS REACTIVITY SCALE

Instructions: This questionnaire asks about your reactions to situations which you may have experienced in the past. Three answers are suggested. Please indicate the answer that most closely describes your own reaction in general. Please don't skip any item, even if it may be hard to find the best answer.

1. When tasks and duties build up to the extent that they are hard to manage...
   - ☐ I am generally untroubled
   - ☐ I usually feel a little uneasy
   - ☐ I normally get quite nervous

2. When I want to relax after a hard day at work . . .
   - ☐ This is usually quite difficult for me
   - ☐ I usually succeed
   - ☐ I generally have no problem at all

3. When I have conflicts with others that may not be immediately resolved...
   - ☐ I generally shrug it off
   - ☐ It usually affects me a little
   - ☐ It usually affects me a lot

4. When I make a mistake...
   - ☐ In general, I remain confident
   - ☐ I sometimes feel unsure about my abilities
   - ☐ I often have doubts about my abilities

5. When I'm wrongly criticized by others...
   - ☐ I am normally annoyed for a long time
   - ☐ I am annoyed for just a short time
   - ☐ In general, I am hardly annoyed at all

6. When I argue with other people...
   - ☐ I usually calm down quickly
   - ☐ I usually stay upset for some time
   - ☐ It usually takes me a long time until I calm down

7. When I have little time for a job to be done...
   - ☐ I usually stay calm
   - ☐ I usually feel uneasy
   - ☐ I usually get quite agitated

8. When I make a mistake...
   - ☐ I am normally annoyed for a long time

- ☐ I am normally annoyed for a while
- ☐ I generally get over it easily

9. When I am unsure what to do or say in a social situation...
   - ☐ I generally stay cool
   - ☐ I often feel warm
   - ☐ I often begin to sweat

10. When I have spare time after working hard...
    - ☐ It often is difficult for me to unwind and relax
    - ☐ I usually need some time to unwind properly
    - ☐ I am usually able to unwind effectively and forget about the problems of the day

11. When I am criticized by others...
    - ☐ Important arguments usually come to my mind when it is too late to still make my point
    - ☐ I often have difficulty finding a good reply
    - ☐ I usually think of a reply to defend myself

12. When something does not go the way I expected...
    - ☐ I usually stay calm
    - ☐ I often get uneasy
    - ☐ I usually get very agitated

13. When I do not attain a goal...
    - ☐ I usually remain annoyed for a long time
    - ☐ I am usually disappointed, but recover soon
    - ☐ In general, I am hardly concerned at all

14. When others criticize me...
    - ☐ I generally don't lose confidence at all
    - ☐ I generally lose a little confidence
    - ☐ I generally feel very unconfident

15. When I fail at something...
    - ☐ I usually find it hard to accept
    - ☐ I usually accept it to some degree
    - ☐ In general, I hardly think about it

16. When there are too many demands on me at the same time...
    - ☐ I generally stay calm and do one thing after the other
    - ☐ I usually get uneasy
    - ☐ Usually, even minor interruptions irritate me

17. When others say something incorrect about me . . .
    - ☐ I usually get quite upset

- ☐ I normally get a little bit upset
- ☐ In general, I shrug it off

18. When I fail at a task...
    - ☐ I usually feel very uncomfortable
    - ☐ I usually feel somewhat uncomfortable
    - ☐ In general, I don't mind

19. When I argue with others...
    - ☐ I usually get very upset
    - ☐ I usually get a little bit upset
    - ☐ I usually don't get upset

20. When I am under stress...
    - ☐ I usually can't enjoy my leisure time at all
    - ☐ I usually have difficulty enjoying my leisure time
    - ☐ I usually enjoy my leisure time

21. When tasks and duties accumulate to the extent that they are hard to cope with...
    - ☐ My sleep is unaffected
    - ☐ My sleep is slightly disturbed
    - ☐ My sleep is very disturbed

22. When I have to speak in front of other people...
    - ☐ I often get very nervous
    - ☐ I often get somewhat nervous
    - ☐ In general, I stay calm

23. When I have many tasks and duties to fulfill...
    - ☐ In general, I stay calm
    - ☐ I usually get impatient
    - ☐ I often get irritable

Appendix D

THE AUTISM SPECTRUM QUOTIENT – CHILDREN'S VERSION

1. S/he prefers to do things with others rather than on her/his own

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

2. S/he prefers to do things the same way over and over again

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

3. If s/he tries to imagine something, s/he finds it very easy to create a picture in her/his mind

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

4. S/he frequently gets so strongly absorbed in one thing that s/he loses sight of other things

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

5. S/he often notices small sounds when others do not

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

6. S/he usually notices house numbers or similar strings of information

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

7. S/he has difficulty understanding rules for polite behavior

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

8. When s/he is reading a story, s/he can easily imagine what the characters might look like

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

9. S/he is fascinated by dates

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

10. In a social group, s/he can easily keep track of several different people's conversations

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

11. S/he finds social situations easy

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

12. S/he tends to notice details that others do not

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

13. S/he would rather go to a library than a birthday party

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

14. S/he finds making up stories easy

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

15. S/he is drawn more strongly to people than to things

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

16. S/he tends to have very strong interests, which s/he gets upset about if s/he cannot pursue

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

17. S/he enjoys social chit-chat

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

18. When s/he talks, it is not always easy for others to get a word in edgeways

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

19. S/he is fascinated by numbers

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

20. When s/he is reading a story, s/he finds it difficult to work out the characters' intentions or feelings

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

21. S/he does not particularly enjoy fictional stories

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

22. S/he finds it hard to make new friends

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

23. S/he notices patterns in things all the time

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

24. S/he would rather go to the cinema than a museum

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

25. It does not upset him/her if his/her daily routine is disturbed

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

26. S/he does not know how to keep a conversation going with her/his peers

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

27. S/he finds it easy to ‘‘read between the lines’’ when someone is talking to her/him

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

28. S/he usually concentrates more on the whole picture, rather than the small details

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

29. S/he is not very good at remembering phone numbers

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

30. S/he does not usually notice small changes in a situation, or a person's appearance

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

31. S/he knows how to tell if someone listening to him/her is getting bored

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

32. S/he finds it easy to go back and forth between different activities

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

33. When s/he talks on the phone, s/he is not sure when it is her/his turn to speak

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

34. S/he enjoys doing things spontaneously

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

35. S/he is often the last to understand the point of a joke.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

36. S/he finds it easy to work out what someone is thinking or feeling just by looking at their face

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

37. If there is an interruption, s/he can switch back to what s/he was doing very quickly

38. S/he is good at social chit-chat

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

39. People often tell her/him that s/he keeps going on and on about the same thing

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

40. When s/he was in preschool, s/he used to enjoy playing games involving pretending with other children

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

41. S/he likes to collect information about categories of things (e.g., types of car, types of bird, types of train, types of plant, etc.)

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

42. S/he finds it difficult to imagine what it would be like to be someone else

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

43. S/he likes to plan any activities s/he participates in carefully

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

44. S/he enjoys social occasions

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

45. S/he finds it difficult to work out people's intentions

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

46. New situations make him/her anxious

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

47. S/he enjoys meeting new people

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

48. S/he is good at taking care not to hurt other people's feelings

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

49. S/he is not very good at remembering people's date of birth

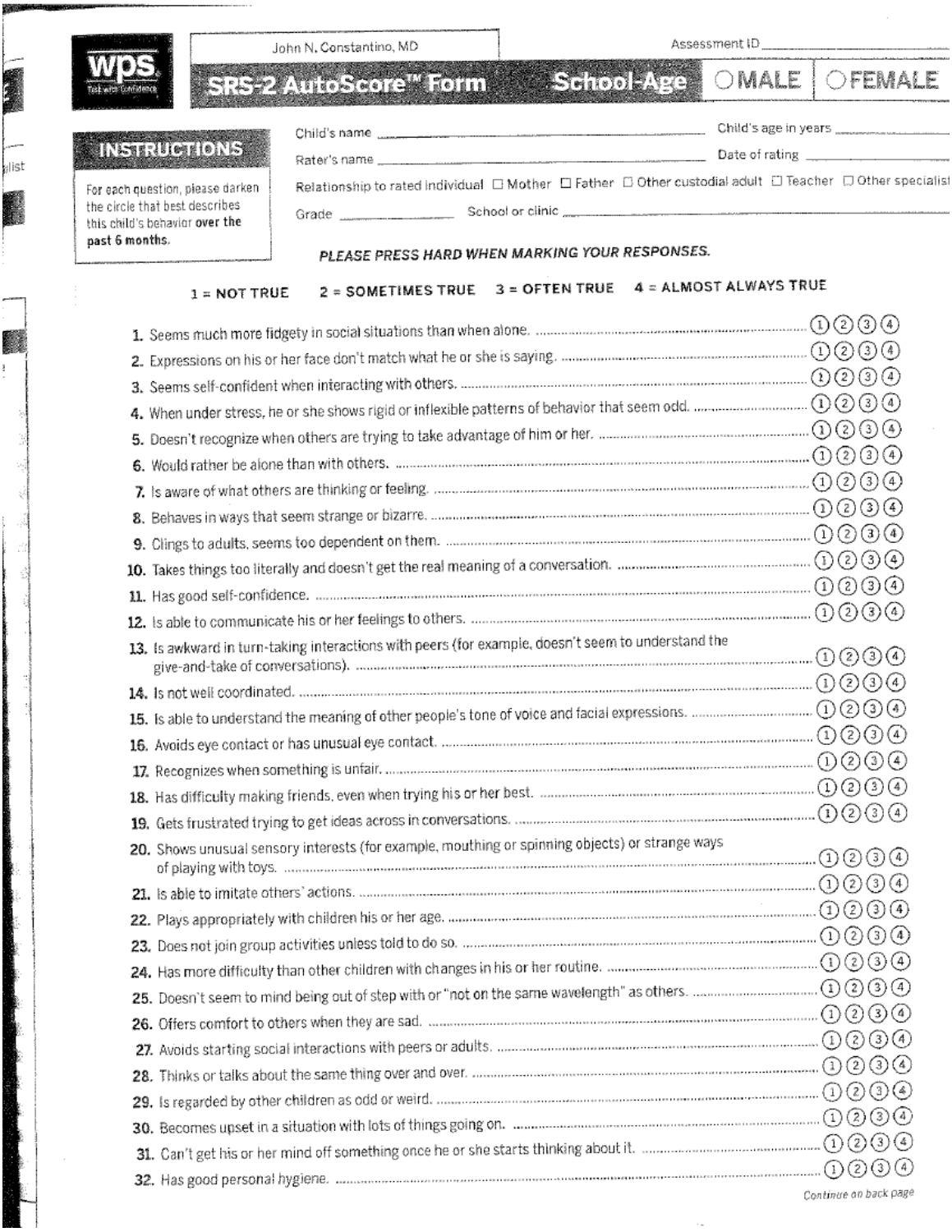
Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

50. S/he finds it very to easy to play games with children that involve pretending

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

Appendix E

SOCIAL RESPONSIVENESS SCALE - 2



wps
Test with Confidence

John N. Constantino, MD

Assessment ID _____

SRS-2 AutoScore™ Form **School-Age** ○ MALE ○ FEMALE

INSTRUCTIONS

For each question, please darken the circle that best describes this child's behavior **over the past 6 months.**

Child's name _____ Child's age in years _____

Rater's name _____ Date of rating _____

Relationship to rated individual ☐ Mother ☐ Father ☐ Other custodial adult ☐ Teacher ☐ Other specialist

Grade _____ School or clinic _____

PLEASE PRESS HARD WHEN MARKING YOUR RESPONSES.

1 = NOT TRUE 2 = SOMETIMES TRUE 3 = OFTEN TRUE 4 = ALMOST ALWAYS TRUE

1. Seems much more fidgety in social situations than when alone. ..... ① ② ③ ④
2. Expressions on his or her face don't match what he or she is saying. ..... ① ② ③ ④
3. Seems self-confident when interacting with others. ..... ① ② ③ ④
4. When under stress, he or she shows rigid or inflexible patterns of behavior that seem odd. ..... ① ② ③ ④
5. Doesn't recognize when others are trying to take advantage of him or her. ..... ① ② ③ ④
6. Would rather be alone than with others. ..... ① ② ③ ④
7. Is aware of what others are thinking or feeling. ..... ① ② ③ ④
8. Behaves in ways that seem strange or bizarre. ..... ① ② ③ ④
9. Clings to adults, seems too dependent on them. ..... ① ② ③ ④
10. Takes things too literally and doesn't get the real meaning of a conversation. ..... ① ② ③ ④
11. Has good self-confidence. ..... ① ② ③ ④
12. Is able to communicate his or her feelings to others. ..... ① ② ③ ④
13. Is awkward in turn-taking interactions with peers (for example, doesn't seem to understand the give-and-take of conversations). ..... ① ② ③ ④
14. Is not well coordinated. ..... ① ② ③ ④
15. Is able to understand the meaning of other people's tone of voice and facial expressions. ..... ① ② ③ ④
16. Avoids eye contact or has unusual eye contact. ..... ① ② ③ ④
17. Recognizes when something is unfair. ..... ① ② ③ ④
18. Has difficulty making friends, even when trying his or her best. ..... ① ② ③ ④
19. Gets frustrated trying to get ideas across in conversations. ..... ① ② ③ ④
20. Shows unusual sensory interests (for example, mouthing or spinning objects) or strange ways of playing with toys. ..... ① ② ③ ④
21. Is able to imitate others' actions. ..... ① ② ③ ④
22. Plays appropriately with children his or her age. ..... ① ② ③ ④
23. Does not join group activities unless told to do so. ..... ① ② ③ ④
24. Has more difficulty than other children with changes in his or her routine. ..... ① ② ③ ④
25. Doesn't seem to mind being out of step with or "not on the same wavelength" as others. ..... ① ② ③ ④
26. Offers comfort to others when they are sad. ..... ① ② ③ ④
27. Avoids starting social interactions with peers or adults. ..... ① ② ③ ④
28. Thinks or talks about the same thing over and over. ..... ① ② ③ ④
29. Is regarded by other children as odd or weird. ..... ① ② ③ ④
30. Becomes upset in a situation with lots of things going on. ..... ① ② ③ ④
31. Can't get his or her mind off something once he or she starts thinking about it. ..... ① ② ③ ④
32. Has good personal hygiene. ..... ① ② ③ ④

Continue on back page

PLEASE PRESS HARD WHEN MARKING YOUR RESPONSES.

1 = NOT TRUE 2 = SOMETIMES TRUE 3 = OFTEN TRUE 4 = ALMOST ALWAYS TRUE

33. Is socially awkward, even when he or she is trying to be polite. ..... ① ② ③ ④

34. Avoids people who want to be emotionally close to him or her. ..... ① ② ③ ④

35. Has trouble keeping up with the flow of a normal conversation. ..... ① ② ③ ④

36. Has difficulty relating to adults. ..... ① ② ③ ④

37. Has difficulty relating to peers. ..... ① ② ③ ④

38. Responds appropriately to mood changes in others (for example, when a friend's or playmate's mood changes from happy to sad). ..... ① ② ③ ④

39. Has an unusually narrow range of interests. ..... ① ② ③ ④

40. Is imaginative, good at pretending (without losing touch with reality). ..... ① ② ③ ④

41. Wanders aimlessly from one activity to another. ..... ① ② ③ ④

42. Seems overly sensitive to sounds, textures, or smells. ..... ① ② ③ ④

43. Separates easily from caregivers. ..... ① ② ③ ④

44. Doesn't understand how events relate to one another (cause and effect) the way other children his or her age do. ..... ① ② ③ ④

45. Focuses his or her attention to where others are looking or listening. ..... ① ② ③ ④

46. Has overly serious facial expressions. ..... ① ② ③ ④

47. Is too silly or laughs inappropriately. ..... ① ② ③ ④

48. Has a sense of humor, understands jokes. ..... ① ② ③ ④

49. Does extremely well at a few tasks, but does not do as well at most other tasks. ..... ① ② ③ ④

50. Has repetitive, odd behaviors such as hand flapping or rocking. ..... ① ② ③ ④

51. Has difficulty answering questions directly and ends up talking around the subject. ..... ① ② ③ ④

52. Knows when he or she is talking too loud or making too much noise. ..... ① ② ③ ④

53. Talks to people with an unusual tone of voice (for example, talks like a robot or like he or she is giving a lecture). ..... ① ② ③ ④

54. Seems to react to people as if they are objects. ..... ① ② ③ ④

55. Knows when he or she is too close to someone or is invading someone's space. ..... ① ② ③ ④

56. Walks in between two people who are talking. ..... ① ② ③ ④

57. Gets teased a lot. ..... ① ② ③ ④

58. Concentrates too much on parts of things rather than seeing the whole picture. For example, if asked to describe what happened in a story, he or she may talk only about the kind of clothes the characters were wearing. ..... ① ② ③ ④

59. Is overly suspicious. ..... ① ② ③ ④

60. Is emotionally distant, doesn't show his or her feelings. ..... ① ② ③ ④

61. Is inflexible, has a hard time changing his or her mind. ..... ① ② ③ ④

62. Gives unusual or illogical reasons for doing things. ..... ① ② ③ ④

63. Touches others in an unusual way (for example, he or she may touch someone just to make contact and then walk away without saying anything). ..... ① ② ③ ④

64. Is too tense in social settings. ..... ① ② ③ ④

65. Stares or gazes off into space. ..... ① ② ③ ④

Appendix F

BROAD AUTISM PHENOTYPE QUESIONNAIRE

1—Very rarely 2—Rarely 3—Occasionally 4—Somewhat often 5—Often 6—Very often

Questions:

1. I like being around other people

1 2 3 4 5 6

2. I find it hard to get my words out smoothly

1 2 3 4 5 6

3. I am comfortable with unexpected changes in plans

1 2 3 4 5 6

4. It's hard for me to avoid getting sidetracked in conversation

1 2 3 4 5 6

5. I would rather talk to people to get information than to socialize

1 2 3 4 5 6

6. People have to talk me into trying something new

1 2 3 4 5 6

7. I am ''in-tune'' with the other person during conversation***

1 2 3 4 5 6

8. I have to warm myself up to the idea of visiting an unfamiliar place

1 2 3 4 5 6

9. I enjoy being in social situations

1 2 3 4 5 6

10. My voice has a flat or monotone sound to it

1 2 3 4 5 6

11. I feel disconnected or ''out of sync'' in conversations with others

1 2 3 4 5 6

12. People find it easy to approach me***

1 2 3 4 5 6

13. I feel a strong need for sameness from day to day

1 2 3 4 5 6

14. People ask me to repeat things I've said because they don't understand

1 2 3 4 5 6

15. I am flexible about how things should be done

1 2 3 4 5 6

16. I look forward to situations where I can meet new people

1 2 3 4 5 6

17. I have been told that I talk too much about certain topics

1 2 3 4 5 6

18. When I make conversation it is just to be polite***

1 2 3 4 5 6

19. I look forward to trying new things

1 2 3 4 5 6

20. I speak too loudly or softly

1 2 3 4 5 6

21. I can tell when someone is not interested in what I am saying***

1 2 3 4 5 6

22. I have a hard time dealing with changes in my routine

1 2 3 4 5 6

23. I am good at making small talk***

1 2 3 4 5 6

24. I act very set in my ways

1 2 3 4 5 6

25. I feel like I am really connecting with other people

1 2 3 4 5 6

26. People get frustrated by my unwillingness to bend

1 2 3 4 5 6

27. Conversation bores me***

1 2 3 4 5 6

28. I am warm and friendly in my interactions with others***

1 2 3 4 5 6

29. I leave long pauses in conversation

1 2 3 4 5 6

30. I alter my daily routine by trying something different

1 2 3 4 5 6

31. I prefer to be alone rather than with others

1 2 3 4 5 6

32. I lose track of my original point when talking to people

1 2 3 4 5 6

33. I like to closely follow a routine while working

1 2 3 4 5 6

34. I can tell when it is time to change topics in conversation

1 2 3 4 5 6

35. I keep doing things the way I know, even if another way might be better

1 2 3 4 5 6

36. I enjoy chatting with people ***

1 2 3 4 5 6

Appendix G

PARENTING SENSE OF COMPETENCE SCALE

Please rate the extent to which you agree or disagree with each of the following statements.

Strongly Disagree	Somewhat Disagree	Disagree	Agree	Somewhat Agree	Strongly Agree
1	2	3	4	5	6

1. The problems of taking care of a child are easy to solve once you know how your actions affect your child, an understanding I have acquired.

   1 2 3 4 5 6

2. Even though being a parent could be rewarding, I am frustrated now while my child is at his / her present age.

   1 2 3 4 5 6

3. I go to bed the same way I wake up in the morning, feeling I have not accomplished a whole lot.

   1 2 3 4 5 6

4. I do not know why it is, but sometimes when I'm supposed to be in control, I feel more like the one being manipulated.

   1 2 3 4 5 6

5. My mother was better prepared to be a good mother than I am.

   1 2 3 4 5 6

6. I would make a fine model for a new mother to follow in order to learn what she would need to know in order to be a good parent.

   1 2 3 4 5 6

7. Being a parent is manageable, and any problems are easily solved.

   1 2 3 4 5 6

8. A difficult problem in being a parent is not knowing whether you're doing a good job or a bad one.

1 2 3 4 5 6

9. Sometimes I feel like I'm not getting anything done.

1 2 3 4 5 6

10. I meet by own personal expectations for expertise in caring for my child.

1 2 3 4 5 6

11. If anyone can find the answer to what is troubling my child, I am the one.

1 2 3 4 5 6

12. My talents and interests are in other areas, not being a parent.

1 2 3 4 5 6

13. Considering how long I've been a mother, I feel thoroughly familiar with this role.

1 2 3 4 5 6

14. If being a mother of a child were only more interesting, I would be motivated to do a better job as a parent.

1 2 3 4 5 6

15. I honestly believe I have all the skills necessary to be a good mother to my child.

1 2 3 4 5 6

16. Being a parent makes me tense and anxious.

1 2 3 4 5 6

17. Being a good mother is a reward in itself.

1 2 3 4 5 6

Appendix H

PARENTAL SELF-EFFICACY IN THE MANAGEMENT OF ASPERGER SYNDROME

How much confidence do you have?

0 None | 1 Slight | 2 Some | 3 Moderate | 4 Mostly | 5 Completely confident

Behaviour	Occurred in the past month? (Yes/No)	Rate confidence in ability to manage behaviour (0–5)
1 When your child has become agitated or distressed by certain sounds		
2 When your child follows routines rigidly		
3 When your child insists things be done his or her way		
4 When your child becomes distressed by change		
5 When he/she misinterprets the motives of others		
6 When he/she can only see one way to do things		
7 When he/she does not make/maintain eye contact		
8 When your child lacks empathy		
9 When he/she does not take turns in conversation		
10 When he/she finds criticism or losing at a game intensely distressing		
11 When your child interrupts conversations		
12 When he/she talks excessively about a particular topic		
13 When he/she makes stereotypical movements when excited or distressed, e.g. rocking, flapping, facial movements		
14 When he/she engages in routines/rituals, e.g. lining things up		
15 When your child spends an excessive amount of time engaged in a particular interest or activity		

Appendix I

PARENTING STRESS INDEX, FOURTH EDITION SHORT FORM

Answer Sheet

Name _____ Gender _____ Date of birth ___/___/___

Ethnic group _____ Marital status _____ Today's date ___/___/___

Child's name _____ Child's gender _____ Child's date of birth ___/___/___

SA = Strongly Agree A = Agree NS = Not Sure D = Disagree SD = Strongly Disagree

1.	I often have the feeling that I cannot handle things very well.	SA	A	NS	D	SD
2.	I find myself giving up more of my life to meet my children's needs than I ever expected.	SA	A	NS	D	SD
3.	I feel trapped by my responsibilities as a parent.	SA	A	NS	D	SD
4.	Since having this child, I have been unable to do new and different things.	SA	A	NS	D	SD
5.	Since having a child, I feel that I am almost never able to do things that I like to do.	SA	A	NS	D	SD
6.	I am unhappy with the last purchase of clothing I made for myself.	SA	A	NS	D	SD
7.	There are quite a few things that bother me about my life.	SA	A	NS	D	SD
8.	Having a child has caused more problems than I expected in my relationship with my spouse/parenting partner.	SA	A	NS	D	SD
9.	I feel alone and without friends.	SA	A	NS	D	SD
10.	When I go to a party, I usually expect not to enjoy myself.	SA	A	NS	D	SD
11.	I am not as interested in people as I used to be.	SA	A	NS	D	SD
12.	I don't enjoy things as I used to.	SA	A	NS	D	SD
13.	My child rarely does things for me that make me feel good.	SA	A	NS	D	SD
14.	When I do things for my child, I get the feeling that my efforts are not appreciated very much.	SA	A	NS	D	SD
15.	My child smiles at me much less than I expected.	SA	A	NS	D	SD
16.	Sometimes I feel my child doesn't like me and doesn't want to be close to me.	SA	A	NS	D	SD
17.	My child is very emotional and gets upset easily.	SA	A	NS	D	SD
18.	My child doesn't seem to learn as quickly as most children.	SA	A	NS	D	SD
19.	My child doesn't seem to smile as much as most children.	SA	A	NS	D	SD
20.	My child is not able to do as much as I expected.	SA	A	NS	D	SD
21.	It takes a long time and it is very hard for my child to get used to new things.	SA	A	NS	D	SD
22.	I feel that I am: (Choose a response from the choices below.)	1	2	3	4	5
	1. a very good parent. 2. a better-than-average parent. 3. an average parent. 4. a person who has some trouble being a parent. 5. not very good at being a parent.					
23.	I expected to have closer and warmer feelings for my child than I do, and this bothers me.	SA	A	NS	D	SD
24.	Sometimes my child does things that bother me just to be mean.	SA	A	NS	D	SD

SA = Strongly Agree **A** = Agree **NS** = Not Sure **D** = Disagree **SD** = Strongly Disagree

25.	My child seems to cry or fuss more often than most children.	SA	A	NS	D	SD
26.	My child generally wakes up in a bad mood.	SA	A	NS	D	SD
27.	I feel that my child is very moody and easily upset.	SA	A	NS	D	SD
28.	Compared to the average child, my child has a great deal of difficulty in getting used to changes in schedules or changes around the house.	SA	A	NS	D	SD
29.	My child reacts very strongly when something happens that my child doesn't like.	SA	A	NS	D	SD
30.	When playing, my child doesn't often giggle or laugh.	SA	A	NS	D	SD
31.	My child's sleeping or eating schedule was much harder to establish than I expected.	SA	A	NS	D	SD
32.	I have found that getting my child to do something or stop doing something is: (Choose a response from the choices below.)	1	2	3	4	5

1. much harder than I expected.
2. somewhat harder than I expected.
3. about as hard as I expected.
4. somewhat easier than I expected.
5. much easier than I expected.

33.	Think carefully and count the number of things which your child does that bothers you. For example, dawdles, refuses to listen, overactive, cries, interrupts, fights, whines, etc. (Choose a response from the choices below.)	1	2	3	4	5

1. 1-3
2. 4-5
3. 6-7
4. 8-9
5. 10+

34.	There are some things my child does that really bother me a lot.	SA	A	NS	D	SD
35.	My child's behavior is more of a problem than I expected.	SA	A	NS	D	SD
36.	My child makes more demands on me than most children.	SA	A	NS	D	SD

Please do not write in this area.

Record/Profile Form

Richard R. Abidin, EdD

Instructions:

On the inside of this form, write your name, gender, date of birth, ethnic group, and marital status; today's date; and your child's name, gender, and date of birth. This questionnaire contains 36 statements.

Read each statement carefully. For each statement, please focus on the child you are most concerned about and circle the response that best represents your opinion. **Answer all questions about the same child.**

Circle SA if you strongly agree with the statement.

Circle A if you agree with the statement.

Circle NS if you are not sure.

Circle D if you disagree with the statement.

Circle SD if you strongly disagree with the statement.

For example, if you sometimes enjoy going to the movies, you would circle A in response to the following statement:

I enjoy going to the movies. SA (A) NS D SD

While you may not find a response that exactly states your feelings, please circle the response that comes closest to describing how you feel. **Your first reaction to each question should be your answer.**

Circle only one response for each statement, and respond to all statements. **Do not erase!** If you need to change an answer, mark an "X" through the incorrect answer and circle the correct response. For example:

I enjoy going to the movies. SA A NS (X) (SD)

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Appendix J

INFORMED CONSENT AND PARENT PERMISSION FORM

Study Title: Physiological Responses During Parent and Child Interaction
Investigators: Reina Factor, B.A. rfactor@vt.edu
Angela Scarpa, Ph.D. ascarpa@vt.edu

I. Purpose of this Research

The purpose of this study is to understand the relationship between maternal stress and mother child interactions. The purpose for conducting this research is for a thesis project and results may be submitted for publication. The number of subjects involved includes 62 mother and child dyads. Children will range in age from 7 to 10 years. There are two possible parts to this study, however, this consent form is only for Part 1.

II. Procedures

Should you agree to participate, you and your child will be asked to complete an hour long session at the Virginia Tech Autism Clinic.

III. Risks

There are no more than minimal risks to you from answering the questionnaires or wearing a heart rate monitor during a task with your son or daughter. However, while participating in the activity with your son or daughter, you may experience some stress as the task may be difficult for him or her. In addition, there could be some discomfort from wearing the chest heart rate monitor. Note, however, that these procedures have been used by these investigators in several other studies, with no complaints.

IV. Benefits

There is a societal benefit of increasing the understanding of the relationship between maternal stress and mother interactions with her child which can help inform future intervention studies.

V. Extent of Anonymity

Confidentiality will be assured by assigning code numbers to all participants, and only these identifiers will appear on data collection instruments and documents used in statistical analyses. No information concerning a participant will be released without the participant's written consent. No presentations or publications resulting from this project will identify individual parties. Confidentiality will not be maintained, however, if you express intent to harm or kill yourself or someone else, as we are legally required to divulge that information to the appropriate public authorities.

VI. Compensation

The child will receive a small toy as compensation for participation in the study. In addition, mother-child dyads that qualify and choose to participate in Phase 2 of the study will be compensated after completing the second phase.

VII. Freedom to Withdraw

You should also understand that you are free to withdraw from the study at any time. You do not have to answer any questions that you do not choose to.

VIII. Participant's Responsibility

Signing of this form and agreement to participate is voluntary. You are responsible for answering questionnaires about your past and recent experiences as well as wear a heart rate monitor while completing several different tasks.

IX. Questions or Concerns

Should you have any questions about this study, you may contact one of the research investigators whose contact information is included at the beginning of this document.

Should you have any questions or concerns about the study's conduct or your rights as a research subject, or need to report a research-related injury or event, you may contact the VT IRB Chair, Dr. David M. Moore at moored@vt.edu or (540) 231-4991 or Dr. David Harrison, the Chair of the Psychology Department Human Subjects Committee, at dwh@vt.edu or (540) 231-4422.

X. Participant's Permission

You have read and understood the Informed Consent Form and conditions of this project. You have had all your questions answered. You hereby acknowledge the above and give your voluntary consent for participation in this project. If you participate, you may withdraw at any time. You agree to abide by the rules of this project.

XI. Subject's Consent

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____ Date_____

Subject signature

_____

Subject printed name

Appendix K

VERBAL CHILD ASSENT FORM (AGES 7-10 YEARS)

Virginia Tech
Physiological Responses During Parent and Child Interaction

Investigators: Reina Factor, B.A.
Angela Scarpa, Ph.D.

Hi _____,

We are asking you to be in a study at Virginia Tech so that we can understand how you and your mom interact while you play a task. We would like to know if you are okay with being in the study. You do not have to be in this study if you do not want to. You can stop being in the study at any time. Nobody will be mad or upset and we will still treat you the same no matter what.

As part of this study, you will be asked to come to Virginia Tech one time play some games with a research assistant and with your mom. Your mom will be filling out forms while you play the games with a research assistant.

Nothing that you do during your visit here is dangerous, and all of the information we get from you or your mom is private. This means nobody can see the information unless your parent says it is okay for them see it. If you tell us about harming or hurting yourself or others or the court asks us, we cannot keep that information private.

If you are worried about something and want to ask questions let the person you are with know that so that they can help you. Do you have any questions right now about anything I just said?

Obtain verbal assent via reading this script and get confirmation from the child that they understand what is going to happen during their visit. Also make sure that the parent consent form, along with this verbal assent for children is completed.

Child's name: _____

Date: _____