TEMPERAMENT IN AUTISM: INDIVIDUAL DIFFERENCES IN YOUNG CHILDREN

A dissertation presented by

Katelyn Vertucci

Submitted to
The Department of Applied Psychology
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in the field of

School Psychology

Northeastern University
Boston, MA
April 2017
TEMPERAMENT IN AUTISM: INDIVIDUAL DIFFERENCES IN YOUNG CHILDREN

A dissertation presented by

Katelyn Vertucci

ABSTRACT OF DISSERTATION

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in School Psychology in the Bouvé College of Health Sciences of Northeastern University April 2017
ABSTRACT

This project examines individual differences in temperament among children with autism spectrum disorder. Although temperament has been studied considerably in typically developing populations, research on temperamental differences within atypical populations is limited. Children with autism spectrum disorder are considered a highly heterogeneous group. Little is known about the temperamental differences that distinguish children with autism from typical peers, or about temperamental differences within the diagnostic classification itself. Using a two-study model, the present project explores the temperament of children with autism as compared to typically developing peers, as well as variation in temperament within the autism phenotype. Study 1 uses a national dataset to explore differences between children with autism and typically developing controls across temperament domains. Results revealed significant differences across 10 of the 15 measured temperament factors. Scores fell within a broader range of values for children on the autism spectrum despite relative intellectual homogeneity within the autism sample (i.e., primarily children with low cognitive scores). Findings suggest considerably more variation within the ASD phenotype than among typically developing children. Results were most notable for the Effortful Control domain; significant differences were observed for all four of the tested factors within this domain. Based on these results, Study 2 focused on examination of differences in Effortful Control within the autism phenotype. This study featured an in-depth, exploratory analysis of 15 children with autism, focusing on observed manifestations of Effortful Control in natural play. Results revealed considerable variation within the autism phenotype, with trends linked to developmental age equivalents. The present project adds to the scientific understanding of autism phenotype, with implications for distinguishing diagnostic subcategories, prediction of outcomes, and efficacy of potential treatments.
ACKNOWLEDGEMENTS

I would like to offer my sincere thanks to a number of individuals without whom this dissertation would not have been possible. First of all, I would like to thank my advisor and mentor, Dr. Emanuel Mason, whose knowledge, support, and encouragement were integral to completion of this project and my graduate studies. Dr. Mason encouraged me to think differently, to explore non-traditional areas, and to conduct research that I found meaningful. His unconventional manner showed me what it means to think critically and to lead with new ideas. His impending retirement is truly a loss to the field, and I am proud to call myself one of his mentees. I will carry his spirit with me throughout my professional career.

I would also like to thank Dr. Karin Lifter, who has served as a mentor to me in a variety of capacities. She taught me about substantially more than children’s play, and has done so with kindness, enthusiasm, and hospitality. I also thank her for allowing me to use video-recorded data from Project Play for purposes other than studying play (!) in the present project. I hope to return the favor by spreading the word about the importance of play wherever my career takes me.

Thanks as well to Dr. Changiz Mohiyeddini, who’s knowledge of cognitive science and thoughtful revisions helped make this project more scientifically sound and meaningful. His enthusiasm for my work was also encouraging, and I am thankful for his astute insight into future directions.

Thanks are also due to those at the National Database for Autism Research (NDAR) for their work compiling and managing data from labs across the country, Dr. David G. Amaral for sharing his lab’s data with NDAR, and the National Institute of Mental Health for funding Dr. Amaral’s work. Study 1 would not have been possible without this data. Further, thanks to the
Institute of Education Sciences for funding Project Play (Grant Number R324A100100), the source of the video-recorded observations for Study 2.

I would also like to thank the Project Play research team for their countless hours of recruitment, data collection, and project management. Most especially, thanks to Ph.D. students Ashley Cameron and Rachel Ruah, who served as Study 2 coders. Their hard work and advanced knowledge of child development were integral to this project’s success.

Finally, thank you to my family and friends, whose emotional support helped me to survive this long graduate school journey. My family never quite understood what I was doing or why it was taking so long, but they always stood by me with encouragement, trips to New York, and Washington Capitals tickets. The family dogs, Lola and Larry, were also instrumental in providing emotional support and comic relief all the way from Maryland.

Countless friends have also helped reduce my stress with support and laughter. I would especially like to thank my dear friend Kat Fischer, who never questioned my sudden, intense need for a distraction. She has been my biggest cheerleader and has helped me to focus on enjoying so many aspects of life outside of graduate school. I am a better person and professional because of her.
TABLE OF CONTENTS

List of Tables .......................................................................................................................... ix
List of Figures .......................................................................................................................... x

Chapter I: Introduction ............................................................................................................. 1

Temperament Theory and Importance .................................................................................... 1
Autism and Temperament ......................................................................................................... 3
Statement of the Problem ......................................................................................................... 6
Research Questions .................................................................................................................. 6
  Study 1 .................................................................................................................................. 6
  Study 2 .................................................................................................................................. 6

Chapter II: Literature Review .................................................................................................. 7

Temperament ........................................................................................................................... 7
  Development of Temperament Theory .................................................................................. 7
  Advances in Temperament Theory ....................................................................................... 10
  Mary Rothbart’s Theory of Temperament ........................................................................... 14
  Three Broad Factors of Temperament ............................................................................... 18
  Approaches to Measurement ............................................................................................... 27
  Temperament and Development ......................................................................................... 31
  Adjustment, Psychopathology, and Treatment Outcomes .................................................. 34

Autism Spectrum Disorder ..................................................................................................... 38
  Diagnostic Criteria and Prevalence .................................................................................... 38
  Temperament in Autism ..................................................................................................... 39

The Present Project .................................................................................................................. 47
### Chapter III: Methods ................................................................. 51

- Aims ........................................................................................ 51
- Study 1 .................................................................................. 51
  - Participants ................................................................. 51
  - Materials ................................................................. 52
  - Measures ................................................................. 53
  - Data Analysis ........................................................... 54
- Study 2 .................................................................................. 55
  - Participants ................................................................. 55
  - Materials ................................................................. 56
  - Setting ................................................................. 56
  - Measures ................................................................. 56
  - Data Analysis ........................................................... 60

### Chapter IV: Results ................................................................. 61

- Study 1 .................................................................................. 61
  - Analysis of Between Group Differences ......................... 61
  - Analysis of Within Group Differences ......................... 67
- Study 2 .................................................................................. 71
  - Pattern Analysis .......................................................... 71
  - Individual Profile Analysis ............................................ 72
Chapter V: Discussion

Discussion of Results

Study 1

Study 2

Relevance to Field of School Psychology

Limitations

Study 1

Study 2

Implications for Future Research

Conclusions

References

Appendix A: Effortful Control Coding Manual

IRB Approval

IRB Renewal

Curriculum Vitae
List of Tables

Table 1: Thomas and Chess’s Nine Temperament Dimensions .................................................. 7
Table 2: Study 1 Race/Ethnicity .............................................................................................. 52
Table 3: Descriptive Statistics by Temperament Domain ........................................................ 63
Table 4: Results and Effect Size by Temperament Domain .................................................... 64
Table 5: Correlations between \( BDIST-2 \) Age Equivalent and Effortful Control Dimension ...... 71
Table 6: Correlations between Effortful Control Dimensions .................................................. 72
Table 7: Effortful Control Ratings by \( BDI-2 \ ST \) Age Equivalent ........................................ 72
List of Figures

Figure 1: Surgency/Extraversion Distributions by Phenotype.........................................................68
Figure 2: Negative Affectivity Distributions by Phenotype ...............................................................69
Figure 3: Effortful Control Distributions by Phenotype.................................................................70
Figure 4: Ratings by Dimension: BDI-2 ST Age Equivalent Under 36 Months............................73
Figure 5: Ratings by Dimension: BDI-2 ST Age Equivalent Over 36 Months..............................73
Figure 6: Ratings by Participant: BDI-2 ST Age Equivalent Under 36 Months............................74
Figure 7: Ratings by Participant: BDI-2 ST Age Equivalent Over 36 Months...............................75
CHAPTER I: INTRODUCTION

Temperament Theory and Importance

The present chapter begins with an overview of temperament and its importance in populations both the typically developing and autism spectrum disorders populations. This overview is followed by an introduction to the present project, including the basic rationale and research questions. The term *temperament* is used by developmental theorists to refer to constitutionally-based individual differences. Most theorists agree that these differences are present very early in life, are largely stable, and have their origin in psychobiology (Zentner & Bates, 2008). Though several theories of temperament exist, Mary Rothbart and her associates developed one of the most prominent and well researched. As defined by Rothbart and Derryberry (1981), *temperament* describes “constitutionally-based individual differences in reactivity and self-regulation” (p. 37), which are influenced by heredity and experience. Within this definition, *reactivity* refers to the onset, intensity, and duration of motor, attentional, and emotional reaction. It can be applied to general behavioral reactions such as negative emotional reactivity, or to more specific physiological reactions, such as heart rate activity (Rothbart, Ellis, Rueda, & Posner, 2003). *Self-regulation* serves the complementary function of modulating reactivity, and includes fearful inhibition, surgency/extraverted approach (i.e., aspects of temperament associated with positive affectivity and approach), and effortful control of behavior (Rothbart et al., 2003).

Previous research shows that temperament is associated with social/emotional development, and influences factors such as social learning, the development of coping skills, empathy, and approach and response patterns to different environmental cues (Miller & opdeHaar, 1997; Rothbart & Bates, 2006). Furthermore, temperament is implicated in the
development of aspects of executive functioning, such as working memory (Wolfe & Bell, 2007) and inhibitory control (Carlson & Wang, 2007). Academic outcomes have also been predicted from temperament (Palisin, 1986; Viljaranta et al., 2015).

Further, temperament is linked to the development of psychopathology, such as anxiety disorders (Lonigan, Vasey, Phillips, & Hazen, 2004; Volbrecht & Goldsmith, 2010), Attention Deficit/Hyperactivity Disorder (AD/HD; (Purper-Ouakil et al., 2010; Sullivan et al., 2015), substance abuse (Horner, Reynolds, Braxter, Kirisci, & Tarter, 2015), and depression (Kotelnikova, Mackrell, Jordan, & Hayden, 2015). Temperament also influences response to intervention for a variety of psychological problems and disorders, such as AD/HD (Purper-Ouakil et al., 2010), Obsessive Compulsive Disorder (Corchs et al., 2008), Major Depression (Joyce et al., 2007), Bulimia Nervosa (Bulik, Sullivan, Joyce, Carter, & McIntosh, 1998) and behavior problems (Gallitto, 2015).

Despite links between temperament and psychopathology, temperament has largely been researched in the context of neurotypical development. As such, few studies examine individual differences between typically developing individuals and those with neurodevelopmental disorders. However, research beyond neurotypical children would provide enhanced diagnostic clarity for a variety disorders. Further, given the link between temperament and treatment outcomes, further research in the area of individual differences across and within diagnostic categories is warranted. One disorder of particular interest to researchers and clinicians over the past several decades is autism spectrum disorder, which is only beginning to be understood in terms of temperament.
Autism and Temperament

Autism spectrum disorder (herein referred to interchangeably as autism, autism spectrum disorder, and ASD) is a pervasive developmental disorder featuring deficits in social communication and social interaction across contexts, as well as the presence of restricted and repetitive patterns of behavior, interests, or activities (American Psychiatric Association, 2013). The Centers for Disease Control and Prevention (2014) currently estimates the prevalence of ASD in the United States to be 1 in 68\(^1\) individuals. Though the disorder was first identified in the 1940s, substantial research on causes, characteristics, and treatments is relatively new, emerging in earnest in only the past 20 years. Given the increasingly high prevalence of the disorder and the pervasive nature of the impairments that characterize it, funding for such research has increased dramatically during this time. Major strides in the understanding of the disorder and its treatment have occurred in just the past decade.

Although understanding of autism has increased significantly in recent years, knowledge of autism in the context of temperament is an area of relatively new inquiry. To date, the majority of studies examining temperamental differences mainly focused on comparison between neurotypical populations and neurodevelopmentally impaired controls (e.g., Bailey, Hatton, Mesibov, Ament, & Skinner, 2000; Brock et al., 2012; Bryson et al., 2007; Clifford et al., 2013; Garon et al., 2015; Hepburn & Stone, 2006; Konstantareas & Stewart, 2006; Zwaigenbaum et al., 2005). Findings suggest that individuals with autism do display differences in temperament as compared to control groups. For example, Brock et al. (2012) demonstrated significant differences between children with autism and neurotypical controls across eight out of nine

---

\(^1\) Note that this figure is based on *DSM-IV* diagnostic criteria. Official prevalence rates are not yet available for *DSM-5* criteria.
measured temperament subscales, including activity level, rhythmicity, approach, intensity, persistence, distractibility, adaptability, and threshold. In this study, children in the ASD group displayed temperamental profiles more consistent with those in the developmentally disabled (DD) control group, but were unique from the DD group in terms of approach (showing more withdrawal) and distractibility (showing less).

Other studies comparing the temperament of children with autism to neurotypical controls using Rothbart’s model of temperament have found that children with autism demonstrate lower Effortful Control, specifically in terms of attention and inhibitory control (Konstantareas & Stewart, 2006; Landry, 2000). As noted in De Pauw, Mervilde, Van Leeuwen, and De Clercq (2011), these studies did not demonstrate significant differences in terms of Negative Affect or Surgency at the domain level. However, differences were noted in terms of unsoothability, discomfort (Konstantareas & Stewart, 2006), and anger (Landry, 2000). Early reactive temperament in infancy has also been shown to predict later regulatory aspects of temperament in children at both low risk and high risk for developing autism, with regulatory aspects of temperament predicting ASD symptoms at 36 months of age (Garon et al., 2015). Studies of this nature are important, as they serve to enhance knowledge of temperamental markers of autism, and provide a useful framework for understanding the emergence of autism in childhood.

Few studies have focused on individual differences within the autism population. One of the earliest studies to investigate these differences revealed that among children with autism, children whose temperament was rated as more difficult displayed less responsiveness and engagement with caregivers and researchers (Kasari & Sigman, 1997). Children identified as “more difficult” were those with higher scores on Thomas and Chess’ (1982) easy to difficult
dimension. Based on this dimension, “difficult children” are more irregular in eating, sleeping and elimination; tend to show a negative approach response to new situations (e.g., tantruming when frustrated); and are slow to adapt to changes.

Several studies also examined the relationship between autism symptomatology and temperamental variability. A 2006 study by Konstantareas and Stewart examined the role of chronological age, ASD symptom score, and academic age on temperament profiles. This study found that children with autism (aged 3-10) varied on the Effortful Control broad temperament factor, with higher symptom scores related to lower Effortful Control. Negative affectivity was shown to increase with academic age, but not symptom score or chronological age. No differences were found for Surgency/Extraversion using the three predictor variables.

Individual differences have also been studied among adolescents with high functioning autism (HFA). Schwartz et al. (2009) found that adolescents with HFA reported higher levels of Negative Affect and lower levels of Surgency compared to a matched comparison sample, and that individual differences in self-reported temperament profiles predicted symptomatology, social skills, and other social-emotional outcomes.

Recent work by De Pauw, Mervielde, Van Leeuwen, and De Clercq (2011) has further increased knowledge of individual differences within the autism phenotype. These researchers compared parent reported differences in temperament, personality, and maladjustment among low-symptom and high-symptom ASD groups, and a comparison group. Findings suggested that low- and high- symptom ASD groups are differentiated primarily by mean sociability and internal distress, and that overall the ASD groups exhibited more extreme means than the control group. Other researchers have linked temperamental differences within the autism phenotype to problem behaviors (Adamek et al., 2011). Further research into temperamental differences within
the autism phenotype is necessary to enhance knowledge of these differences and their implications, which are important in terms of both diagnosis and treatment.

**Statement of the Problem and Purpose of the Present Project**

Within the field of psychology, knowledge of individual differences between children with autism and typically developing peers is limited. Even less is known about differences within the autism phenotype. These differences have important implications for diagnosis, research, and treatment of the disorder. The purpose of this project is to further investigate these differences both quantitatively and qualitatively. The project is composed of two studies, described below. Discussion of both studies focuses on findings as they relate to existing research, as well as implications for diagnosis, treatment, and future research.

**Research Questions**

**Study 1**

*Question 1.* How do the temperament profiles of young children on the autism spectrum differ from the temperament profiles of neurotypical peers?

*Question 2.* Is the intellectual functioning of children with autism associated with their temperament profile?

**Study 2**

*Question 1.* Does observation of child behavior during natural play with a familiar caregiver reveal measurable patterns within the Effortful Control domain (i.e., the dimensions of Attentional Focusing, Perceptual Sensitivity, Low Intensity Pleasure, and Inhibitory Control)?

*Question 2.* What do any observable patterns in Effortful Control reveal about the temperament of children with autism?
CHAPTER II: LITERATURE REVIEW

Temperament

Development of Temperament Theory

Scientific interest in the constitutionally-based individual differences known as temperament began in earnest with the work of pioneering researchers Stella Chess and Alexander Thomas. Using data from the New York Longitudinal Study, which followed 136 children from early infancy into adolescence, they delineated nine temperament dimensions thought to describe the origins of personality (see Table 1; Thomas & Chess, 1977). Based on their analyses of observations and parent interviews, temperament was defined as “individuality in behavioral styles,” and three distinct temperament groups were identified: easy, difficult, and slow to warm up (Chess & Thomas, 1977, p. 218).

Table 1

<table>
<thead>
<tr>
<th>Thomas and Chess’s Nine Temperament Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension</td>
</tr>
<tr>
<td>Definition</td>
</tr>
<tr>
<td>Activity Level</td>
</tr>
<tr>
<td>Proportion of active periods to inactive periods</td>
</tr>
<tr>
<td>Regularity/Rhythmicity</td>
</tr>
<tr>
<td>Regularity of hunger, sleep, wakefulness, and excretion</td>
</tr>
<tr>
<td>Distractibility</td>
</tr>
<tr>
<td>Degree of behavioral alteration due to extraneous stimuli</td>
</tr>
<tr>
<td>Approach Withdrawal</td>
</tr>
<tr>
<td>Response to a novel object or person</td>
</tr>
<tr>
<td>Adaptability</td>
</tr>
<tr>
<td>Ease of adaptation to changes in the environment</td>
</tr>
<tr>
<td>Attention span and persistence</td>
</tr>
<tr>
<td>The amount of time spent attending to an activity and the effect of distraction on an activity</td>
</tr>
<tr>
<td>Intensity of Reaction</td>
</tr>
<tr>
<td>The strength of a reaction, regardless of its direction or quality</td>
</tr>
<tr>
<td>Threshold of Responsiveness</td>
</tr>
<tr>
<td>The intensity of stimulation needed to evoke a perceptible response</td>
</tr>
<tr>
<td>Quality of Mood</td>
</tr>
<tr>
<td>The extent of pleasant and friendly behavior as opposed to unfriendly and unpleasant behavior</td>
</tr>
</tbody>
</table>

Note. Information in this table gathered from Thomas & Chess, 1977
Several researchers soon expanded on this work, some using Chess and Thomas’ model, while others developed their own theories based in part upon Chess and Thomas’ work. By the mid-1980s four models of temperament dominated the literature, each with their own definitions and central principles. In 1987, H. Hill Goldsmith convened a roundtable discussion among researchers representing each of the major temperament models in order to explore each theory’s foundational tenets, including points of agreement and divergence. The theories discussed included those of Thomas and Chess; Arnold Buss and Robert Plomin; Mary Rothbart; and H. Hill Goldsmith and Joseph Campos, respectively. A brief overview of each theory, as described in Goldsmith et al., 1987, is provided below:

**Thomas and Chess.** Thomas and Chess define temperament as “the stylistic component of behavior—that is, the how of behavior as differentiated from motivation, the why of behavior, and abilities, the what of behavior” (Goldsmith et al., 1987, p. 508). Although individuals may have similar motivations and abilities, the way they perform may be markedly different due to temperament characteristics, such as intensity of mood expression, ease of adaptability, and persistence. Temperament is thought to be an independent psychological attribute, unique from other attributes such as emotionality, motivation, and cognition. Further, expressions of temperament are always in response to an external stimulus, expectation, demand, or opportunity. Temperament is a dynamic factor that mediates the influence of environmental interactions on psychological structure. It is important to view temperament within the social context.

**Buss and Plomin.** This theory defines temperament as “a set of inherited personality traits that appear early in life” (Goldsmith et al., 1987, p. 508). These traits are thought to have genetic origins, and to be present in the first year of life. Only individual differences that are personality
traits are included within the definition (i.e., other traits, such as intelligence, are not). The personality traits must occur during infancy, and provide a foundation for the development of later personality. As such, traits such as rhythmicity (i.e., regularity in physiological functions such as eating and sleeping) are not included, as they are not thought to have an enduring effect on later personality.

Goldsmith. H. Hill Goldsmith, along with his colleague Joseph Campos, defines temperament as “individual differences in the probability of experiencing and expressing the primary emotions and arousal” (Goldsmith et al., 1987, p. 510). Temperament’s nature is considered behavioral, genetic, and physiological, but only the behavioral nature is explicated in their approach. Goldsmith and Campos chose to focus on behavioral manifestations because they consider them the most meaningful in social contexts, and the most amenable to empirical investigation. Temperament refers to behavioral tendencies and not actual occurrences of emotional behavior, is relatively stable, and does not include cognitive or perceptual factors. Temperament is also hypothesized to form the basis of later personality.

Rothbart. Mary Rothbart and Douglas Derryberry define temperament as “relatively stable, primarily biologically-based individual differences in reactivity and self-regulation” (Goldsmith et al., 1987, p. 510). Reactivity is defined as “the excitability or arousability of behavioral, endocrine, autonomic, and central nervous system response, as assessed through response parameters of threshold, latency, intensity, rise time, and recovery time” (Goldsmith et al., 1987, p. 510). Further, self-regulation is defined as “processes, such as attention, approach, avoidance, and inhibition; that serve to modulate (enhance or inhibit) reactivity” (Goldsmith et al., 1987, p. 510). Behavioral manifestations can be observed in patterns of activity, attention,
and emotionality at all ages. Temperament is experienced as feelings of interest, energy, and affect.

**Points of consensus and disagreement.** A number of points of agreement emerged through Goldsmith’s (1987) roundtable. For one, the researchers agreed that dimensions of temperament reflect observable behavior but do not necessarily map directly onto discrete behavioral acts. Emphasis on a biological basis of temperament, and on some level of continuity over time, was also noted. Further, the researchers agreed that temperament is easiest to study in infancy, as the relationship between temperament and behavior becomes increasingly complex as the child matures.

Notwithstanding these commonalities, the approaches differed in terms of which dimensions were considered characteristic of temperament, as only activity level and emotionality were agreed upon by all four theorists. Each approach posits a different boundary for what is considered temperament, with criteria such as behavioral style, relation to emotional behavior, stability, and inheritance varying between theorists. The difference between personality and temperament also varies between theories, with some establishing a firm distinction between the two, and others suggesting ambiguity.

**Advances in temperament theory**

Temperament theory has advanced substantially since Goldsmith’s roundtable in 1987. A primary goal of the Goldsmith roundtable was synthesis of the various definitions of temperament in order to develop a specific empirical strategy to unite the theorists in future research. One of the article’s commentators, Robert McCall, generated a definition of temperament that integrated all four theories:
Temperament consists of relatively consistent, basic dispositions inherent in the individual that underlie and modulate the expression of activity, reactivity, emotionality, and sociability. Major elements of temperament are present early in life, and those elements are likely to be strongly influenced by biological factors. As development proceeds, the expression of temperament increasingly becomes more influenced by experience and context (Goldsmith et al., 1987, p. 524).

Though this definition was never adopted on a wide scale, these shared assumptions have guided research over the past several decades. All of the theories presented in Goldsmith’s discussion generated further research, leading to adjustments to the original models and their applications (Shiner et al., 2012). In some cases, central tenets have been supported, and in others they have been challenged. Buss and Plomin, for example, were criticized for overemphasizing the role of heritability in their model. However, their theory has spurred considerable temperament research grounded in behavioral genetics, enhancing knowledge of behavioral and environmental influences on its development (Shiner et al., 2012). Similarly, Goldsmith’s definition of temperament, which features the experience and expression of emotion as its defining feature, has been criticized as too narrow. Nevertheless, his theory has shaped the conceptualization of individual differences in emotional behavior, resulting in significant advances in research in this area (Shiner et al., 2012).

**Contributions of Jerome Kagan.** In addition to the researchers who participated in Goldsmith’s roundtable, Jerome Kagan has also significantly contributed to the study of temperament. Rather than approach temperament theory in a comprehensive manner, Kagan’s theory focuses specifically on reactivity. His approach to the study of temperament differs from
many other theorists, as he eschews traditional theory-based approaches in which researchers develop measurements to test their own theoretical views. Instead, he takes an inductive approach, letting data guide the development of temperamental categories (Zentner & Bates, 2008). Based on a series of laboratory studies, Kagan and colleagues noted that when exposed to unfamiliar situations, some children consistently become quiet, restrained, and vigilant while they assess the situation and formulate a response based on their perceived resources before acting. Other infants respond to novel situations with spontaneity, displaying little difference in behavior in familiar and unfamiliar situations. As such, Kagan’s theory focuses largely on the two observed temperamental styles: the inhibited and uninhibited (Shiner et al., 2012). Though Kagan recognizes that temperament extends beyond responses to familiar and unfamiliar situations, examination of behavioral inhibition is a major focus of his work.

Kagan’s theory of behavioral inhibition and reactivity classifies infants as either high or low reactive, rather than falling on a continuum of reactivity (Zentner & Bates, 2008). Further, he posits that these classifications are distinguished by biological factors influenced by genetics (Kagan, 1999). He implicates amygdalar activity in children’s reactivity, and gives attention to physiological indicators of reactivity, such as muscle tension, sweating of palms, facial flushing, breathing patterns, and blood pressure changes (Zentner & Bates, 2008). Kagan and Rothbart are united in their belief that additional temperament dimensions are will likely be identified in future research (Rothbart & Bates, 2006).

The lasting impact of Rothbart, and Thomas and Chess. The two models that have arguably contributed most significantly to the modern understanding of temperament are those of Mary Rothbart, and Thomas and Chess. Thomas and Chess’ theory continues to substantially influence temperament research. It established foundational ideas about temperament,
convincing researchers, practitioners, and parents that individual differences in children are biological, emerge early in life, and influence social relationships and adjustment as children age (Shiner et al., 2012). The theory, however, is not without criticism. Research exploring the psychometric properties of Thomas and Chess’ nine dimensions of temperament has uncovered empirical redundancy among many of them (De Pauw & Mervielde, 2010; Martin, Wisenbaker, & Huttunen, 1994). This has reduced the use of the full list of dimensions in more recent research (Zentner & Bates, 2008). Further, Thomas and Chess’ typology of temperaments, which classify children as easy, difficult, and slow to warm, based on patterns of behavior, can also vary significantly based on cultural attitudes and practices, minimizing their usefulness (Zentner & Bates, 2008). Thomas and Chess acknowledged this criticism and addressed it by emphasizing goodness-of-fit between children’s temperament styles and parental responses to these styles. The goodness-of-fit model has formed the foundation of temperament-based interventions, which are individually-based interventions that occur within the target child’s environmental context (Graham McClowry, Rodriguez, & Koslowitz, 2008).

Thomas and Chess’ work influenced a number of temperament researchers, including Mary Rothbart, who went on to pioneer her own prominent theory. Her model of temperament emerged in part from her own criticisms of Thomas and Chess. Although she expressed respect for their work and the foundation it laid for further research, Rothbart criticized the psychometric properties of their scale formation, including their use of a three-point scale. She also took issue with the New York Longitudinal Study sample, which was highly homogeneous in terms of socioeconomic status and ethnicity, and featured many siblings (47% of the families who participated contributed more than one child to the study) (Rothbart, 1981). Rothbart would go on to develop one of the most comprehensive and widely accepted theories of temperament. As
such, it has been chosen as the primary theory guiding this study, and is described in detail below.

**Mary Rothbart’s Theory of Temperament**

The theory developed by Rothbart and colleagues is unique compared to those of other researchers. As opposed to theories that emphasize behavioral manifestations of temperament (i.e., Thomas and Chess), Rothbart argues for investigation of individual differences at a number of levels, including the neural, genetic, endocrine, autonomic, and central nervous system levels (Putnam & Stifter, 2008). Further, Rothbart views temperament as a much broader concept than others, whose theories denote it as distinct from personality, motivation, and cognition. Rothbart sees all of these facets as interconnected and interrelated (Putnam & Stifter, 2008). The broad definition and scope of temperament that she proposes has resulted in a multidisciplinary approach to the study of the construct; research contributions have emerged from such diverse fields as psychology, neurobiology, and behavioral genetics (Putnam & Stifter, 2008).

Rothbart also views temperament as a developmental process rather than a constellation of stable traits. Temperament research has its origins in the study of infants, as infancy is thought to be a period in which temperament is in its most “pure” state, relatively unaffected by environmental influences and the impact of cognition (Rothbart & Bates, 2006). The study of temperament at later ages, including childhood, adolescence, and adulthood, requires attention to development in ways that are limited by theories emphasizing trait stability. Developmental changes are thought to affect reactive and regulatory process in important ways, especially as children gain new experiences and are exposed to new environments (Rothbart, 1989). Though the underlying temperamental underpinnings of behavior may be somewhat constant across the lifespan, the introduction of newly emergent traits may alter their behavioral manifestations as
individuals age. For example, whereas one might expect an infant with a temperamental predisposition toward negative affect to exhibit high levels of distress throughout life, the development of strong Effortful Control may reduce this likelihood (Putnam & Stifter, 2008). Further, environmental processes such as socialization influence development and the manifestation of temperamental characteristics across time. The static view of temperament offered by some theorists minimizes or ignores these influences. Taking them into account, however, provides a clearer picture of temperament after infancy.

Rothbart does, however, make a distinction between personality and temperament. Although the two constructs overlap considerably, personality is theorized as a much broader concept. Personality is thought to include “thoughts, skills, habits, values, morals, beliefs, and social cognition” (Rothbart & Bates, 2006, p. 100). Social cognition is a particularly important aspect of personality, as it elicits and moderates temperamental processes. Both temperament and personality are thought to show consistency across situations and to be relatively stable. However, they are distinguished in that temperament “is limited to basic processes of reactivity and self-regulation, and [does] not include the specific content of thought or the use of conceptually based defenses (e.g., paranoia)” (Rothbart & Bates, 2006, p. 100).

The details of Rothbart’s theory will be discussed in the next several sections. First, a detailed definition of temperament and its dimensions will be presented. Then, measurement of temperament will be discussed, with special attention to the Children’s Behavior Questionnaire, Short Form (CBQ-Short; Putnam & Rothbart, 2006), which is used in Study 1 of the present project. Finally, discussion will shift to the implications of research on temperament, including its link to psychopathology and treatment outcomes.
**Definition.** Mary Rothbart’s definition of temperament has evolved significantly since the early 1980s, though its central tenets have remained unchanged. According to Rothbart and Bates (2006), temperament is defined as “constitutionally based individual differences in reactivity and self-regulation in the domains of affect, activity, and attention” (p. 100). Constitutional differences are considered biologically-based and influenced by heredity, experience, and maturation over time. The terms *reactivity* and *self-regulation* are used to organize the construct of temperament, with a number of distinct dimensions falling under each term. Rothbart derived these dimensions from reviews of empirical studies and the examination of factor structures underlying a number of temperament scales (Rothbart & Bates, 2006). The dimensions reflect the integration of study results across theoretical orientations, and synthesize ideas from a number of temperament theorists. Further, these dimensions vary based on developmental period, with somewhat different dimensions characterizing temperament in infancy, childhood, and beyond. For purposes of the present project, the dimensions relevant to childhood are discussed.

**Reactivity.** Rothbart and Bates (2006) define reactivity as “responsiveness to change in the external and internal environment” (p. 100). Reactivity refers to both emotional and physiological reactions and broad tendencies, such as a tendency toward negative emotionality. Reactivity is measured by the intensity, duration, and latency of motor, attentional, and affective responses. Action tendencies are also included in reactivity, such as the tendency to respond to fear by a freeze, attack, or inhibition response (Rothbart & Bates, 2006). Further, action tendencies can influence ongoing emotional reactions, creating a feedback loop. Reactivity is thought to manifest in new and increasingly complex ways as an individual develops (Rothbart & Derryberry, 1981). It is also thought to be particularly important in infancy, as much of early
behavior is reactive to events involving immediate stimuli and changes in infant state. Self-regulatory systems develop as the child ages, and serve to modulate reactivity (Rothbart & Rueda, 2005).

**Self-regulation.** Self-regulation is defined as “children’s ability to control reactions to stress, maintain focused attention, and interpret mental states in themselves and others” (Fonagy & Target, 2002, as described in Rothbart, Sheese, Rueda, & Posner, 2011). Differentiation between reactive and self-regulatory processes is important in the study of development. Activity, emotion, and attention are reactionary, as they are reactions to environmental stimuli. As young children develop, they show increasing control of both behavioral and emotional reactions. Self-regulatory aspects of temperament modulate reactivity and include processes such as orienting and effortful control (Rothbart & Bates, 2006).

**Attention networks and the development of self-regulation.** Three distinct neural attention networks exist within the brain. These networks have distinct functions, are composed differently in terms of neural anatomy, and involve different neuromodulators (Posner & Fan, 2008; Rothbart et al., 2011; Rueda, Posner, & Rothbart, 2011). The first of these networks, the alerting network, controls readiness to receive and respond to information. Alerting and subsequent activation are considered early, core aspects of self-regulation that are present in neonates (Geva, Zivan, Warsha, & Olchik, 2013). The brain’s alerting system involves “norepinephrine systems arising in the midbrain and making contact with frontal and parietal areas” (Rothbart et al., 2011, p. 3). The second network is the orienting network, which serves to direct attention to target stimuli. This network is produced by a distributed neural network consisting of the frontal eye fields, the parietal lobe, the temporal parietal junction, the thalamus, and the superior colliculus (Geva et al., 2013). The third network, the executive attention network, serves to monitor and
resolve errors arising in other networks (Geva et al., 2013; Rothbart et al., 2011). This network involves the anterior cingulate, as well as lateral prefrontal areas of the brain (Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005).

One theory of self-regulation postulates that it develops, in part, from a shift in brain networks. Specifically, self-regulation is theorized to develop from a shift from the dominance of the brain’s orienting network, to the brain’s executive attention network (Rothbart et al., 2011). Control of orienting processes begins to emerge as early as 3-4 months of age, and flexibility in orienting is associated with greater soothability and lower negative affectivity on parent-report measures (Johnson, Posner, & Rothbart, 1991). Studies of neonates show strong connectivity between parietal brain areas prominent in the orienting network, and lateral and medial frontal areas, which are important in the executive attention network later in development. The executive attention network is highly associated with the temperamental factor of Effortful Control, which involves voluntary behavioral regulation and attention (Rothbart et al., 2011).

Three broad factors of temperament

Factor analyses of the Children’s Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) identified three distinct, broad factors of temperament in children ages 3-7, including Surgency/Extraversion, Negative Affectivity, and Effortful Control (Rothbart et al., 2011). These factors map both conceptually and empirically onto the Big Five factors of personality, including the extraversion/positive emotionality, neuroticism/negative emotionality, and conscientiousness/constraint dimensions (Rothbart & Rueda, 2005). Each of these factors is described below, along with their respective contributing dimensions.

Surgency/Extraversion. The first factor, Surgency/Extraversion, is primarily defined by loadings for the scales of Approach/Positive Anticipation, Activity Level, High Intensity
Pleasure, Smiling/Laughter, Impulsivity, and Shyness, which loads negatively (Rothbart, Ahadi, & Evans, 2000). The label “Surgency/Extraversion” was derived from the broad dimension identified by a number of previous investigations of the structure of personality. It is consistent with responses such as preference for risk taking, lack of unease in social situations, and rapid initiation of response. The Positive Anticipation scale loads strongly on this factor as well, though it also loads equally strongly on the Negative Affect factor (Rothbart et al., 2001). The component dimensions of Surgency/Extraversion are described below:

**Approach/Positive Anticipation.** One dimension of Surgency/Extraversion is Approach, which refers to emotional exuberance, sensitivity to rewards, anticipatory excitement toward pleasurable activities, and behavioral approach to both novelty and challenge (Dennis, 2006; Elliot & Thrash, 2010). In opposition to approach is avoidance, which reflects fear, shyness, behavioral withdrawal, sensitivity to potential threats, and an inhibited response to novelty and challenge (Carver, 2004; Dennis, 2006; Derryberry & Rothbart, 1997; Elliot & Thrash, 2010). Approach and avoidance tendencies are important because they produce immediate cognitive, affective, and behavioral responses to a variety of real and imagined stimuli. They also contribute to individual consistency in orienting across situations (Elliot & Thrash, 2010).

Individual differences in Approach have important implications. For example, relative fearfulness in response to novelty is related to self-regulatory strengths, including better frustration tolerance and higher rates of compliance. Vulnerabilities are also associated with fearfulness in response, however, such as a tendency toward shyness, behavioral withdrawal, and anxiety (e.g., Dennis, 2006; Fox, Calkins, & Bell, 1994; Kagan, 1999; Stansbury & Harris, 2000). The observable behavioral outcomes in these relationships are moderated by self-regulatory processes. As a result, temperamental inclinations toward approach or avoidance
influence behavioral responses, but are not directly responsible for such responses (Elliot & Thrash, 2010).

**Shyness.** Shyness is an aspect of avoidance, as it refers to a slow or inhibited approach tendency in situations involving novelty or uncertainty (Rothbart, Ahadi, et al., 2000). Shyness in response to strangers develops toward the end of the first year of life, but is distinct from later manifestations of shyness. Other types of shyness appear around 4-5 years of age, such as self-conscious shyness (Matsuda, Okanoya, & Myowa-Yamakoshi, 2013). Shyness in childhood is modestly linked to anxiety disorders in adolescence (Prior, Smart, Sanson, & Oberklaid, 2000).

**Activity Level.** The temperament dimension of Activity Level refers to the level of motor activity an individual exhibits, including the rate and extent of locomotion (Rothbart et al., 2001). Twin studies of temperament have demonstrated a genetic basis for Activity Level, as monozygotic twins demonstrated significantly more similar levels of activity than dizygotic twins (Saudino & Eaton, 1991). Activity Level has rarely been studied independently of other temperament dimensions, but is shown to interact with other dimensions, such as High Intensity Pleasure, to influence outcomes. For example, a significant interaction between activity level and intensity of stimulation in toddlers was found to predict both exploratory competence and total exploration (Gandour, 1989).

**High Intensity Pleasure.** High Intensity Pleasure refers to a tendency to seek stimulation (Elliot & Dweck, 2005). Individuals high in loadings of High Intensity Pleasure tend to seek out highly stimulating, novel, and exciting stimuli and experiences (Schwebel, Stavrinos, & Kongable, 2009). The situations and stimuli eliciting the positive affect associated with the High Intensity Pleasure dimension often involve risk (Rothbart, Ahadi, et al., 2000). The dimension is also thought to correspond to sensory seeking behavior (Rothbart et al., 2001). High Intensity
Pleasure contrasts with Low-Intensity Pleasure, which refers to pleasure derived from low-intensity situations and stimuli (Rothbart et al., 2001).

**Smiling/Laughter.** Smiling/Laughter refers to the amount of positive affect generated in response to changes in stimulus rate, intensity, incongruity, novelty, and complexity (Rothbart, Ahadi, et al., 2000). Smiling and laughing are linked to speed of approach to objects in laboratory studies of infants (Rothbart, 1988). Smiling and laughter in infancy are also linked to both the positive affect and stronger approach tendencies characteristic of extraversion in childhood (Molfese, Molfese, & McCrae, 2000).

**Impulsivity.** In temperament theory, Impulsivity refers to the speed of response initiation, and is driven by approach tendencies with neuropsychological origins in subcortical brain systems (Derryberry & Rothbart, 1997; Rothbart, Ahadi, et al., 2000). Children who demonstrate high impulsivity have a preference for immediate gratification, place importance on immediate results at the expense of future accomplishments, and often to do not adequately reflect on actions before engaging in them (Valiente, Swanson, & Lemery-Chalfant, 2012). Impulsivity is most often studied in conjunction with other temperament dimensions, such as Inhibitory Control. For example, high Impulsivity and low Inhibitory Control are linked to a higher rate of unintentional injury in children (Schwebel & Plumert, 1999; Schwebel, 2004). Impulsivity is also linked to difficulties in the classroom, including lower levels of classroom participation and positive attitudes toward school (Valiente et al., 2012).

**Negative Affectivity.** The construct of Negative Affectivity stands in contrast to Surgency/Extraversion. Whereas Surgency/Extraversion is characteristic of pleasure and approach, Negative Affectivity is characteristic of distress and withdrawal. These two constructs compose two opposing motivational systems, which support a level of optimal arousal whereby
approach and pleasure are at their highest but withdrawal processes have yet to dominate (Rothbart & Bates, 2006). Several studies provide evidence that positive and negative emotionality are linked to approach tendencies. For example, children’s activity level is positively linked to anger on parent-report temperament measures (Rothbart & Derryberry, 2002). Infant activity level is also linked to positive emotionality, low Soothability/Falling reactivity, and higher Frustration/Anger (Derryberry & Reed, 1994; Rothbart & Bates, 2006; Rothbart, Derryberry, & Hershey, 2000). In addition, substantial research exists demonstrating a relationship between Negative Affectivity and both internalizing and externalizing behaviors (Rothbart, 2011; Rothbart & Bates, 2006).

Negative Affectivity specifically is related to the Big Five personality factor of Neuroticism, which includes negative emotions (Rothbart & Bates, 2006). Much like other temperamental factors, Negative Affectivity is shown to arise from a combination of genetic and environmental factors (e.g., Clifford, Lemery-Chalfant, & Goldsmith, 2015). From a neurobiological perspective, different neural systems are related to different forms of negative affect. Aggressive responses as self-defense, for example, are based on the amygdala circuits responsible for fear (Blanchard & Takahashi, 1988, as cited in Rothbart & Bates, 2006). In contrast, aggressive responses for protection of resources, competition, or as an offensive attack involve a different system based on monoamine dopamine (Lawrence & Calder, 2004 as cited in Rothbart & Bates, 2006). Further, examination of the genetics underlying negative emotionality revealed heritable aspects of fear and anger not explained by a common genetic factor (Clifford et al., 2015). Despite differing origins, neurochemical influences may contribute to coherence within the emotional states of an individual, which supports Negative Affectivity as a general factor of temperament. These systems include dopaminergic and serotonergic projections from
the midbrain, as well as the circulation of corticosteroid and gonadal hormones (Rothbart & Bates, 2006). The component dimensions of Negative Affectivity are described below:

**Anger/Frustration.** The Anger/Frustration dimension reflects the level of negative affect related to the disruption of ongoing tasks or goal blocking (Rothbart et al., 2001). A tendency to react to challenge or provocation with anger and frustration puts children at risk for developing conduct problems, especially when self-regulation skills are weak (Deater-Deckard, Petrill, & Thompson, 2007). Attentional control and persistence are particularly important self-regulatory abilities that influence the relationship between temperament high in Anger/Frustration and later conduct problems, and these aspects have genetic and neurobiological underpinnings (Deater-Deckard et al., 2007). Anger and Frustration are also linked to internalizing problems (Gartstein, Putnam, & Rothbart, 2012).

**Fear.** Fear refers to the amount of negative affect displayed in response to anticipated pain or distress and/or potentially life threatening situations. Such affect includes unease, worry, or nervousness (Rothbart et al., 2001). Fear corresponds with Thomas and Chess’ Approach/Withdrawal dimension, and is identified as a primary emotion (Rothbart et al., 2001). Children high in Fear demonstrate higher levels of inhibition, lower levels of approach, and a predisposition for internalizing problems (Kagan, 1999; Kochanska, Murray, Jacques, Koenning, & Vandegeest, 1996).

**Discomfort.** The dimension of Discomfort denotes the amount of negative affect related to sensory stimulation, including qualities such as rate, intensity, or complexity of light, texture, sound, or movement (Rothbart et al., 2001). Children high in Discomfort are sensitive to pain and irritation from varying levels of stimulation. Discomfort is thought to best represent the type
of negative affect related to high levels of arousal (Derryberry & Rothbart, 1988). Further, Discomfort is linked to internalizing problems in preschoolers (Gartstein et al., 2012).

**Sadness.** Sadness refers to lowered mood and energy related to exposure to suffering, disappointment, and object loss (Rothbart et al., 2001). Sadness is a primary emotion and is linked to internalizing problems (Eisenberg et al., 2001, 2010; Gartstein et al., 2012; Lemery, Essex, & Smider, 2002). Further, children exhibiting high levels of Sadness are more likely to experience social difficulties and decreased motivation to pursue goals, which can worsen internalizing symptoms (Muhtadie, Zhou, Eisenberg, & Wang, 2013).

Research on temperamental Sadness has also explored Sadness within the context of other dimensions. For example, a study examining the role of affective aspects of temperament on self-regulatory tasks demonstrated a relationship between Sadness, Anger, Discomfort, and Approach/Anticipation and girls’ performance on Stroop tasks (Gonzalez, Fuentes, Carranza, & Estevez, 2001). Girls with higher parent-reported levels of these temperament dimensions showed a stronger flanker interference effect, indicating difficulty filtering out non-relevant information. Sadness was not found to have a statistically significant effect on boys despite similar effects for Anger and Discomfort. Such research furthers the link between affective and attentional aspects of temperament.

**Falling Reactivity/Soothability.** Falling Reactivity/Soothability (herein referred to as Falling Reactivity) refers to the rate of recovery from peak arousal, including distress, excitement, or general arousal (Rothbart et al., 2001). Falling Reactivity is linked to components of Effortful Control (Putnam & Rothbart, 2006; Putnam & Stifter, 2002). It is also implicated in the emergence of both internalizing and externalizing problems. In a 2012 study by Gartstein, Putnam and Rothbart, Falling Reactivity was linked to symptoms of depression and anxiety, as
well as under-controlled externalizing behaviors. Results suggest that Falling Reactivity can be protective at high levels and can pose risk at low levels.

**Effortful Control.** Effortful Control is considered one of the most important aspects of self-regulation, and is defined as “the ability to inhibit a dominant response to perform a subdominant response, to detect errors, and to engage in planning” (Rothbart & Rueda, 2005, p. 3). It is a particularly important aspect of temperament because it suggests that temperamental responses to stimuli are not purely emotional. Effortful Control allows individuals to respond in ways that may be incongruent with emotional state through the exercise of behavioral inhibition. Emotions remain important, however, as the efficiency of control is affected by strength of the emotional processes against which control is exerted (Rothbart, Derryberry, et al., 2000).

Effortful Control develops substantially in the toddler and preschool years, and signifies a shift from a regulatory system based on orienting to one based on systems of Effortful Control (Gartstein et al., 2012). Effortful Control emerges at the same time as rapid development of the brain’s executive control system, and is influenced by anterior cingulate and lateral prefrontal cortex brain regions (Posner & Rothbart, 2007; Rothbart, Derryberry, & Posner, 1994).

Oblique factor rotations examining broad factors of temperament revealed that Effortful Control is unrelated to positive emotionality, but inversely related to negative emotionality (Rothbart & Rueda, 2005). Individual differences in Effortful Control are linked to the development of conscience and empathy, as well as lower levels of maladjustment and psychopathology (Rothbart et al., 2003). The dimensions falling under the broad temperament dimension of Effortful Control are discussed below:

**Attentional Focusing.** Attentional Focusing refers to a tendency to maintain task-related attentional focus (Rothbart et al., 2001). Attention has both reactive and regulatory components.
Attentional Focusing is important in the development of the ability to sustain attention over extended periods of time, which is essential in the development of increased capacity for Effortful Control (Rothbart & Bates, 2006). As the brain’s attentional systems mature, attentional focusing and attentional shifting combine to serve important regulatory functions. These aspects of attentional control have important implications for social and emotional development, as they select emotional and social information for conscious processing (Rothbart & Bates, 2006). Although conceptually similar, attentional focusing and attentional shifting did not hold together during item analysis of the CBQ (Rothbart et al., 2001). There were, however, enough items for an Attentional Focusing scale, which is why it is featured in the CBQ whereas attentional shifting is not.

**Perceptual Sensitivity.** Perceptual Sensitivity refers to the detection of low-intensity stimuli from the external environment (Rothbart, 2007). This dimension corresponds to Thomas and Chess’ construct of Threshold, and is related to attentional systems of orienting (Rothbart & Posner, 2001). Thomas and Chess suggested that individuals could either require a high level of stimulation to evoke a response, or a low level of stimulation to evoke a response. Individuals could also fall somewhere in between, as the two extremes exist along a continuum. More recent theorists have suggested that sensory responsiveness is not limited to a single continuum, but rather is a multidimensional phenomenon consisting of hyper-responsiveness, hypo-responsiveness, and sensory seeking behaviors (Brock et al., 2012).

**Low Intensity Pleasure.** In contrast to the Surgency/Extraversion dimension of High Intensity Pleasure, Low Intensity Pleasure refers to the amount of pleasure or enjoyment derived from situations involving low levels of intensity, novelty, rate, complexity, and incongruity; such situations are often considered “low-risk” as opposed to the high-risk situations characteristic of
High Intensity Pleasure (Rothbart et al., 2001). Cuddliness in toddlerhood is linked to enjoyment of low intensity pleasures in childhood, which suggests that social affiliation may predispose individuals to pleasure (Rothbart et al., 2011).

Inhibitory control. The temperamental dimension of Inhibitory Control refers to a child’s ability to plan, as well as to inhibit inappropriate approach responses in novel or uncertain situations, or in compliance with instructions (Rothbart et al., 2001). Inhibitory Control is a complex construct that can be either active or passive. Active Inhibitory Control is characterized by reactive and self-regulatory aspects of temperament (Rothbart, 1989), whereas passive Inhibitory Control refers to a system encompassing anxiety, shyness, fear, and inhibited approach (Kagan, 1989). Inhibitory control is linked strongly to socialization, as children must learn to actively inhibit impulses and comply with demands from parents and other authority figures (Kochanska et al., 1996).

Approaches to Measurement

The measurement of temperament in childhood has taken many forms, including caregiver reports, self-reports, structured laboratory experiments and observations, and naturalistic observations; each of these approaches has relative strengths and weaknesses. In their 2006 chapter on Temperament, Rothbart and Bates provide an overview of these approaches. The strengths and weaknesses that emerged through their examination are presented below:

In-home naturalistic observation. Naturalistic observations allow assessment high in ecological validity and objectivity, as they occur in the child’s natural environment. However, several important limitations exist, particularly in the study of a construct as theoretically complex as temperament. As Rothbart and Bates (2006) suggest, in vivo coding of behaviors is limited by coder’s capacity to process all relevant behavior. The state of the coder during...
observation, knowledge of implicit reference groups, and coding of ambiguous behaviors that occur at a low intensity can also introduce measurement error. Measurement error may also occur due to halo effects. Many of these weaknesses can be lessened through videotaping, as portions of tapes can be re-watched for accuracy, a system of inter-rater reliability can be established, and coders can take breaks as needed to remain in the proper state required for coding. The potential to miss low-intensity or ambiguous behaviors remains, though is less in video coding than in in vivo coding.

Rothbart and Bates (2006) note that measurement error can also occur due to factors outside of the researcher’s control. For example, caregiver-child interaction can serve to moderate the observed behavior, rendering it a less “pure” representation of the child’s behavior. The very presence of the coder can affect the behavior of both the child and the caregiver, resulting in lowered levels of conflict or a tendency to behave in socially desirable ways that may not characterize typical interactions. Further, the number of instances of behavior that can be observed is limited by the time the researcher spends in the natural setting, and it may not be possible to observe the child across settings or contexts. As such, it is also difficult to determine whether the behaviors observed are stable, as the observation provides a limited sample of behavior. Lack of normative data is also a limitation of the naturalistic observation approach, and naturalistic observations can be both time consuming and expensive.

**Laboratory measures.** Rothbart and Bates (2006) define laboratory measures as those “objective measures scored from videotape in episodes designed to elicit temperament-related reactions” (p. 114). Laboratory measures have the advantage of allowing researchers to control the context with precision, and to elicit specific behaviors. They also allow for the measurement of the duration and intensity of the child’s reaction to specific paradigms. Like naturalistic
observations, coding weaknesses emerge in terms of the scoring of ambiguous, low-intensity reactions, coder knowledge of implicit reference groups, limitations in the capacity of the coder to process relevant behaviors, limits in the precision of coding, and accuracy in detecting important rare events (Rothbart & Bates, 2006). These coder-related weaknesses can again be reduced by videotaping and the use of inter-rater reliability. Other sources of error include problems during testing, such as uncontrolled caregiver behaviors, experiences occurring prior to or during testing, and subtle variations in experimenter reactions toward different children. Limitations also include a lack of normative data, limits in the number of behavioral instances that can be observed and recorded, limits on the range of behavioral options, the novelty of the setting, and carryover effects that may occur with repeated testing (Rothbart & Bates, 2006).

**Caregiver report.** Caregiver report is one of the most common forms of measurement used in the study of temperament. Caregivers spend a substantial amount of time with their children across a variety of situations and thus have an extensive knowledge base. Further, questionnaires are convenient, inexpensive, and can be administered, scored, and analyzed relatively easily. They also allow the study of multiple variables that may be difficult to elicit in the context of a laboratory observation, and may be unlikely to be observed in a naturalistic observation (Rothbart & Bates, 2006).

Despite the strengths of caregiver report, Rothbart and Bates (2006) note a number of sources of potential measurement error. First, there are a variety of rater characteristics that can influence responses independently of child behavior. For example, caregivers may have difficulty comprehending the instructions or understanding the questions presented in the rating scale. They may also be biased in their general impression of their child, or may lack adequate knowledge of their child’s behavior. Inaccuracies in memory, including recency effects and
selective recall are of additional concern, as are potential biases resulting from social desirability. Caregivers may also be inaccurate in their detection and coding of rare events that may be important indicators of temperament constructs, or may have knowledge of an implicit reference group that could influence ratings. Caregiver-child interaction can also introduce bias, as parents may interpret certain behaviors as occurring as a function of characteristics of themselves, which may affect reporting. Finally, questionnaire specific factors such as item wording, selection, and response options may affect the scale’s psychometrics, reducing reliability and validity of the measure.

The variety of potential sources of measurement error in the use of parent report measures has resulted in questioning of the scientific merit of the use of such measures in the study of temperament. Specifically, Kagan (1994, 1998) has argued that bias and inaccuracy seriously compromise the validity of parent report measures. He and Fox (2006), recommend the use of multiple measures of temperament, a stance which has been supported by Rothbart and Bates (2006). Rothbart and Bates (2006), however, have argued that parent reports are a highly valuable source of information in their own right, and that such measures should continue to be used prominently in temperament research. They argue that though bias and inaccuracy are relevant concerns, parent reports still provide valid estimations of child temperament, as parents are “in a good position to observe the child’s behavior on multiple occasions, including infrequently occurring behavior that nevertheless may be critical to defining a temperament dimension” (Rothbart & Bates, 2006, p. 115). They note that measurement bias has been dealt with satisfactorily in personality research, with the conclusion that personality can be reliability assessed by knowledgeable informants. Further, they call attention to the previously described
measurement difficulties inherent in laboratory investigations and naturalistic observations, noting that no form of measurement is free of potential bias or measurement error.

Rothbart’s defense of parent report measures is unsurprising given the extent to which her career has focused on the development and validation of these scales, and subsequent inquiry using them. Despite criticisms, her scales have demonstrated high levels of reliability and validity, are widely accepted in temperament research today, and have been used prominently in the formation of arguably the prevailing theory in contemporary temperament research.

**Temperament and Development**

Temperament is an important developmental process, as it contributes to development across domains. In their 2006 chapter in the *Handbook of Child Development*, Rothbart and Bates describe temperament’s role in social/emotional and personality development. They note that temperament is implicated in social learning, as it predisposes children to responsiveness to reward and punishment. Temperament is also linked to the development of coping skills via approach patterns and responses to positive feedback. Genotype x environment interactions have an impact on development as well, as children self-select experiences in their environments based on their temperamental profiles. The authors give the example that “the child who stays at the edge of a nursery class or a party is selecting a different experience than the child who goes directly to the center of social excitement” (p. 126). Further, temperament is thought to influence children’s responses to different caregiving styles, and children’s temperament styles can elicit reactions from others that likewise influence development. Mismatches in temperamental fit between caregiver and child can require significant adaptations in parenting. Such a mismatch is central to theories of goodness-of-fit, and forms the foundation for temperament-based interventions (Graham McClowry et al., 2008).
Though some level of stability in temperament over time is a defining characteristic of temperament, temperament itself is something that develops (Rothbart, 1989). Rothbart and Bates’ (2006) chapter discusses the development of temperament, describing the development of each of the three main temperament factors. They describe the early patterns of Surgency and Extraversion emerging at 2-3 months of age in the form of smiling, vocalizations, and limb movements. Positive affect increases in duration across the first year of life, and smiling and laughter in infancy were noted to predict approach tendencies both concurrently and in 6- to 7-year-old children. Inhibition and approach are described as developing later in the first year, with inhibitory reactions particularly noticeable in relation to high intensity stimuli. Longitudinal data suggests that following the establishment of inhibition of approach, individual differences in approach versus inhibition to challenge or novelty are relatively stable.

Moderate stability in social inhibition with strangers is noted by early childhood, and studies show some of the most stable temperamental attributes are Introversion versus Extroversion, Inactivity versus Activity, Reserve versus Spontaneity, and Inhibition versus Approach (Bayley & Schafer, 1963; Honzik, 1965; Kagan, Fox, & Eisenberg, 2006; Tuddenham, 1959, as cited in Rothbart & Bates, 2006). Rothbart and Bates (2006) also note that inhibition in preschoolers has been linked to high harm avoidance, low aggression, and low social potency at 18 years of age, and that temperamental fearfulness is linked to the later development of conscience.

Activity Level is also noted as a major temperamental characteristic that develops over time. Rothbart and Bates (2006) noted that Activity Level is considered a major dimension of individual differences in infancy, though it is relatively unstable in the early infancy period. They point to the tendency for activity to be linked to affect, and note differences in activity to be
linked to positive and negative emotionality, with the highest levels of motor activity in infancy noted during distress. As infants age, they begin to display motor activity in response to novelty and caregiver stimulation, which are linked to positive emotionality. The authors go on to cite a study by Kroner et al. (1985), in which the vigor of non-distress motor activity in newborns predicted high daytime activity and high approach scores at ages 4 to 8 years. Thus, developmentally-linked differences in positive and negative emotionality are likely contributors to the lack of stability in temperamental activity levels in infancy. Rothbart and Bates (2006) also propose that the onset of inhibition as a result of fearfulness in the later part of the first year of life may contribute to the lack of stability, as more fearful children may inhibit motor responses to high intensity conditions or those involving novelty. The development of such inhibition signifies the emergence of the Effortful Control system and executive attention. The emergence of Effortful Control coincides with decreases in Activity Level, which peak at around 7-9 years of age (Campbell, Eaton, & McKeen, 2002).

The emergence of attentional orienting and Effortful Control is also important to consider when examining the development of temperament. Attention can be both reactive and self-regulatory, and serves both functions throughout the lifespan. As Rothbart and Bates (2006) explain, reactive attention involves orienting to exogenous stimulation and is characteristic of attention early in infancy. Late in a child’s first year, visual orienting and signs of executive attention begin to emerge. Executive attention allows for increased attentional control and planning and signifies the beginning of the development of Effortful Control. As children continue to develop, executive attention becomes more efficient, and children become able to inhibit dominate responses, activate subdominant responses, plan, and detect errors. All of these abilities are linked to the ability to maintain focused attention, which develops concurrently.
Stability in Effortful Control is shown to increase between 22 and 45 months of age, and stability at 33 to 45 months of age is equivalent to IQ. Children’s ability to control both attention and emotions continues to develop as they age, and measures of self-regulation appear considerably stable throughout much of childhood.

**Adjustment, Psychopathology, and Treatment Outcomes**

**Adjustment.** Just as temperament is linked to psychopathology, several aspects of temperament are linked to general psychological adjustment. Self-regulatory capacity and emotionality, for example, are linked to social functioning; the ability to control emotional over- and under-arousal and to appropriately express emotion is related to the expression of socially acceptable emotions and behaviors (Eisenberg, Fabes, Guthrie, & Reiser, 2000). Temperament is also implicated in the development of empathy and morality, as Effortful Control and fearfulness are demonstrated to directly relate to conscience development (Stifter, Cipriano, Conway, & Kelleher, 2009).

Links to academic adjustment have also been demonstrated. Temperament is shown to moderate the relationship between maternal parenting style in early childhood and academic competence, social skills, and relationships with peers and teachers in first grade (Stright, Kelley, & Gallagher, 2008). A relationship between temperament and IQ has also been demonstrated, with infants displaying greater distress to novelty displaying higher IQs at 36 months; distress to limitations was not related to IQ (Karrass & Braungart-Rieker, 2004). Distress to novelty at four months was theorized as a sign of advanced cognitive ability, because the infant recognized that a stimulus was discrepant from those previously encountered. IQ in preschoolers has also been predicted from temperament, with infants higher in anger and irritability demonstrating lower performance on cognitive measures at 36 months than peers lower in anger and irritability
Further, preschool achievement test performance is also linked to temperament, with attention span, persistence, activity level, approach/withdrawal, and soothability all contributing to performance (Palisin, 1986).

**Psychopathology.** Researchers have theorized that negative emotionality, positive emotionality, attentional/effortful control, and behavioral inhibition in particular are likely all related to various forms of psychopathology (Lahey, 2004). Regulatory under-control, including high levels of impulsivity and low voluntary behavioral control, has been shown to predict externalizing behaviors (Eisenberg et al., 2000). Regulatory control has been implicated in the development of psychopathology, including Attention Deficit/Hyperactivity Disorder (AD/HD). Though AD/HD is generally diagnosed in childhood, researchers have theorized that symptoms may be rooted in infant temperament (Nigg, 2006a). A recent study by Sullivan and colleagues (2015), predicted familial history of AD/HD based on examination of the temperament of 6-month-olds using both laboratory and parent report measures. The researchers found that anger/irritability, infant distress to limitations, and lower levels of parent-oriented attention-seeking were linked to familial AD/HD. Though longitudinal follow up is needed to determine whether this hypothesized pattern of temperamental risk is predictive of AD/HD diagnosis, the study supports other studies linking behavioral problems in early childhood with the development of AD/HD (e.g., Arnett, Macdonald, & Pennington, 2013). Negative emotionality and irritability have been shown to be characteristic of children with AD/HD, further supporting the hypothesis that early dispositional factors may signify the earliest manifestations of the disorder (Karalunas et al., 2014; e.g., Nigg, 2006b).

Poor self-regulation and difficulty with anger and frustration are linked to conduct problems (Deater-Deckard et al., 2007; Eisenberg et al., 2000; Krueger, Caspi, Moffitt, & White,
Symptoms such as irritability, frustration, and angry outbursts are features of Oppositional Defiant Disorder (ODD), and are linked to negative emotionality and difficulty with emotional regulation (Frick & Morris, 2004). A fine grained analysis of temperament attributes linked to externalizing behaviors in preschoolers found that frustration, sadness, and low falling reactivity were all related to externalization (Gartstein et al., 2012). Higher surgency was also linked to externalizing problems, and Negative Emotionality was most strongly linked to conduct problems when Effortful Control was low. Such findings again suggest that limited emotional self-regulation plays an important role in the development of maladaptive behaviors.

Temperament is also linked to internalization. Specifically, behavioral inhibition and negative emotionality have been linked to internalizing problems (Eisenberg et al., 2000; Gartstein et al., 2012; Kagan, 1989). Positive emotionality, including interest, positive affect, and sociability, has been found to serve a protective function against depressive symptoms, as high scores these dimensions at three years of age predicted lower depressive symptoms at 10 years of age (Dougherty, Klein, Durbin, Hayden, & Olino, 2010). In contrast, lower surgency, higher negative affect, and low effortful control are linked to depressive symptoms in middle childhood (Kotelnikova et al., 2015). High inhibitory control is also linked to internalization (Kochanska et al., 1996) suggesting that the extremes of inhibition (i.e., particularly high or low levels) predispose children to psychopathology. Further, anxiety in children is linked to high negative affectivity, low effortful control, attentional bias toward threat-relevant stimuli (Lonigan et al., 2004) and shy/inhibited temperament (Prior et al., 2000; Volbrecht & Goldsmith, 2010). These links, and the fact that related temperament dimensions are present early in life, support temperament as an important indicator of psychological functioning.
**Treatment Outcomes.** In addition to its relation to psychopathology and general psychological adjustment, temperament is also implicated in treatment outcomes for a variety of psychological disorders. For example, high avoidance and low reward dependence predicted poor response to interpersonal psychotherapy among a group of adults presenting with depression, accounting for 18% of treatment outcome (Joyce et al., 2007). Temperament is also shown to influence treatment outcomes among adults with obsessive compulsive disorder. In a 2008 study, non-responders to Cognitive Behavioral Therapy (CBT) and selective serotonin reuptake inhibitors (SSRIs) displayed low self-directedness and high persistence (Corchs et al., 2008). Response to methylphenidate for AD/HD symptoms in children is also related to temperament, with high persistence and low self-directedness predictive of short term remission status (Purper-Ouakil et al., 2010).

Treatment outcomes for adolescents with substance abuse problems have also been evaluated in terms of temperament. Researchers found that individuals classified as having “difficult” temperament, including irregularity in biological functions such as appetite, sleep, and daily activity, showed reduction in alcohol use when treated with a psychoeducation program, but did not show a decrease in the use of other substances or an increase in psychological distress (Burleson & Kaminer, 2008). Those with more optimal rhythmicity showed an improvement in psychological functioning when treated with CBT. This work supports other research suggesting that temperament and personality factors influence adolescent response to treatment, and that adolescents may respond best to treatment that is tailored to their personality (Conrod, Castellanos-Ryan, & Strang, 2010). Overall, the literature on temperamental influences on treatment outcomes is limited. However, initial findings do suggest that temperament influences response to both psychopharmacological and behavioral treatments for a variety of disorders.
Autism Spectrum Disorder

Diagnostic Criteria and Prevalence

Autism spectrum disorder (herein referred to interchangeably as ASD, autism, and autism spectrum disorder) is a pervasive developmental disorder characterized by deficits in social communication and interaction, as well as the presence of restricted and repetitive patterns of behavior, interest, or activities. These patterns of behavior are persistent across multiple contexts. As delineated in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013)* social criteria may include (1) deficits in social reciprocity (e.g., abnormal social approach, difficulty with back and forth conversation); (2) nonverbal social communication (e.g., difficulty integrating verbal and nonverbal cues, abnormalities in eye contact and body language, lack of facial expressions, lack of understanding and use of gestures); and (3) the development, maintenance, and understanding of social relationships (e.g., lack interest in peers, difficulty adjusting behavior to suit social contexts, difficulty making friends, lack of imaginative play). Restricted and repetitive behaviors, interests, and activities may include (1) stereotyped motor movements, speech, or object use (e.g., lining up toys, echolalia, use of idiosyncratic phrases, or simple motor stereotypies); (2) inflexibility in adherence to routines, insistence on sameness, or ritualistic behaviors (e.g., difficulty with transitions, rigid thinking, high levels of distress in response to small changes); (3) interests that are highly fixated and abnormal in focus or intensity (e.g., preoccupation with unusual objects or perseverative interests); and (4) sensory difficulties, which may involve hypo- or hyper- sensitivity to sensory input or unusual interest in sensory aspects of the environment (e.g., adverse reactions to sounds or textures, indifference to pain or temperature, excessive touching or smelling of objects, or fascination with movement or visual stimuli such as lights).
DSM-5 diagnosis of ASD requires deficits in both social communication and restricted/repetitive behaviors, as opposed to DSM-IV criteria which did not require the presence of restricted/repetitive behaviors. Prevalence of autism spectrum disorder in the United States prior to the switch from DSM-IV to DSM-5 was estimated at 1 in 68 (Centers for Disease Control and Prevention (CDC), 2014). Due to the change in diagnostic criteria, many children who previously qualified for an ASD diagnosis no longer do. The majority of these children are now classified as having Social Communication Disorder (SCD). The CDC estimates that this change decreases the current estimated prevalence to 1 in 100 children, though prevalence has not been formally re-evaluated since the diagnostic changes (Maenner et al., 2014).

**Temperament in Autism**

Temperament provides a useful context for the study of psychopathology, yet research on temperamental differences within diagnostic categories is limited. The nature of ASD diagnostic criteria results in a high level of variability within the autism phenotype. Individuals with ASD can present with a variety of symptom constellations and severities. Intellectual functioning can vary from profound intellectual disability to extremely superior intelligence, and symptoms can result in mild to severe impairment. However, study of individual differences within the diagnostic category is limited. Researchers are generally cognizant of controlling their studies through the use of differentiating criteria such as intellectual functioning, but are less apt to control for personality and temperamental differences that may have important implications for diagnostic subtyping and ultimately, treatment outcomes. Compared to research on temperament in the general population, the study of temperament within the autism phenotype is limited. However, interest in temperament within the ASD diagnostic category is growing, and
recent findings support the claim that temperamental variability exists and is worthy of additional study.

**The study of high risk infants.** One prominent area of inquiry among autism researchers is the study of infants at high risk of developing autism spectrum disorders by virtue of having an older sibling with the disorder. Studies of the autism genotype have found moderate genetic heritability, and twin studies have suggested a substantial twin environment component to autism risk (Hallmayer et al., 2011). A study published by the Baby Siblings Consortium, which studies high risk children at nine sites across the country, found that 18.7% of at-risk infants went on to develop autism, compared to previous estimates of 3-10% (Ozonoff et al., 2011). The study of infant sibling risk has demonstrated not only a considerable genetic predisposition toward the disorder, but also a number of behavioral and neurological makers that appear early in development. In a study of 294 high-risk siblings and 116 low-risk siblings, the high-risk siblings showed considerable atypical development distinguishing them from low-risk siblings by 12 months of age (Ozonoff et al., 2014). Atypical development was noted in terms of cognitive, social, motor, and language skills, with particular deficits noted in social communication, a key diagnostic feature of ASD. Results suggest that detectable signs of autism exist in the first year of life, and that close monitoring of at-risk siblings is warranted.

Behavioral differences in high- and low-risk infants extend beyond core developmental domains. A study of 150 infant siblings, including 65 studied longitudinally to 24 months of age, revealed a number of factors distinguishing high risk infants from low risk infants (Zwaigenbaum et al., 2005). Identified differences included atypicality in behavioral markers, including eye contact, visual tracking, disengagement of visual attention, reactivity, social smiling, orienting to name, imitation, social interest, affect, and sensory
behaviors, as measured via experimental and observational measures. Several of these behavioral markers correspond directly to temperament dimensions, and others are related to one or more dimensions. Further, the same study examined temperament specifically using the parent-report Infant Behavior Questionnaire (IBQ; Rothbart, 1981). Results indicated what the authors describe as “a characteristic pattern of early temperament, with marked passivity and decreased activity level at 6 months, followed by extreme distress reactions, a tendency to fixate on particular objects in the environment, and decreased expression of affect by 12 months” (Zwaigenbaum et al., 2005, p. 143). The finding of such marked temperamental differences among the at-risk sample increased scientific interest in temperament as an early indicator of autism, an area largely neglected by previous researchers.

Since Zwaigenbaum’s study, several other studies have examined temperament in high-risk infant siblings. One study investigated the temperament profiles of 54 high-risk infants and 50 controls (Clifford et al., 2013). High-risk infants were distinguished at 7 and 14 months of age, showing reduced surge compared to controls. Reduced Effortful Control was found at 14 and 24 months. The authors followed these children through 3 years of age, at which time a diagnostic assessment was conducted. Results revealed that infants who went on to meet diagnostic criteria for ASD at 3 years demonstrated a temperament profile significant for increased Perceptual Sensitivity in their first year, and both increased Negative Affect and reduced Cuddliness in the second year.

A 2014 longitudinal examination of infant siblings also suggests a developmental trajectory of temperament among infants who are subsequently diagnosed with autism (Del Rosario, Gillespie-Lynch, Johnson, Sigman, & Hutman). Using scores on the parent report Carey
Temperament Scales (CTS; Carey & McDevitt, 1995) administered at 6, 12, 18, 24, and 36 months, an increase over time in Activity Level was noted. Decreasing levels of Adaptability and Approach behaviors, relative to high-risk children who were typically developing at 36 months, were also noted. This study was the first to compare temperament trajectories between high-risk siblings who went on to develop ASD, and typically developing high-risk siblings. Additional research has shown temperament differences between high- and low-risk groups, and differences in higher order temperament factors. In a 2015 study, high-risk children were characterized by high levels of negative affect and low levels of effortful control compared to low-risk children (Garon et al.). The authors posit Effortful Control at 24 months as a critical predictor of ASD symptoms at 36 months, and suggest that early temperament is useful as an endophenotype for ASD.

**Early and middle childhood temperament and ASD.** One of the earliest studies of temperament in the autism population compared children from 36 to 95 months of age on the autism spectrum to those with Fragile X (Bailey et al., 2000). This study found that children with autism showed considerably more developmental variability than children with Fragile X, and that both groups displayed temperament profiles characterized by lower Adaptation and Persistence, and higher Withdrawal than the reference group, as measured by the Behavioral Style Questionnaire (BSQ; McDevitt & Carey, 1978). Further, compared to the reference group, boys with ASD were rated as more distractible, less intense, less rhythmic, and having a higher threshold for response. Consistent with the findings of Bailey and colleagues (2000), a larger study revealed the children with autism as a group were reportedly less adaptable, less persistent, and required more intense environmental stimulation for a response than typical controls (Hepburn & Stone, 2006). Children with ASD have also been shown to score lower than controls
on the temperamental dimensions of Attentional Focusing, Inhibitory Control, and Soothability, with Effortful Control distinguishing children with ASD from controls (Konstantareas & Stewart, 2006).

Building upon these studies, Adamek and colleagues conducted a study examining temperament in children with ASD versus neurotypical controls, temperament within the ASD phenotype, and links between temperament and problem behavior (Adamek et al., 2011). They found that compared to typical controls, children with autism differed in terms of all measured aspects of Effortful Control (i.e., Inhibitory Control, Attentional Focusing, and Low Intensity Pleasure), as well as High Intensity Pleasure, Anger/Frustration, and Discomfort. They also found considerable variability within the ASD group, and linked high Negative Affectivity, high Surgency, and low Effortful Control to problem behavior.

In addition, a 2012 study found that children ages 3 to 7 with autism displayed temperament profiles distinct from typically developing children on the dimensions of Activity, Rhythmicity, Adaptability, Distractibility, Approach, Intensity, Threshold, and Persistence as measured by the BSQ (Brock et al.). This study also compared children with autism to controls with developmental delays, finding that the children in the ASD group differed from the group of children with developmental delay on only two dimensions: Distractibility and Approach. Such findings add to the literature suggesting children with autism display temperament features that vary significantly from those of controls. It also suggests that such variation is not exclusively tied to diagnosis-related domains.

Later childhood, adolescent, and adult temperament and ASD. Additional studies examined temperament among older individuals within the autism population. A 2013 study found that ASD in 9- to 12-year-old Swedish children is positively correlated with harm
avoidance and negatively correlated with reward dependence (Kerekes et al.). Further, study of adolescents with high functioning autism showed that ASD is associated with lower self-reported levels of Surgency, and higher levels of fear and Negative Affectivity (Schwartz et al., 2009). In adulthood, the autism phenotype has been positively correlated with harm avoidance, and negatively correlated with novelty seeking, reward dependence, self-directedness, and cooperativeness (Picardi et al., 2015). Overall, results suggest that individuals with autism continue to show measureable differences in temperament throughout childhood and into adulthood.

**Temperament within the ASD diagnostic category.** Though relatively little literature has examined temperament in individuals with autism as compared to typical controls, even less attention has been given to temperament *within* the autism diagnostic category. As previously described, autism is a highly variable diagnostic category. Just as ASD symptoms vary, considerable variation in psychological profiles exists among individuals within the diagnostic classification. Genetic research demonstrates that although a number of genes are associated with autism, there is likely no single common genetic or environmental etiology across all cases. Further, considerable neurocognitive variation in the disorder has been documented, including subtypes based on language and cognitive profiles (Mottron, Belleville, Rouleau, & Collignon, 2014; Tager-Flusberg & Joseph, 2003). Despite documented neurocognitive differences and anecdotal assertions of variability across domains noted by many clinicians, the study of temperamental and personality differences within the autism phenotype is limited. Within the past decade, however, research has begun to explore this area, and early results suggest that individual differences within the autism category are considerable and likely have important implications.
In their 2007 paper, Mundy, Henderson, Inge, and Coman propose the modifier model of autism. In contrast to conceptualizations of autism suggesting that the phenotypic variability in autism is attributable to syndrome-specific etiological processes that interact with one another to create the phenotypic expression of the disorder, the modifier model proposes that individual differences interact with autism and contribute to developmental, behavioral, and psychological differences. Modifier processes include both proximal and distal influences such as cognitive style, socialization processes, genes, and temperament. Though these modifier processes are proposed as a model for use in the understanding of autism, the authors theorize that the majority of forms of psychopathology can be similarly conceptualized. The authors suggest that modifier processes may have important implications for treatment. They propose that individual differences in behavioral dimensions may modify an individual’s response to specific types of intervention. In conjunction with individual differences in areas such as the capacity to make inferences about the behavior of others, temperament-related factors such as the behavioral motivation tendencies characteristic of approach and withdrawal, and self-regulatory abilities including the ability to monitor goal directed behavior, may modify intervention appropriateness, and ultimately response (Mundy et al., 2007).

The modifier model of autism has been applied in the study of neurobiological contributors to symptom presentation. Specifically, resting anterior EEG asymmetry, which reflects brain processes associated with differences in Approach and Avoidance, is linked to differentiation in the expression of autism among children without intellectual disabilities (Sutton et al., 2005). Further, children demonstrating a pattern of left frontal EEG asymmetry were shown to display milder social symptoms, and parents retrospectively reported significantly later onset of symptoms (Burnette et al., 2011). Despite these positive associations, left frontal
EEG asymmetry was also associated with higher reported externalization of anger and symptoms of obsessive compulsive disorder in higher functioning school-aged children with ASD.

The modifier model has also informed the study of temperament as a predictor of ASD symptomatology and adaptive functioning in adolescents with high functioning autism. A 2009 study found that higher levels of Surgency and Effortful Control are predictive of more adaptive outcomes, including lower levels of internalizing and externalizing symptoms (Schwartz et al.). This suggests that the same mechanisms that link temperament to emotional functioning in typically developing individuals also apply to high functioning adolescents with autism spectrum disorders.

Other studies that do not specifically mention the use of the modifier model have also generated findings supporting the model’s utility. One of the earliest studies to examine temperament among individuals with autism found that children who were rated by parents as more “difficult” displayed less social engagement and responsiveness with parents or the experimenter (Kasari & Sigman, 1997). Specific temperament dimensions combining to form what the authors describe as “difficult temperament” included a composite of approach/withdrawal tendencies, adaptability, intensity, mood, and rhythmicity. Differences in Effortful Control have also been found to vary based on symptom severity, with higher Effortful Control linked to lower symptom scores and higher chronological age (Konstantareas & Stewart, 2006). The same study found that reports of Negative Affectivity increased with academic ability, but that no differences were detectable for Surgency/Extraversion. Further, self-reported high levels of reward dependence have been noted among adults meeting DSM-IV criteria for Asperger’s disorder (Soderstrom, Rastam, & Gillberg, 2002).
A 2011 study revealed differences in mean scores on personality measures of shyness, expressiveness, need for affiliation, altruism, and high-intensity pleasure, between groups scoring high and low on measures of ASD symptomatology (De Pauw et al.). These findings reflect differences in Extraversion and Surgency at the domain level. The high-ASD group was found to exhibit more negative affect and lower optimism than the low-ASD group. Variability of traits was higher for children with ASD than for controls, suggesting that children with ASD present as a heterogeneous group in terms of both personality and temperament. The authors note that their findings contradict previous hypotheses positing restricted trait expression in ASD, and support future research examining trait differences.

**Conclusions.** The study of temperament in autism is a relatively new area of inquiry and has focused largely on the study of high-risk infant siblings. Findings across age groups indicate that temperament distinguishes between autism and typically developing groups, as well as between high- and low-risk groups. Results demonstrating the predictive power of temperament in the later diagnosis of autism suggest that temperament may form a useful diagnostic endophenotype for autism. Studies of temperament in autism at later ages suggest that individuals with autism display temperament profiles distinct from those of the general population. The differences are posited to reflect individual strengths and weaknesses that are useful in the tailoring of interventions to specific individual needs. Additional research may also help to define subtypes of autism and to detect moderators of variability in adaptive behavior and psychiatric comorbidities.

**The Present Project**

Within the field of psychology, knowledge of individual differences between children with autism and typically developing peers is limited. Even less is known about differences
within the autism phenotype. These differences have important implications for diagnosis, research, and treatment of the disorder. The purpose of the present project is to further investigate these differences in temperament both quantitatively and qualitatively. The project is composed of two studies, described below. Discussion of both studies focuses on findings as they relate to existing research, as well as exploration of implications for diagnosis, treatment, and future research.

**Study 1**

Study 1 explores temperament in early and middle childhood through quantitative analysis of data from the National Database for Autism Research (NDAR; NIMH, 2015). Temperament scale data collected using the *CBQ-Short* was analyzed to examine differences between children with ASD and neurotypical controls. The same data were then examined to explore differences between children within the ASD diagnostic classification.

**Study 2**

Study 2 explores temperament among children with ASD via qualitative analysis of observational data. Based on the results of Study 1, which identified significant differences between children with Autism and typical controls across all factors of Effortful Control (see Chapter 4), Effortful Control was selected for in depth study. Analysis involved observational coding of natural play with familiar caregivers. Participants included 15 children ages three to five years with a diagnosis of autism. The primary aim of Study 2 is to examine differences in Effortful Control within the autism phenotype.

**Research Questions and Hypotheses**

Both studies contribute to the existing literature by: (1) supporting existing literature suggesting temperamental differences and similarities, and (2) exploring previously unidentified
differences within the autism diagnostic category through the use of a novel data set. The following research questions are re-stated from Chapter 1, with the addition of the hypotheses generated from the review of literature.

**Study 1.**

*Question 1.* How do the temperament profiles of young children on the autism spectrum differ from the temperament profiles of neurotypical peers?

*Hypothesis.* Children with autism will show a temperament profile characterized by significantly lower levels of Surgency/Extraversion and Effortful Control, and higher levels of Negative Affectivity as compared to typical controls.

*Question 2.* Is the intellectual functioning of children with autism associated with their temperament profile?

*Hypothesis.* Intellectual functioning will influence variation within the phenotype, with children with lower cognitive scores displaying a temperament profile characterized by significantly lower levels of Surgency/Extraversion and Effortful Control, and higher levels of Negative Affectivity, as compared to children with higher cognitive scores.

**Study 2.**

*Question 1.* Does observation of child behavior during natural play with a familiar caregiver reveal measureable patterns within the Effortful Control domain (i.e., the dimensions of Attentional Focusing, Perceptual Sensitivity, Low Intensity Pleasure, and Inhibitory Control)?

*Hypothesis.* Yes, natural play will provide the opportunity for measurement of patterns of behavioral and emotional signs of all four dimensions of Effortful Control. Some dimensions will be easier to observe and to measure than others, and pattern analysis may be limited by infrequent observations of behaviors associated with certain dimensions.
**Question 2.** What do any observable patterns in Effortful Control reveal about the temperament of children with autism?

*Hypothesis.* Significant variability will be detected among children with autism. Intellectual ability will significantly influence variation within the phenotype, with children with lower cognitive functioning displaying a temperament profile characterized by lower levels of Effortful Control.
CHAPTER III: METHODS

Aims

The present project examines temperament among children with autism spectrum disorders using a two-study model. Analyses center on both examination of temperamental variability between children with autism and typical controls, as well as variability within the autism diagnostic category. Study 1 used a national dataset derived from the National Database for Autism Research (NDAR) to examine differences in temperament between children with autism and typically developing controls. Temperament is measured via the Children’s Behavior Questionnaire, Short Form (CBQ-Short; Putnam & Rothbart, 2006), and comparisons are made using Hotelling’s $T^2$. Study 2 features analysis of video-recorded data of young children with autism playing with a familiar caregiver. An observational coding system based on the dimensions defined and measured via the CBQ was developed to allow for exploration of temperamental variation with the autism phenotype. Study 2 focused specifically on the temperament factors that fall under the domain of Effortful Control, as statistically significant differences between children in the ASD group and the typically developing group were found across all four dimensions of Effortful Control. The methods used in each of these studies are described below.

Study 1

Participants

Study 1 included 89 total participants, 54 of whom were identified as having ASD (42 males), and 35 typically developing controls (TD; 20 males). The average age of participants in the ASD group was 35.07 months ($SD = 5.64$; Range 24-44 months), and the average age of the TD group was 31.83 months ($SD = 6.16$; Range 24-43 months). Race/ethnicity information is
provided in Table 2, with 15.7% of participants across races identified as Hispanic.

Developmental level was assessed using the *Mullen Scales of Early Learning (MSEL; Mullen,* 1995). Considerable differences in ability were evident between the two groups as measured by the Early Learning Composite Standard Score, with TD children scoring much higher \((M = 99.4, SD = 23.75)\) than children in the ASD group \((M = 47.26, SD = 32.66)\).

**Table 2**

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>50</td>
<td>56.2</td>
</tr>
<tr>
<td>Mixed Race</td>
<td>14</td>
<td>15.7</td>
</tr>
<tr>
<td>Asian</td>
<td>6</td>
<td>6.7</td>
</tr>
<tr>
<td>African American</td>
<td>5</td>
<td>5.6</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>7.9</td>
</tr>
<tr>
<td>Unreported</td>
<td>7</td>
<td>7.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>89</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Materials**

Materials included personal computers with internet connections, as well as software for statistical analysis (i.e., SPSS), word processing (Microsoft Word for Mac 2016), and data management (Excel for Mac 2016). Data were obtained from the National Database for Autism Research (NDAR) via NDAR’s online platform. Data used in the preparation of this project reside in the NIH-supported NIMH Data Repositories under Study Identification Number (SID) 1358. Approval for access to and use of the dataset was obtained from both NDAR and Northeastern University’s Institutional Review Board. Data were collected via the following research program: The Interdisciplinary Investigation of Biological Signatures of Autism Subtypes, a project funded by the National Institute of Mental Health under the National
Institutes of Health under award number R01MH089626 and led by Principal Investigator David G. Amaral, Ph.D., of the University of California at Davis. The content of the study and of the present project is solely the responsibility of the respective authors and does not necessarily represent the official views of the National Institutes of Health.

**Measures**

Measures included the *Children’s Behavior Questionnaire, Short Form (CBQ-Short; Putnam & Rothbart, 2006)*, for the measurement of temperament, and the *Mullen Scales of Early Learning (MSEL; Mullen, 1995)* for information on developmental level.

**Children’s Behavior Questionnaire, Short Form.** The *CBQ* is a highly differentiated caregiver report measure of temperament, designed for use with children 3 to 7 years of age (Rothbart, Ahadi, & Hershey, 1994; Rothbart, Ahadi, Hershey, & Fisher, 2001). It is grounded in Rothbart’s temperament theory, and is based on temperament constructs measured by the *Infant Behavior Questionnaire* (Rothbart, 1981) and the adult-based *Physiological Reactions Questionnaire* (Derryberry & Rothbart, 1988). The standard form features 195 items assessing temperamental dimensions characteristic of Rothbart’s theory of childhood temperament, while the short form (*CBQ-Short; Putnam & Rothbart, 2006*) features 94 items across 15 scales. Items on both versions are rated on a 7-point Likert scale ranging from 1 (*extremely untrue of your child*) to 7 (*extremely true of your child*), and parents are also provided with a *not applicable* option for times when the parent has not observed the child in the described situation. The validity and reliability of the standard form has been demonstrated, with internal consistency estimates (α) ranging from 0.64-0.92, and a mean reliability estimate of 0.78 across the 15 scales (Rothbart et al., 2001). The tool has been widely used to study temperament by a number of prominent researchers (e.g., Ahadi, Rothbart, & Ye, 1993). Satisfactory internal consistency,
criterion validity, longitudinal stability, and cross-informant agreement have been demonstrated for the short form (Putnam & Rothbart, 2006).

**Mullen Scales of Early Learning.** The MSEL (Mullen, 1995) is an assessment of cognitive and motor abilities, designed for use in young children ages birth to 5 years, 8 months. Its five scales include: Visual Reception, Gross Motor, Fine Motor, Expressive Language, and Receptive Language. It also generates a composite score, known as the Early Learning Composite. The MSEL is used regularly to assess the skills of young children with Autism Spectrum Disorder (Akshoomoff, 2006).

**Data Analysis**

Data analysis involved examination of descriptive statistics for each group, including means, standard deviations, and plots of distributions. Differences between children with autism and typical controls were compared using Hotelling’s Multivariate Paired $T$-squared test (Hotelling, 1931). Hotelling’s Multivariate Paired $T$-squared test, herein referred to as the $T^2$ test, is the multivariate application of Student’s $t$-test, and compares the vectors of the means of two groups. A $t$-test produces a $t$ statistic, which is the ratio formed from the subtraction of a hypothesized value from a statistical estimate, which is then divided by the estimated standard error. When this value is squared, it produces an $F$ statistic. However, if the difference between the sample mean and population mean is replaced with the difference between the sample mean vector and the hypothesized mean vector, a $T^2$ statistic is produced. Using $T^2$ over several $t$-tests to examine group level differences creates a more conservative test, reducing the probability of a Type 2 error. $T^2$ is also preferable over the use of ANOVA with corrections, such as the Bonferroni correction, as it is somewhat less conservative and reduces the probability of a Type
1 error. The $T^2$ test is equivalent to $F$ test with $p$ (equals the number of dependent variables) and $N_1 + N_2 - 2 - 1$ degrees of freedom (Hair, Black, Babin, Anderson, & Tatham, 2010).

Use of the $T^2$ test was contingent on the satisfaction of statistical assumptions, which include the following: (1) the vectors have a common population mean vector; (2) the vectors share a common variance-covariance matrix; (3) the samples follow a multivariate normal distribution; (4) and the samples are independent. Assumptions were evaluated and are presented in Chapter 4. Visual analysis of graphic data was also used to examine differences between and within groups. Line graphs were generated using SPSS chart builder to model the distributions of ratings across each dimension, allowing for comparison between and among phenotypes.

**Study 2**

**Participants**

Participants were 15 children with autism spectrum disorders, all recruited from the greater Boston, MA area. The children with autism were diagnosed by outside professionals, with autism status established via parent report. All participants were tested as part of Project Play, an Institute for Education Sciences funded research project examining the development of play in young children with and without developmental disabilities led by Co-Principal Investigators Karin Lifter, PhD, Emanuel Mason, Ed.D., and Takuya Minami, Ph.D. at Northeastern University (Grant Number R324A100100). At the time of this writing Dr. Minami had moved to University of Massachusetts at Boston.

The sample children were between the ages of 36 and 64 months. To allow for age-based groupings, children were assessed as close to their birthday or half birthday as possible. Three children with autism from each age group (i.e., 36, 42, 48, 54, and 60 months) were randomly selected for inclusion in Study 2. The sample included 12 males. Five of the children received
passing composite scores on the *Battelle Developmental Inventory Screening Test, Second Edition* (*BDI-2 ST*; Newborg, 2005), with the remaining ten children falling below age-based cut scores. Five were identified by their parents as White, Non-Hispanic; four as Black, Non-Hispanic; three as mixed race; and three as Hispanic of any race. English was the only language spoken in the home for 12 of the 15 children, with three children exposed to both English and another language (i.e., two English/ Spanish, one English/ Haitian Creole).

**Materials**

Materials included personal computers with internet connections, as well as software for viewing videos, statistical analysis (i.e., SPSS), word processing (Microsoft Word for Mac 2016), and data management (Excel for Mac 2016). MAXQDA 12, a software package designed for mixed methods and qualitative analysis, was used for coding of video-recorded data (VERBI, 2015).

**Setting**

Play samples were collected in the homes of the participants, which provided a natural setting for observation. One to two trained research assistants were present in the home for each observation. Prior to the start of the assessment, caregivers are told to engage in play as they normally would with their child, with one exception: to not show or tell the child what to do with the toys.

**Measures**

*Developmental Play Assessment.* The observational samples of children’s play used to examine temperament were collected via the *Developmental Play Assessment (DPA)*; Lifter, 2000) as part of Project Play. The *DPA* is a standardized assessment that uses a standard set of toys, standard administration procedures, and a standard scoring procedure. Administration
involves the child sitting on an examiner-provided blanket with their caregiver. The child is then presented with one of four different sets of toys, which are switched every 7-8 minutes. All children receive all four toy sets, though the administration order is randomized. The total assessment takes approximately 30 minutes to administer and is video recorded by a research assistant who remains in the room operating the camera throughout the assessment. The assessment is designed to capture the child’s spontaneous play actions with objects. As the assessment is not designed to measure social aspects of play or the quality of the dyadic interaction, the caregiver is present as a play partner and is told to follow the child’s lead.

For purposes of the present study, the DPA video-recorded data are used as an observational tool to examine child temperament. The naturalistic nature of the observations provides a window into the reactive and self-regulatory processes characteristic of temperament. A coding system examining behavioral manifestations of temperament was developed through exploratory analysis of the play videos.

**Battelle Developmental Inventory, Second Edition—Screening Test.** The BDI-2 ST (Newborg, 2005) was used as a measure of developmental level. It is a norm-referenced measure for use in children aged from birth to 7 years, 11 months. Children receive scores across developmental domains, and also receive a composite score. This composite score is then compared to an established cut score to determine if the child is demonstrating age appropriate developmental abilities.

**Development of a coding system.** The coding system is based upon the work of Rothbart and colleagues, and expands upon the definitions of the temperament dimensions defined in the CBQ. Results of Study 1 revealed statistically significant differences in Effortful Control across all measured dimensions within this temperament domain (See Chapter 4 for a
description of these results). Given the importance of Effortful Control in development (see Chapter 2), this temperament domain was selected for in depth analysis through the observational coding system.

The coding system consists of ratings representing the observed level of each dimension across two 7- to 8-minute segments of the DPA (i.e., the first and second toy sets presented). Although the toy sets presented in the first two segments vary randomly across the assessed children, the first two segments were selected for analysis uniformly due to the situational variables present during these two segments that could confound results. The first segment was thought to be of value because it allows for observation of the child’s initial reaction to the observational situation, when this situation is most novel and the examiner most unfamiliar to the child. The second segment was chosen because it represents the same point in acclimation to the situation across all participants. Although there are potential confounds associated with differences in the toy sets used across time segments, it was reasoned that the larger temperament-related confound would occur in terms of time rather than toy set. For example, it was thought that impulsivity and attentional control might vary more based on how long the child had been exposed to the situation.

The coding system itself uses ratings on a 1-7 scale, with 1 representing very low levels of the observed dimension, and 7 representing very high levels of the observed dimension. Criteria for each point on the scale were explicitly defined, with definitions based on both definitions and item analysis of the CBQ (See Appendix B). Coders utilized MAXQDA software to assist in assigning ratings. The software allowed them to highlight portions of the video that were consistent with points on the 1-7 scale. They also used the software to make notes about
their observations as they were watching the videos, and the software allowed them to easily return to flagged sections of video when making their ratings.

**Interobserver agreement.** Three coders were responsible for coding the samples. The primary investigator and coding system developer in the present project was responsible for coding all 15 samples and was considered the expert coder for purposes of reliability. The other two coders (hereafter referred to as secondary coders) were both research assistants and Ph.D. students in School Psychology at Northeastern University with extensive experience in early childhood research. These coders also had extensive experience administering the *DPA*, making them familiar with the natural variability observed among participants. These students were trained on the use of the coding system through a one-and-a-half-hour workshop led by the primary investigator of the present project.

Reliability was defined as a rating within two points of the expert coder on each of the four coded temperament dimensions. All three coders were responsible for coding the same initial sample to determine initial reliability. All three coders were reliable across the Perceptual Sensitivity, Attentional Focus, and Inhibitory Control dimensions on this initial sample. One secondary coder was unreliable on the Low Intensity Pleasure dimension, and was provided additional training in this domain.

Each secondary coder was then responsible for coding seven of the 15 remaining videos, so that each video was coded twice (i.e., once by the expert coder and once by one of the two secondary coders). Interrater reliability was calculated across all samples. One secondary coder was reliable within two points across all rated dimensions on 100% of samples. The other secondary coder was reliable within two points on 94% of dimensions.
Data Analysis

Histograms were generated via SPSS and Microsoft Excel to examine the distribution of scores on each measured dimension. Trends within each dimension were examined via visual analysis and descriptive statistics, which are described in Chapter 4. To examine relationships between dimensions, correlations were calculated using Pearson’s $r$. Correlations were calculated between chronological age and scores on each dimension, as well as between $BDI-2 ST$ age equivalent and scores on each dimension. Correlations were also calculated to examine relationships between each dimension, in order to examine how the dimensions influence and are related to each other. Histograms were also generated to examine the profiles of individual participants. The histograms were grouped by $BDI-2 ST$ age equivalent, with age equivalents under 36 months displayed together, and age equivalents over 36 months displayed together. One set of histograms was generated to display participant ratings across all dimensions, with each individual participant’s rating on all five dimensions displayed side by side (i.e., one histogram for each participant with their scores on all dimensions displayed). Another set was generated to display ratings on each dimension by participant, with each participant’s ratings on each individual dimension displayed side by side (i.e., all the ratings on Attentional Focus across participants displayed).
CHAPTER IV: RESULTS

The results of each study are presented separately, below. Results of Study 1, presented first, revealed several significant differences between the temperament profiles of children with autism and typically developing controls. Within group differences were observed as well, and visual analysis of these differences is presented. Following the results of Study 1, Study 2 results are presented, with primary analyses revealing considerable differences based on developmental age equivalent. Secondary analyses examining variability between individual children are also reported.

Study 1

Analysis of Between-Group Differences

Study 1 research questions were addressed principally using the SPSS multivariate General Linear Model application of Hotelling’s $T^2$. The General Linear Model procedure in SPSS generates Hotelling’s Trace, a multivariate statistic. SPSS then converts this value to Hotelling’s $T^2$ by multiplying it by $(N - L)$, where $N$ is the sample size across all groups and $L$ is the number of groups. When $L = 2$, the product is Hotelling’s two sample $T^2$. SPSS transforms Hotelling’s Trace and $T^2$ into equal values of $F$ with the same degrees of freedom. The resulting $F$ value and the significance level of Hotelling’s Trace found in the SPSS output are the appropriate $F$ and significance for Hotelling’s $T^2$, and are reported in this text (IBM Support, 2016).

Assumptions. Statistical assumptions were assessed prior to conducting the primary analyses. Each assumption is detailed below:

Independence. The observations were independent of one another by design.
Multivariate normality. Multivariate normality is difficult to demonstrate with existing software. However, it has been suggested that according to the central limit theorem, the univariate sampling distribution is assumed to “take the shape of a normal distribution regardless of the shape of the population from which the sample was drawn,” when sample sizes are roughly 30 or greater (Field, 2009, p. 782). Sufficient sample size in the present study supports multivariate normality. Further, Hotelling’s $T^2$ is considered robust against deviations from normality, particularly when there are no outliers (Field, 2009). Given that the dependent variables were normally distributed, multivariate normality can be assumed.

Homogeneity of covariance matrices. The assumption of equality of covariance matrices was tested using the Box’s Test of Equality of Covariance Matrices, $F(120, 16,569.4) = 1.22, p = 0.52$. Generally, it is best when the significance value is greater than .05, and thus this condition is satisfied (Field, 2009). Though the sample sizes are somewhat unequal between the ASD and TD groups, the extent of this imbalance is not substantial enough to cause concern.

Multicollinearity. A correlation matrix of the dependent variables was generated in order to examine multicollinearity. Correlations ranged from $r = +/- 0.01$ to 0.57, suggesting conceptual similarity between dependent variables but no concerning levels of multicollinearity (criterion for concern typically established as correlations greater than 0.9; Field, 2009).

Results. Descriptive statistics and graphs of the distributions of scores on each of the dependent variables were analyzed to examine differences within the ASD group, and to provide insight into the ways in which the distribution of ratings attributed to children with ASD vary compared to those attributed to typically developing controls. Descriptive statistics revealed that children with autism were assigned a larger range of ratings with larger standard deviations on each of the measured variables (See Table 3).
Table 3

Descriptive Statistics by Temperament Domain

<table>
<thead>
<tr>
<th>Dimension</th>
<th>TD Group</th>
<th></th>
<th>ASD Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Activity Level</td>
<td>5.20</td>
<td>0.63</td>
<td>4.77</td>
<td>1.07</td>
</tr>
<tr>
<td>Anger/frustration</td>
<td>4.64</td>
<td>0.91</td>
<td>4.72</td>
<td>1.13</td>
</tr>
<tr>
<td>Attentional Focus</td>
<td>4.49</td>
<td>0.87</td>
<td>3.99</td>
<td>0.91</td>
</tr>
<tr>
<td>Discomfort</td>
<td>3.65</td>
<td>1.04</td>
<td>3.29</td>
<td>1.12</td>
</tr>
<tr>
<td>Falling Reactivity/Soothability</td>
<td>5.04</td>
<td>0.95</td>
<td>4.50</td>
<td>1.15</td>
</tr>
<tr>
<td>Fear</td>
<td>3.16</td>
<td>0.99</td>
<td>3.03</td>
<td>1.02</td>
</tr>
<tr>
<td>High Intensity Pleasure</td>
<td>5.16</td>
<td>0.96</td>
<td>5.02</td>
<td>1.03</td>
</tr>
<tr>
<td>Impulsivity</td>
<td>4.63</td>
<td>0.98</td>
<td>3.90</td>
<td>1.13</td>
</tr>
<tr>
<td>Inhibitory Control</td>
<td>4.67</td>
<td>0.79</td>
<td>3.28</td>
<td>1.04</td>
</tr>
<tr>
<td>Perceptual Sensitivity</td>
<td>5.27</td>
<td>0.86</td>
<td>4.09</td>
<td>0.97</td>
</tr>
<tr>
<td>Sadness</td>
<td>3.73</td>
<td>0.88</td>
<td>3.47</td>
<td>1.03</td>
</tr>
<tr>
<td>Shyness</td>
<td>3.75</td>
<td>1.21</td>
<td>4.44</td>
<td>1.26</td>
</tr>
<tr>
<td>Smiling/Laughter</td>
<td>5.91</td>
<td>0.81</td>
<td>4.76</td>
<td>1.05</td>
</tr>
<tr>
<td>Approach/Positive Anticipation</td>
<td>5.01</td>
<td>0.73</td>
<td>4.07</td>
<td>1.04</td>
</tr>
<tr>
<td>Low Intensity Pleasure</td>
<td>6.15</td>
<td>0.50</td>
<td>5.76</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Among children with autism, the largest range between high and low ratings was 5.83 for Anger/Frustration. Several other variables, including Falling Reactivity/Soothability, Activity Level, and Shyness also had ranges at or above 5.0. All variables except Low Intensity Pleasure ($SD = 0.60$), Perceptual Sensitivity ($SD = 0.97$), and Attentional Focus ($SD = 0.91$) had standard deviations above 1.0. Shyness ($SD = 1.26$) and Falling Reactivity/Soothability ($SD = 1.15$) had the largest standard deviations within the ASD group. In contrast, no variables had a range above 4.50 among typically developing children. Four variables, Discomfort, Falling Reactivity/Soothability, High Intensity Pleasure, and Shyness, had ranges between 4.0 and 4.27. Only two variables, Discomfort ($SD = 1.04$) and Shyness ($SD = 1.23$), had standard deviations above 1.0.

Results of analyses using Hotelling’s $T^2$ to examine differences in temperament between the ASD and TD groups revealed a number of significant findings, $F(15, 73) = 7.84, p < .01, \eta_p^2$.
Effect size was estimated using $\eta_p^2$, which is the proportion of variance explained by a given variable that is not explained by other variables in the analysis (Field, 2009). In total, the multivariate model found significant effects for ten variables, accounting for a substantial portion of variance in the model. These variables represent all the variables composing the Effortful Control subscale of the CBQ, as well as five of six variables from the Surgency/Extraversion subscale. The Negative Affectivity subscale was least represented, with significance observed for just one of five measured variables.

### Table 4

**Results and Effect Size by Temperament Domain**

<table>
<thead>
<tr>
<th></th>
<th>$F$ value</th>
<th>$\eta_p^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surgency/Extraversion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approach/Positive Anticipation</td>
<td>21.27*</td>
<td>0.20</td>
</tr>
<tr>
<td>Activity Level</td>
<td>4.52*</td>
<td>0.05</td>
</tr>
<tr>
<td>High Intensity Pleasure</td>
<td>0.44</td>
<td>--</td>
</tr>
<tr>
<td>Smiling/Laughter</td>
<td>30.67*</td>
<td>0.26</td>
</tr>
<tr>
<td>Impulsivity</td>
<td>9.76*</td>
<td>0.10</td>
</tr>
<tr>
<td>Shyness</td>
<td>6.57*</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Negative Affectivity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anger/Frustration</td>
<td>0.12</td>
<td>--</td>
</tr>
<tr>
<td>Fear</td>
<td>9.76</td>
<td>--</td>
</tr>
<tr>
<td>Discomfort</td>
<td>2.32</td>
<td>--</td>
</tr>
<tr>
<td>Sadness</td>
<td>1.55</td>
<td>--</td>
</tr>
<tr>
<td>Falling Reactivity/Soothability</td>
<td>5.59*</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>Effortful Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attentional Focusing</td>
<td>6.66*</td>
<td>0.07</td>
</tr>
<tr>
<td>Perceptual Sensitivity</td>
<td>33.97*</td>
<td>0.28</td>
</tr>
<tr>
<td>Low Intensity Pleasure</td>
<td>10.30*</td>
<td>0.11</td>
</tr>
<tr>
<td>Inhibitory Control</td>
<td>44.91*</td>
<td>0.34</td>
</tr>
</tbody>
</table>

$p < .05$

Notably, children with ASD were rated lower than typical controls in terms of Impulsivity, $F(15, 73) = 9.76, p < .01, \eta_p^2 = .10$. The Impulsivity scale measures the speed of response initiation and is thought to be driven by approach tendencies with neuropsychological
origins in subcortical brain systems. Items measured both impulsive behaviors, such as rushing into activities and saying things without thinking, as well as aspects of inhibition, including being slow and unhurried in decision making and being among the last children to try out new activities. Results suggest that children with ASD tend to be less impulsive than their typically developing counterparts, with a small to moderate effect size. This finding suggests that children with autism may show more latency in their response to situations and in decision making.

However, children with ASD scored lower than typically developing peers on the related construct of Inhibitory Control, \(F(15, 73) = 44.91, p < .01, \eta^2_p = .34\). Inhibitory Control accounted for the largest proportion of variance not explained by other temperament dimensions, suggesting that it is a particularly salient distinguishing aspect of temperament. The Inhibitory Control subscale specifically measures aspects of executive functioning, including the child’s ability to plan, as well as to inhibit inappropriate approach responses in novel or uncertain situations, or in compliance with instructions. Results indicate that children with ASD tend to have more difficulty exercising inhibitory control than typically developing peers, despite showing increased response latency.

Further, children with ASD were rated lower than typically developing controls in terms of Falling reactivity/Soothability, indicating that they have more difficulty recovering from peak states of arousal than children in the TD group, \(F(15, 73) = 5.59, p = .02, \eta^2_p = .06\). Effect size was small. Low ratings of Falling Reactivity/Soothability are linked to internalizing and externalizing symptoms, as well as components of Effortful Control.

Children with ASD were further rated as demonstrating significantly lower levels of activity than typical controls on the Activity Level subscale, \(F(15, 73) = 4.53, p = .04, \eta^2_p = .05\). This finding suggest that children with ASD tend to be less physically active than typical
controls, and may prefer quiet activities to high energy ones. Despite this lower level of activity, children with ASD were rated as lower in Attentional Focusing than typical peers, $F(15, 73) = 6.66, p = .01, \eta^2_p = .07$, indicating difficulty maintaining focus on tasks and a tendency to become easily distracted.

Ratings on the Perceptual Sensitivity scale indicated that children with ASD are less sensitive to perceptual stimuli than typical controls, $F(15, 73) = 33.97, p < .01, \eta^2_p = .28$. This suggests that children with ASD are less likely to notice differences in sensory stimulation, such as the gradient of objects, odors, and changes in the appearance of rooms and/or caregivers. Children with ASD were also found to exhibit lower levels of positive affect generated in response to changes in stimulus rate, intensity, incongruity, novelty, and complexity, as measured by the Smiling/Laughter subscale, $F(15, 73) = 30.67, p < .01, \eta^2_p = .26$. Higher scores on the Smiling/Laughter subscale are associated with stronger approach tendencies and higher levels of extraversion.

Consistent with lower scores on the Smiling/Laughter subscale, children with autism were rated lower than typically developing peers on the Approach/Positive Anticipation subscale $F(15, 73) = 21.27, p < .01, \eta^2_p = .20$. This suggests lower levels of emotional exuberance, sensitivity to rewards, anticipatory excitement toward pleasurable activities, and behavioral approach to both novelty and challenge, among children with autism. Likewise, children with autism were rated higher on the Shyness subscale than typical peers, $F(15, 73) = 6.57, p < .01, \eta^2_p = .07$, indicating uneasiness around new adults and children. The Smiling/Laughter and Approach/Positive Anticipation subscales each accounted for a substantial proportion of variance not explained by other variables, with medium to large effect sizes. The effect size for Shyness was more modest, explaining a smaller proportion of variance.
Finally, children with ASD also exhibited lower levels of Low Intensity Pleasure, indicating caregiver perception of less pleasure or enjoyment derived from situations involving low levels of intensity, novelty, rate, complexity, and incongruity, $F(15, 73) = 10.30, p > .01, \eta_p^2 = .11$. Effect size was small to moderate. No significant difference was found in terms of High Intensity Pleasure, suggesting that children with ASD do not necessarily require higher levels of stimulation to experience pleasure as compared to typical controls, $F(15, 73) = 0.44, p = .051, \eta_p^2 = .005$.

**Analysis of Within-Group Differences**

Visual analysis of graphs examining the distribution of ratings across dimensions revealed differences between typically developing children and those with ASD (See Figures 1-3). Ratings of Activity Level, for example, varied considerably among the ASD group, with ratings ranging across the distribution (Minimum = 1.43, Maximum = 6.43) and negatively skewed (see Figure 1). Among typically developing children, ratings were also negatively skewed, but only ranged from 4.0 to 6.14. In terms of Falling Reactivity/Soothability, children with autism displayed a multimodal distribution, with spikes at several points across the distribution (See Figure 2). In contrast, typically developing children peaked toward the higher end of the distribution, skewing toward higher values with no spikes at lower values (See Figure 2). Children with autism were most similar to typically developing controls in terms of the distribution of ratings along the Sadness dimension, with most ratings for both groups falling toward the center of the distribution (See Figure 2). Overall, scores tended to fall within a broader range of values for children on the autism spectrum as compared to typical controls. This finding suggests considerably more variation within the ASD phenotype than among typically developing children, as well as differences in the distribution of ratings between the two groups.
Figure 1

*Surgency/Extraversion Distributions by Phenotype*

- **Surgency/Extraversion Distributions by Phenotype**
- **Activity Level**
- **Approach/Positive Anticipation**
- **High Intensity Pleasure**
- **Smiling/Laughter**
- **Shyness**
- **Impulsivity**

*phenotype*

*ASD*

*Typical*
Figure 2

Negative Affectivity Distributions by Phenotype
Figure 3

Effortful Control Distributions by Phenotype
Study 2

Study 1 revealed significant differences in temperament among all dimensions within the Effortful Control domain. Based on this finding, Effortful Control was chosen for focused examination in Study 2. Note that only children with autism were examined in Study 2.

Pattern Analysis

Study 2 research questions were addressed through examination of histograms for each of the Effortful Control temperament dimensions, as well as through the generation of Pearson’s $r$ correlations. Examination of histograms revealed that ratings of individual children with ASD spanned a range from low-to-high for each of the measured variables, with ratings clustering around the center of the distribution.

Calculation of Pearson’s $r$ revealed no significant correlations between chronological age and any of the measured variables. However, significant positive correlations were found between age equivalent and the variables of attentional focus ($r = 0.56, p = .039$) and low intensity pleasure ($r = 0.54, p = .047$). See Table 5 for a complete report of correlations. Note that one child was not included in this analysis due to refusal to complete parts of the BDI-2 ST, so no age equivalent could be established.

Table 5

<table>
<thead>
<tr>
<th>Correlations between BDI-2 ST Age Equivalent and Effortful Control Dimension</th>
<th>$r$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attentional Focus</td>
<td>0.56</td>
<td>.039*</td>
</tr>
<tr>
<td>Low Intensity Pleasure</td>
<td>0.54</td>
<td>.047*</td>
</tr>
<tr>
<td>Inhibitory Control</td>
<td>0.34</td>
<td>.235</td>
</tr>
<tr>
<td>Perceptual Sensitivity</td>
<td>0.42</td>
<td>.138</td>
</tr>
</tbody>
</table>

* $p < .05$
Examination of correlations between variables revealed significant relationships between Attentional Focus and Inhibitory Control ($r = 0.65, p = 0.01$) and between Attentional Focus and Low Intensity Pleasure ($r = 0.56, p = 0.03$). See Table 6 for a complete report of correlations between Effortful Control dimensions.

Table 6

<table>
<thead>
<tr>
<th>Correlations between Effortful Control Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension</td>
</tr>
<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>Attentional Focus</td>
</tr>
<tr>
<td>Low Intensity Pleasure</td>
</tr>
<tr>
<td>Inhibitory Control</td>
</tr>
<tr>
<td>Perceptual Sensitivity</td>
</tr>
</tbody>
</table>

*p < .05

Individual Profile Analysis

Secondary analysis included examination of the profiles of individual participants on the Effortful Control domain ($N = 15$). Histograms were generated across individual participants and dimensions. Participants were grouped by BDI-2 ST age equivalent, with one group featuring participants with age equivalents below 36 months ($n = 8$), and one group representing age equivalents above 36 months ($n = 6$). Children with age equivalents below 36 months were rated lower across all dimensions (See Table 7 for means, standard deviations, and ranges). Note that means could not be compared using hypothesis testing due to small sample size.

Table 7

<table>
<thead>
<tr>
<th>Effortful Control Ratings by BDI-2 ST Age Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Attentional Focus</td>
</tr>
<tr>
<td>Low Intensity Pleasure</td>
</tr>
<tr>
<td>Inhibitory Control</td>
</tr>
<tr>
<td>Perceptual Sensitivity</td>
</tr>
</tbody>
</table>
Despite apparent mean level differences, examination of histograms revealed considerable variation across children within each group. For example, though participants with *BDI-2 ST* age equivalents under 36 months tended to be rated lower on Inhibitory Control, three out of the eight children in this group were rated above a “4” on this dimension (See Figure 4). Five of the six children with age equivalents above 36 months were rated a “4” or higher on this dimension, with one child rated a “2.5.” This child had the highest age equivalent of all children in Study 2, at 71 months (See Figure 5).

**Figure 4**

<table>
<thead>
<tr>
<th>Participant ID and Age Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>#001- 15mo</td>
</tr>
<tr>
<td>#002- 16mo</td>
</tr>
<tr>
<td>#003- 19mo</td>
</tr>
<tr>
<td>#004- 21mo</td>
</tr>
<tr>
<td>#005- 22 mo</td>
</tr>
<tr>
<td>#006- 22 mo</td>
</tr>
<tr>
<td>#007- 32 mo</td>
</tr>
<tr>
<td>#008- 34 mo</td>
</tr>
</tbody>
</table>

**Figure 5**

<table>
<thead>
<tr>
<th>Participant ID and Age Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>#009- 37 mo</td>
</tr>
<tr>
<td>#010- 41 mo</td>
</tr>
<tr>
<td>#011- 52 mo</td>
</tr>
<tr>
<td>#012- 62 mo</td>
</tr>
<tr>
<td>#013- 65 mo</td>
</tr>
<tr>
<td>#014- 71 mo</td>
</tr>
</tbody>
</table>
Examination of ratings of individual participants also revealed considerable variation within each participant’s profile. Some participants displayed a relatively flat profile, with ratings on each dimension falling with a 1.5 points of each other. Five participants displayed such profiles, with all five of these participants having BDI-2 ST age equivalents below 36 months (See Figure 6). Children with age equivalents below 36 months were also more likely to be rated low across all dimensions, with four children from this group rated a “4” or lower on all four dimensions.

**Figure 6**

*Ratings by Participant: BDI-2 ST Age Equivalent Under 36 months*

Children with age equivalents above 36 months tended to show more variation in their profiles (See Figure 7). Within this group, the two children with the least variation displayed two points between their lowest and highest ratings, and the child with the most variation displayed 3.3 points between the lowest and highest rating. Children in this group tended to be rated high on Attentional Focus, with all participants rated at least a “4.5” on this dimension. Only one participant from this group was rated a “4” or higher on all four dimensions, and none were rated a “4” or lower across all dimensions.
Figure 7

Ratings by Participant: BDI-2 ST Age Equivalent Over 36 months

Participant ID and Age Equivalent

- #009-37 mo
- #010-41 mo
- #011-52 mo
- #012-62 mo
- #013-65 mo
- #014-71 mo

Legend:
- Blue: Attentional Focus
- Orange: Perceptual Sensitivity
- Yellow: Low Intensity Pleasure
- Green: Inhibitory Control
CHAPTER V: DISCUSSION

This chapter begins with a discussion of the results as they relate to the primary research questions and hypotheses, as well as to previous research. Relevance to the field of school psychology, limitations, and directions for future research are then discussed. Finally, general conclusions are presented.

Discussion of Results

The present project examines temperament in young children with autism through two studies: one using a national dataset and one featuring an exploratory analysis of video-recorded data. Below, the research questions and hypotheses for each study are restated from Chapter 2, along with a discussion of the results in consideration of previous research.

Study 1

Question 1. How do the temperament profiles of young children on the autism spectrum differ from the temperament profiles of neurotypical peers?

Hypothesis. Children with autism will show a temperament profile characterized by significantly lower levels of Surgency/Extraversion and Effortful Control, and higher levels of Negative Affectivity as compared to typical controls.

Results. As hypothesized, results revealed children with autism were rated lower than TD children in terms of Surgency/Extraversion and Effortful Control. The Surgency/Extraversion domain reflects such traits as a preference for risk taking, lack of unease in social situations, and rapid initiation of response (Rothbart et al., 2000). In the present study, children with autism were rated significantly lower on four of the six dimensions within the Surgency/Extraversion domain (i.e., Approach/Positive Anticipation, Activity Level, Smiling/Laughter, and Impulsivity) and higher on one of the six dimensions (i.e., Shyness), indicating overall lower levels of
Surgency/Extraversion. Comparison of ratings of High Intensity Pleasure across ASD and TD children were not statistically significant.

These results suggest that children with autism are broadly less outgoing than typically developing children, and are less likely to demonstrate enthusiasm for novelty. This finding is consistent with previous research examining Surgency/Extraversion between children with autism and typically developing peers (e.g., Adamek et al., 2011; Clifford et al., 2013; Garon et al., 2015). The finding that children with autism demonstrated lower levels of emotional exuberance, less anticipatory excitement toward pleasurable activities, and more hesitance to approach novel and/or challenging situations, was also consistent with previous research (e.g., Bailey Jr., Hatton, Mesibov, Ament, & Skinner, 2000; Hepburn & Stone, 2006). It is also consistent anecdotal clinical knowledge about children with autism, who are seen as resistant to change, less socially interested, and less emotional than typically developing peers.

In terms of Effortful Control, defined by Rothbart and Rueda (2005) as “the ability to inhibit a dominant response to perform a subdominant response, to detect errors, and to engage in planning,” (p. 3) significant differences were revealed across all CBQ-Short factors. Children with ASD were rated significantly lower on the Inhibitory Control dimension, indicating weaknesses in executive functioning. Specifically, the lower rating on this dimension suggests that children in the ASD group are less likely to inhibit inappropriate responses and more likely to have difficulty with planning and compliance with instructions than typically developing children. Inhibitory control requires a high level of socialization, as children learn to inhibit impulses and comply with demands from adults (Kochanska et al., 1996). Social difficulties, including difficulties understanding social cues, are a key component of the autism diagnostic
criteria, making this finding unsurprising. It is also consistent with previous research revealing similar temperament patterns among children aged 3-10 years (Konstantareas & Stewart, 2006).

Children with autism were also rated lower than typical controls in terms of Attentional Focusing, indicating weaknesses maintaining attention that are consistent with earlier studies (e.g., Konstantareas & Stewart, 2006; Landry, 2000). Lower ratings on the Low Intensity Pleasure dimension were found as well, suggesting that children with autism derive less pleasure from activities that are low in stimulus intensity, rate, complexity, and novelty than typical controls. Given that children with autism display lower levels of Smiling/Laughter, and restricted affectivity is considered part of the DSM-5 diagnostic criteria for autism, this finding is unsurprising. However, research on this factor is extremely limited and no studies supporting this finding specifically were found.

Significant differences in Perceptual Sensitivity were found as well. This finding stands in contrast to a 2013 study by Clifford and colleagues, which revealed increased Perceptual Sensitivity among high risk infants who were later diagnosed with autism at 3 years of age. A 2006 study by Konstantareas and Stewart supports the finding of lower levels of Perceptual Sensitivity in children with autism aged 3-8. Rothbart and colleagues postulated that although temperament is largely stable, it is a developmental construct affected by cognition and environmental influences as children age (Rothbart & Bates, 2006). It is possible that Perceptual Sensitivity may be higher for children with autism in infancy and lower once they reach early childhood, though additional research is necessary to test this hypothesis.

It was also hypothesized that children with autism would display higher levels of Negative Affectivity compared with typical controls, as previous studies have demonstrated this relationship (Adamek et al., 2011). However, this hypothesis was not supported by Study 1, with
results revealing a significant difference only for Falling Reactivity/Soothability. Other studies have also demonstrated lower levels of Falling Reactivity/Soothability among children with autism, making this finding consistent with previous research (Konstantareas & Stewart, 2006).

**Question 2.** Is the intellectual functioning of children with autism associated with their temperament profile?

**Hypothesis.** Intellectual functioning will influence variation within the phenotype, with children with lower cognitive scores displaying a temperament profile characterized by significantly lower levels of Surgency/Extraversion and Effortful Control, and higher levels of Negative Affectivity, as compared to children with higher cognitive scores.

**Results.** This question was not directly tested due to insufficient power. However, the autism sample in the study was largely low functioning, with MSEL scores falling well below age expectations. Visual inspection of histograms of ratings along each dimension revealed considerable variation in ratings among children with autism, suggesting that substantial variability exists despite the relative intellectual homogeneity of the sample. This finding suggests that children with autism do not fall neatly into temperament classifications based on intellectual functioning. This finding counters common thinking in which children with autism are often arbitrarily subtyped based on intellectual functioning. Although intellectual functioning certainly plays a role in presentation, it alone does not adequately capture the variability of the autism phenotype.

However, a relationship between intellectual functioning and temperament likely does exist. Within the context of Study 2, children with lower BDI-2 ST age equivalents were often rated lower and flatter across dimensions of Effortful Control than children with higher age equivalents. This finding supports the hypothesis that children with autism and lower intellectual
functioning display a temperament profile characterized by lower levels of Effortful Control. Additional research is needed to examine the relationship between intellectual functioning and Negative Affectivity and Surgency/Extraversion among children with autism, and all domains should be further examined using a larger sample of children as well as a combination of validated temperament measures such as the CBQ-Short, observational data, and laboratory studies.

**Study 2**

**Question 1.** Does observation of child behavior during natural play with a familiar caregiver reveal measureable patterns within the Effortful Control domain (i.e., the dimensions of Attentional Focusing, Perceptual Sensitivity, Low Intensity Pleasure, and Inhibitory Control)?

**Hypothesis.** Yes, natural play will provide the opportunity for measurement of patterns of behavioral and emotional signs of all four dimensions of Effortful Control. Some dimensions will be easier to observe and to measure than others, and pattern analysis may be limited by infrequent observations of behaviors associated with certain dimensions.

**Results.** Results suggested that temperament, specifically within the Effortful Control domain, was detectable and measureable through video-recorded observations of children engaged in natural play with a familiar caregiver. A coding scheme was developed based on the empirically validated CBQ-Short, and coders were trained to reliability as described earlier in this report. Based on conceptual similarities between the definitions of the factors in the CBQ-Short and the coding system developed for this study, the coding system demonstrated face validity. Construct and content validity were not directly assessed, though the coding system’s basis in temperament research and development based on the CBQ-Short suggests that the
system measures the underlying theoretical constructs of Effortful Control, and that the scale points accurately represent the content they are intended to assess.

The factors of Attentional Focusing and Inhibitory Control were generally readily observable, as children tended to display overt behaviors that could more directly be attributed to these factors. Low Intensity Pleasure and Perceptual Sensitivity were somewhat more difficult to measure. Children displayed Low Intensity Pleasure through affective cues such as smiling and laughter, though there was little opportunity to observe or measure other indicators of pleasure (i.e., physiological reactions, subjective self-report). Perceptual Sensitivity was particularly challenging to measure, as environmental differences made opportunities to respond to low intensity stimuli inconsistent across children.

**Question 2.** What do any observable patterns in Effortful Control reveal about the temperament of children with autism?

**Hypothesis.** Significant variability will be detected among children with autism. Intellectual ability will significantly influence variation within the phenotype, with children with lower cognitive functioning displaying a temperament profile characterized by lower levels of Effortful Control.

**Results.** Consistent with the hypothesis, results reveal considerable variability in Effortful Control within the autism phenotype. Few studies have examined within group differences. A 2009 study by Schwartz and colleagues examined temperament in high functioning adolescents with autism, finding within group variability across temperament domains. A 2011 study by Adamek and colleagues investigated individual differences among children with autism aged 3-8 years, again finding considerable variability. Few, if any, other studies have examined these differences empirically, though they have important implications for both diagnostic subtyping
and treatment. Ademek and colleagues (2011) discussed the importance of temperament considerations and the dangers of diagnostic overshadowing, in which individual differences are neglected because of the presence of an autism diagnosis. Their study highlighted temperament factors as predictors of problem behaviors, finding that high Surgency, low Effortful Control, and high Negative Affectivity were all linked to problem behaviors in children with autism. Further, the study by Schwartz and colleagues (2009) linked self-report of higher levels of Effortful Control to lower levels of repetitive behaviors, atypicality (i.e., engaging in behaviors considered odd or unusual, appearing disconnected from one’s surroundings), withdrawal, and internalizing and externalizing symptoms. The present study supports these previous researchers’ assertions that temperamental variability is present within the autism diagnostic classification, and that temperamental differences are not adequately captured through diagnosis-related domains. However, given the small sample size of the present study, further research is needed to confirm this finding.

Relevance to Field of School Psychology

The present project is primarily an exploratory study of temperament in autism. Studies like this one are usually considered more closely related to the field of Developmental Psychopathology than to School Psychology. Many school psychologists may not see a project of this nature as particularly relevant to research and practice in the field. Despite its differences from traditional School Psychology research, however, the present project does offer important insight for those who provide psychological services in schools and/or conduct research with children with developmental disabilities in schools.

According to the National Center for Education Statistics, children with an IDEA disability classification of autism comprised 8% of the 6.5 million children who received special
education services in the United States in 2013-2014 (U.S. Department of Education, Institute of Education Sciences, 2016). Realistically, every school psychologist will be tasked with serving a child on the spectrum at some point in his/her career, and many serve several students with autism daily. Recognition of the role of temperament in the presentation of children with autism has important ramifications for treatment and research. The present project revealed considerable variability in temperament within the autism phenotype, supporting what many service providers have long recognized anecdotally. Despite this recognition, service providers continue to operate under a model in which these individual differences are only considered superficially, if at all. Professional associations such as the National Association of School Psychologists (NASP) recommend the use of Evidence Based Practices, which are established upon empirical evidence. However, intervention studies that specifically target children with autism have not examined the role of temperament in response to treatment, despite evidence that individual differences influence outcomes. As the field of School Psychology advances, increased attention to individual differences would help school psychologists to better understand and serve their students.

Limitations

Limitations for each study are discussed separately, below.

Study 1

Study 1 was limited by a relatively small sample size and a fairly homogenous participant group, particularly in terms of intellectual functioning. The total sample size was 89, with 52 children with autism (42 males) and 35 typically developing controls (20 males). The autism sample was largely male, limiting the generalizability of the results to females. Further, the children in the ASD sample scored considerably lower on the MSEL than their typically
developing peers. Thus, the extent to which differences between groups are attributable to differences in intellectual functioning is unclear. Further, given the small sample size and limited number of children with ASD scoring within the Average range on the MSEL, low statistical power prevented sub-analyses based on developmental level. Age of diagnosis, ADOS-2 algorithm scores, scores on measures of adaptive functioning, services received, and other information related to diagnosis and intervention would also have been useful ways to classify children. The findings support exploring these sub-analyses with larger representative samples.

In addition, several demographic variables may have confounded the results. Information such as family socioeconomic status, parental age, and family structure was unavailable. In addition, although the racial/ethnic makeup of the sample was diverse, it was not nationally representative. Additional research with a more racially and ethnically representative sample of children would provide additional insight into the temperament of children with autism.

**Study 2**

Study 2 was conducted with existing video-recorded observations from a separate study examining play development in children with and without disabilities. Data collection was not specifically designed with measurement of temperament in mind, which limited data collection in several ways. The video-recorded observations represent only a small snapshot of each examined child’s temperament, collected on a single day and time. Caregiver completion of the CBQ-Short was not possible retroactively, and so no validated comparison instrument was used to establish the content validity of the coding scheme or to supplement the video-recorded data. The qualitative nature of the coding scheme also makes it susceptible to measurement errors, despite the establishment of interrater reliability. The scheme was developed by a single
researcher, and although it was based on the work of Rothbart and colleagues, it should be vetted by experts in the field for content validity.

Further, video-recorded observations were collected via natural observation within the child’s home. Although there are several benefits to conducting this type of research in an environment familiar to the child, the environment was difficult to control. In some instances, children were exposed to a variety of distractors (i.e., siblings playing in the background, phones ringing, availability of non-study toys nearby, etc.), while other children were observed in a quieter environment with fewer distractions. The free play scenario also did not involve any experimental components that could have been incorporated to elicit certain behaviors or reactions related to temperament. For example, the introduction of unfamiliar soft noises in the background could have been used to elicit reactions related to Perceptual Sensitivity.

Implications for Future Research

The present project serves as a pilot investigation of individual differences in temperament between children with autism and typical controls, and within the autism phenotype. Additional research is needed to establish the presence and nature of these differences among a larger, more representative sample of children using a variety of additional measures to control for potential confounds. A large-scale project examining temperament within the autism phenotype would be particularly useful, as research in this area is especially lacking. Comparing groups based upon intellectual functioning and symptom severity among other factors would likely reveal more robust trends between groups. These within group differences could ultimately inform diagnostic subtyping. Ideally, a large enough sample would be collected to allow for advanced statistical analysis using methods such as Factor Analysis. This type of analysis could uncover subtypes that the present analysis was unable to capture. Additional
studies of high-risk siblings are also warranted, as children who go on to develop autism have been shown to demonstrate early differences in temperament (Garon et al., 2015; Zwaigenbaum et al., 2005; Zwaigenbaum et al., 2015).

Additional observational and experimental studies of temperament are merited as well. Conducting an additional mixed-methods study with a larger sample size that uses a combination of naturalistic observation, experimental methods (i.e., standardized environmental triggers for dimensions such as Perceptual Sensitivity and Low Intensity Pleasure), and parent report measures would be valuable. Studies that seek to validate observational methods of measuring temperament are of value as well, as few researchers have used such methodology in the past. Longitudinal data collection that uses these techniques to examine temperament overtime and within an at-risk sample would also provide additional insight into both temperament and its measurement.

In addition to further exploration of between and within group differences in temperament, an entire line of research examining the role of temperament in treatment outcomes is justified. Previous research has shown that temperament influences response to interventions for a variety of disorders, but little research has examined it within the context of autism. Given the growing emphasis on use of Evidence Based and Evidence Informed practices, clinicians serving clients with autism would benefit from research considering temperament in inclusion criteria and/or discussion of intervention and outcomes.

Conclusions

The present project provides an additional portal for insight into the individual differences in temperament present in young children with autism. Several key findings emerged. Significant differences were observed across a variety of temperament factors, most notably
within the Surgency/Extraversion and Effortful Control domains. These findings suggest that children with autism are less likely to approach new situations with exuberance, to express positive emotions, and to display underlying traits linked to the development of self-regulation (i.e., attentional focusing, inhibitory control). Some of the temperament dimensions emerging as statistically significant are conceptually linked in part to diagnostic criteria (i.e., Shyness, Smiling/Laughter, Approach/Positive Anticipation, Falling Reactivity/Soothability, Perceptual Sensitivity), while others are not (i.e., Attentional Focusing, Impulsivity, Inhibitory Control). This suggests that temperamental variability exists beyond behavioral symptom-based diagnosis-related traits.

The project also found considerable variability in the temperament profiles of children with delays in cognition, suggesting no clear subtypes based solely on intellectual functioning. Children with lower cognitive scores tended to show profiles with more variability than typical peers when measured via the CBQ-Short. Small scale video analysis of Effortful Control factors revealed that children with lower cognitive scores tended to display relatively flatter profiles and lower ratings across measured factors. This finding suggests that intellectual functioning may have some predictive power, but is not sufficient on its own for subtyping. Though intellectual functioning may be related to temperament difference, it does not serve as a proxy for it. Additional research would help to clarify the relationship between intellectual functioning and temperament, and may prove useful in diagnostic subtyping.

The primary goal of this project was to provide additional empirical support for the existence of temperamental variation between children with autism and typical controls, and within the autism phenotype. Though the autism community knows that these differences exist, this assumption lacks empirical evidence and is highly understudied. The present results serve
primarily as a basic examination and pilot for future research, and support the notion that temperamental variation exists and is important among this population. Anecdotally, the consensus among researchers and service providers within the autism community is that each child on the spectrum displays a unique temperamental presentation in both diagnosis and non-diagnosis related domains. However, few researchers are taking these differences into account in descriptive or intervention studies. According to the modifier model of autism, individual differences interact with autism to contribute to developmental, behavioral, and psychological differences (Mundy et al., 2007). These individual differences include temperament, and have important implications for treatment suitability and outcomes. Because of lack of attention to these differences, we are left with an incomplete view of autism, and an emerging set of Evidence Based Practices that do not account for individual differences that may affect response to treatment.

It is hoped that dissemination of the results of the present study will encourage further interest in the examination of temperament as it relates to autism. Such study has practical implications for early diagnosis, diagnostic subtyping, and treatment. Many within the autism community are unhappy with the current diagnostic criteria delineated by the DSM-5, as they feel that the system fails to capture the variability inherent within the autism population. This lack of attention to variability means that service providers gain limited practical insight into a child’s presentation and therapeutic needs from an autism diagnosis. As the primary purpose of diagnosis is to inform treatment, a diagnostic system that does little to capture an individual’s presentation does little to further this purpose. It also limits the effectiveness of researchers, who often recruit study participants based on diagnosis and rarely account for individual differences in their inclusion criteria beyond intellectual functioning and comorbidities. Temperament is
important as it relates to autism, though we will only know how important through additional research. It is hoped that this project contributes to interest in this topic, as it could trigger major changes in the way autism is studied, diagnosed, and treated.
References


Corchs, F., Corregiari, F., Ferrao, Y. A., Takakura, T., Mathis, M. E., Lopes, A. C., … Bernik,


http://doi.org/10.1016/j.paid.2015.03.001


http://doi.org/10.1001/jamapsychiatry.2013.3893


http://doi.org/10.1002/9780470720714.ch10


Valiente, C., Swanson, J., & Lemery-Chalfant, K. (2012). Kindergartners’ Temperament, Classroom Engagement, and Student-teacher Relationship: Moderation by Effortful


http://doi.org/10.1016/j.ijdevneu.2004.05.001
Appendix A

Effortful Control Coding Manual

Attentional Focusing: Tendency to maintain attentional focus upon task-related channels.

- Key Questions:
  
  o How long does the child stay focused on a particular toy or task?
  
  o Does he or she move quickly from one toy or task to another, or stay focused on one toy or task for an extended period of time?

- Notes:
  
  o Note that time spent attending to the toys should be used to help approximate attentional level, and should be used in conjunction with other qualitative information to make a final rating. Quality of play is not important, though perseverative play and complex play, respectively, may be associated with higher levels of attentional focusing.

- Ratings:

1. Child maintains virtually no attention to or engagement with the toys. The child may wander around the room and spend significant time off camera, not responding to bids for redirection. The child is easily distracted by environmental stimuli and has marked difficulty returning to the task following such distraction, if he/she returns at all.

2. The child maintains very minimal attention to or engagement with the toys. Interactions with each toy are typically very short, lasting less than 10 seconds each. The child is easily distracted by environmental stimuli and has difficulty returning to the task following such distractions.
3. The child maintains some attention to the toys, though attention is often fleeting. Interactions with toys tends to last less than 15 seconds per instance, although the child may perseverate on one toy for a longer period time. The child attends to the play session for at least 30-45% (5-7.5 minutes) of the 15-minute session. The child may be distracted by environmental stimuli and have difficulty returning to the task.

4. The child maintains a moderate amount of attention to the play session, shifting between periods of engagement and non-engagement. Interactions with toys tend to be longer in duration (i.e., more than 15 seconds at a time). The child attends to the play session for 45-60% (7.5-9 minutes) of the 15-minute session. The child may shift abruptly between toys and themes. The child may become distracted by environmental stimuli, but is able to return to the task with some redirection.

5. The child attends to the toys more often than not throughout the session, spending more than 60% of the session attending to the toys. The child’s play is characterized by several interactions with toys that last more than 10-15 seconds, and the child does not demonstrate a marked tendency to shift abruptly between toys or themes. The child may become distracted by environmental stimuli, but is able to focus again with minimal redirection.

6. The child spends a substantial portion of the session (i.e., 75-90%; 11-12.5 minutes) attending to the toys and the play session. The child’s play with toys is characterized by continuity (e.g., spending substantial time devoted to the same toys or themes), and not by rapid or abrupt shifts between toys or themes. The child is generally able to maintain focus despite environmental distractions, and, if distracted, is able to regain focus without prompts.
7. The child spends nearly all of the session (90-100% of the time; 13-15 minutes) attending to the toys and the play session. A high level of focus is evident, and that focus may be difficult to break. The child is rarely, if ever, distracted by environmental stimuli, and is able to immediate redirect him/herself when distractions do occur. The child spends substantial time attending to the same toys and/or themes.

**Perceptual Sensitivity:** Detection of slight, low-intensity stimuli from the external environment.

- **Key Questions:**
  - How in-tune is the child with the environment? Does the child become distracted by noises, sounds, or activities going on in the background (i.e., does the child notice the sounds of cars passing by, a sibling or pet in the corner of the room, planes passing over head)?
  - Does the child notice and/or comment on low-intensity stimuli like the sound the car wheels make when the car is pushed?
  - Is the child in-tune with subtle caregiver or researcher actions? Does the child notice when the caregiver or researcher is manipulating objects without directly engaging the child?

- **Notes:**
  - The stimuli must be low intensity (e.g., loud sirens outside the home, loud noises or crying from another child in the home, a dog barking in the immediate vicinity, etc. do not count)
- Opportunities to respond to low level stimuli will vary significantly from environment to environment, and differences in the environment should be considered when establishing ratings.

- Sensory stimuli can include sounds, visual details, tactile sensations (such as noticing the feeling of clothing tags or the surface of toys), etc.

- Ratings:

  1. Child has little to no observable reaction to low level stimuli (reacts to 0-1 instance). The child does not comment on soft but noticeable sounds in the environment, and does not notice indirect caregiver or researcher bids for attention (e.g., does not notice when the caregiver puts a toy close to the child to encourage the child to interact with it). The child does not notice when pets, siblings, or others walk by.

  2. The child has minimal reactions to low level stimuli. The child may look up if he or she hears or sees something, but does not react to the majority of soft but noticeable sounds, caregiver or researcher actions, or other potentially distracting stimuli.

  3. The child has some reaction to low level stimuli. The child may look up if he or she hears or sees something, but reacts to less than half of soft but noticeable sounds, caregiver or researcher actions, or other potentially distracting stimuli.

  4. The child is moderately in tune with low level stimuli. The child reacts to approximately half of the low level stimuli in the environment, such as soft but noticeable sounds, caregiver or researcher actions, or other potentially distracting stimuli.
5. The child reacts to low level stimuli more than half of the time. The child may occasionally comment on the stimuli, but does not perseverate on it. The child’s focus is not significantly impacted by the stimuli.

6. The child reacts to low level stimuli the majority of the time. The child may comment and/or perseverate on the stimuli, and may have some difficulty maintaining task-related focus because of it.

7. The child notices and reacts to low level stimuli that most people would ignore (e.g., sounds like ticking clocks). The child has noticeable difficulty maintaining task-related focus because he/she is distracted by low level stimuli. The child may frequently comment on the stimuli and have a difficult time ignoring it.

**Low Intensity Pleasure:** Amount of pleasure or enjoyment related to situations involving low stimulus intensity, rate, complexity, novelty and incongruity.

- **Key Questions:**
  - How much pleasure does the child appear to derive from the DPA session?
  - How positive is the child’s affect?
  - Does the child appear engaged (a sign of pleasure) or disinterested?

- **Notes:**
  - The DPA is primarily composed of low intensity stimuli--the toys are simple and are not self-animated (i.e., they don’t make noise or move on their own)
  - Flat affect for the majority of the session contributes to a lower score

- **Ratings:**
1. The child appears bored, disinterested, or flat for the entire session, and displays no observable task-related positive affect (e.g., smiling in response to stimuli, commenting that something is cool or interesting, or playing with/manipulating a toy in a way that suggests interest or enjoyment).

2. The child appears bored, disinterested, or flat for the majority of the session, but does display one to two episodes of observable task-related positive affect (e.g., smiling in response to stimuli, commenting that something is cool or interesting, or playing with/manipulating a toy in a way that suggests interest or enjoyment). Signs of enjoyment are subtle and rarely, if ever, overt (i.e., big smiles, laughter).

3. The child may appear bored, disinterested, or flat for part of the session, but displays multiple instances of observable task-related positive affect or enjoyment (e.g., smiling in response to stimuli, commenting that something is cool or interesting, or playing with/manipulating a toy in a way that suggests interest or enjoyment). These episodes are confined to less than half the session, and are generally subtle (e.g., generally not characterized by big smiles or laughter).

4. The child displays positive affect and/or signs of task-related enjoyment (e.g., smiling in response to stimuli, commenting that something is cool or interesting, or playing with/manipulating a toy in a way that suggests interest or enjoyment). The child occasionally displays overt signs of enjoyment such as smiling and laughter.

5. The child displays positive affect and/or signs of task-related enjoyment (e.g., smiling in response to stimuli, commenting that something is cool or interesting, or playing with/manipulating a toy in a way that suggests interest or enjoyment) for roughly two
thirds of the session. At least one instance of prolonged smiling or other overt signs of positive affect (e.g., laughter) occurs.

6. The child displays positive affect and/or signs of task-related enjoyment (e.g., smiling in response to stimuli, commenting that something is cool or interesting, or playing with/manipulating a toy in a way that suggests interest or enjoyment) for a majority of the session (more than two-thirds). The child’s affect is more obviously positive.

7. The child displays positive affect and/or signs of task-related enjoyment (e.g., smiling in response to stimuli, commenting that something is cool or interesting, or playing with/manipulating a toy in a way that suggests interest or enjoyment) for virtually the entire session. The child does not appear bored or disinterested at any discernible point during the session. Overt signs of enjoyment (e.g., smiling, laughter) occur regularly.

**Inhibitory Control:** The capacity to plan and to suppress inappropriate approach responses under instructions or in novel or uncertain situations. This includes aspects of emotional control.

- Key questions:
  - Is the child quick to jump into each toy set, or does the child appear more inhibited?
  - Does the child attempt to take toys from the caregiver or researcher at inappropriate times (e.g., does the child try take things out of the researcher’s bag, or take toys out of the caregiver’s hands while the caregiver is working with those toys)?
Does the child wonder off in the middle of a toy set? Does the child attempt to bring their own toys into the session? How well does the child respond to redirection?

Notes:
- A rating of 1 indicates very low levels of inhibition, and a 7 indicates high levels

Ratings:
1. The child displays a high level of impulsive behavior throughout the session, displaying several of the following impulsive behaviors:
   a. The child approaches the toys very quickly, often before the examiner has a chance to take them out of the bag.
   b. The child may attempt to take the toys out of the bag him or herself, or may attempt to go through the larger bag to find other toys.
   c. If the child attempts problem solving tasks such as putting together the puzzle, building with the tinker toys, or nesting the cups, he or she does so haphazardly or through trial and error rather than thoughtful planning.
   d. The child may abruptly get up and leave the blanket in the middle of a toy set, or may suddenly declare him or herself finished with the current toys and ask for new toy set.
   e. The child does not respond well to redirection, continuing to do as he or she pleases when corrected by the researcher or caregiver.
   f. The child may have an emotional outburst that impedes the assessment. The impulsivity impedes the child’s ability to engage with the toys in a meaningful
manner (e.g., the child is unable to stay on task and generates few code-able
play activities).

The child shows virtually no discernible signs of inhibition (e.g., being able to
wait for new toys, thoughtful planning, staying seated, following through on
themes or toy-related tasks, approaching cautiously, etc.)

2. The child displays several of the impulsive characteristics described as qualifying for
a score of “1,” and the impulsivity impedes the child’s ability to engage in the toys in
a meaningful manner (e.g., the child is unable to stay on task and generates few code-
able play activities). However, the child is able to engage meaningfully in the session
for at least a few minutes. The child may respond to redirection, but frequent prompts
are necessary. The child may display one or two signs of inhibition (e.g., being able
to wait for new toys, thoughtful planning, staying seated, following through on
themes or toy-related tasks, approaching cautiously, etc.), but these signs are not
characteristic of the child’s behavior.

3. The child displays at least 1-2 of the impulsive characteristics described as qualifying
for a score of “1,” but the child is able to engage meaningfully in the session for at
least a quarter of the session. The child displays at least one sign of inhibition (e.g.,
being able to wait for new toys, thoughtful planning, staying seated, following
through on themes or toy-related tasks, approaching cautiously, etc.), but these signs
are not characteristic of the child’s behavior.

4. The child displays at least 1-2 of the impulsive characteristics described as qualifying
for a score of “1,” but the child is able to engage meaningfully in the session for
approximately half of the session. Occasional redirection may be necessary, and the
child typical responds to such redirection. The child displays two to three signs of inhibition (e.g., being able to wait for new toys, thoughtful planning, staying seated, following through on themes or toy-related tasks, approaching cautiously, etc.).

5. The child displays at least 1-2 of the impulsive characteristics described as qualifying for a score of “1,” but requires few prompts for redirection. In addition, the child shows at least two to three clear signs of inhibition (e.g., being able to wait for new toys, thoughtful planning, staying seated, following through on themes or toy-related tasks, approaching cautiously, etc.). The child generally appears behaviorally and emotionally regulated.

6. The child displays one or less of the impulsive characteristics described as qualifying for a score of “1,” and requires few, if any, prompts for redirection due to impulsive behavior. In addition, the child shows at least two to three clear signs of inhibition (e.g., being able to wait for new toys, thoughtful planning, staying seated, following through on themes or toy-related tasks, approaching cautiously, etc.). The child generally appears behaviorally and emotionally regulated, but may also appear overly cautious (i.e., is hesitant to touch the toys, seems uncomfortable with the situation).

7. The child displays none of the impulsive characteristics described as qualifying for a score of “1,” and requires no prompts for redirection due to impulsive behavior. In addition, the child shows at least two to three clear signs of inhibition (e.g., being able to wait for new toys, thoughtful planning, staying seated, following through on themes or toy-related tasks, approaching cautiously, etc.). The child generally appears behaviorally and emotionally regulated, but shows clear signs of overly cautious behavior (i.e., is hesitant to touch the toys, seems uncomfortable with the situation).
Notification of IRB Action

Date: November 19, 2015  IRB #: 15-11-12
Principal Investigator(s): Emanuel Mason
Department: Applied Psychology
Address: 404 International Village
Northwestern University
Title of Project: Individual Differences and Temperament in Children Who Display Autism Symptomatology
Participating Sites: NIMH - approval forthcoming
Informed Consent: N/A
DHHS Review Category: Expedited #5
Monitoring Interval: 12 months

APPROVAL EXPIRATION DATE: NOVEMBER 18, 2016

Investigator’s Responsibilities:

1. Informed consent form bearing the IRB approval stamp must be used when recruiting participants into the study.
2. The investigator must notify IRB immediately of unexpected adverse reactions, or new information that may alter our perception of the benefit-risk ratio.
3. Study procedures and files are subject to audit any time.
4. Any modifications of the protocol or the informed consent as the study progresses must be reviewed and approved by this committee prior to being instituted.
5. Continuing Review Approval for the proposal should be requested at least one month prior to the expiration date above.
6. This approval applies to the protection of human subjects only. It does not apply to any other university approvals that may be necessary.

C. Randall Colvin, Ph.D., Chair
Northeastern University Institutional Review Board

Nan C. Regins, Director
Human Subject Research Protection

Northeastern University FWA #: 4630
NOTIFICATION OF IRB ACTION
RENEWAL APPROVAL

Date: November 3, 2016    IRB #: 15-11-12
Principal Investigator(s): Emmanuel Mason
                        Karalyyn Verrucci
Department: Applied Psychology
            Bouvé College of Health Sciences
Address: 404 International Village
          Northeastern University
Title of Project: Individual Differences and Temperament in Children who
Display Autism Symptomatology
Approval Status: Ongoing Data Analysis
Participating Sites: NIMH/NIH National Database for Autism Research – approval on file
Original Protocol Approved: November 19, 2015
DHHS Review Category: Expedited #5
Informed Consents: N/A
Monitoring Interval: 12 months

APPROVAL EXPIRATION DATE: NOVEMBER 2, 2017

Investigator’s Responsibilities:
1. The informed consent form bearing the IRB approval stamp must be used when recruiting
   participants into the study.
2. The investigator must notify IRB immediately of unexpected adverse reactions, or new
   information that may alter our perception of the benefit-risk ratio.
3. Study procedures and files are subject to audit any time.
4. Any modifications of the protocol or the informed consent as the study progresses must be
   reviewed and approved by this committee prior to being instituted.
5. Continuing Review Approval for the proposal should be requested at least one month prior to the
   expiration date above.
6. This approval applies to the protection of human subjects only. It does not apply to any other
   university approvals that may be necessary.

C. Randall Colvin, Ph.D., Chair
Northeastern University Institutional Review Board

Nan C. Regina, Director
Human Subject Research Protection

Northeastern University FWA #4630
EDUCATION

Northeastern University, Boston, MA  
**Doctor of Philosophy**, School Psychology, September 2011- May 2017 (Anticipated)

Northeastern University, Boston, MA  

Northeastern University, Boston, MA  
**Master of Science**, Applied Educational Psychology, August 2012

University of Miami, Coral Gables, FL  
**Bachelor of Arts**, Psychology, May 2009  
*Summa Cum Laude*  
Minors: Family and Human Services, Political Science

CLINICAL AND PROFESSIONAL EXPERIENCE

**Clinical Psychology Intern, Neurodevelopmental Disorders Track (APA Accredited Internship)**  
*University of New Mexico Health Sciences Center*, Albuquerque, NM (July 2016-Present)

— Conduct ADOS-2, cognitive evaluations, and clinical interviews as part of an interdisciplinary team specializing in differential diagnosis of autism spectrum disorders in children ages 3-18  
— Write comprehensive evaluation reports communicating complex diagnoses  
— Conduct individual and family psychotherapy with children and adolescents with a variety of significant psychiatric concerns, including PTSD, psychosis, suicidality, anxiety, and depression  
— Conduct group therapy using the *Facing Your Fears* model to address anxiety in children with autism  
— Provide in-home, behavioral parent training to families of children diagnosed with autism under age 5

**School Psychologist**  
*ACCEPT Education Collaborative*, Natick, MA (September 2015-June 2016)

— Conducted group and individual therapy sessions with students with a variety of presenting concerns, including depression, trauma, anxiety, and social skills deficits using CBT/DBT techniques  
— Conducted comprehensive evaluations of children and young adults with significant social/emotional difficulties and prepare integrated assessment reports  
— Served as a member of the special education team including developing interventions, presenting at IEP meetings, and formulating treatment goals  
— Developed, implemented, and monitored interventions for children and young adults with social/emotional needs

**Graduate Extern, Neuropsychology**  
*Metrowest Neuropsychology, LLC*, Westborough, MA (September 2015-June 2016)  
Supervisors: Stacy B. Horner, PhD; Jeffrey J. Gaines, PhD, ABPP-CN

— Conducted and interpret a variety of neuropsychological, cognitive, academic, behavioral, and social/emotional assessments on children and young adults with a variety of presenting concerns  
— Delivered assessment feedback to children and families and counseled children and families in regard to diagnoses and treatment planning
Graduate Extern, School Psychology
Zervas Elementary School (K-5), Newton, MA (Sept 2014-June 2015)
Supervisor: Lindsey Hogan, PhD, NCSP

— Conducted group and individual weekly counseling with students with a variety of social/emotional needs using cognitive-behavioral techniques
— Developed and conducted a classwide bullying prevention program focused on relational aggression
— Conducted and interpreted a variety of cognitive, behavioral, and social/emotional assessments
— Served as a member of the special education and student support teams, team, including presenting evaluation results at IEP meetings, formulating IEP goals based on assessment results, and developing interventions
— Consulted with teachers and other staff to help address a variety of social/emotional and academic needs

Graduate Extern, Pediatric Neuropsychology
Tufts Floating Hospital for Children, Boston, MA (Sept 2013-August 2014)
Supervisors: Jenifer Walkowiak, PhD; Laurel Leslie, MD, MPH

— Conducted and interpreted a variety of neuropsychological, cognitive, academic, behavioral, and social/emotional assessments on children from 6-20 years of age and wrote comprehensive, integrated reports
— Wrote comprehensive, integrated reports including diagnostic formulation and treatment recommendations
— Worked as part of an interdisciplinary team within the department of developmental behavioral pediatrics to assess children and formulate diagnoses and recommendations
— Delivered assessment feedback to children and families and counseled children and families in regard to diagnoses and treatment planning
— Assisted in the supervision and training of medical residents and fellows rotating through the CCSN

Practicum Student, School Psychology
Edward Devotion School (K-8), Brookline, MA (September 2012-June 2013)
Supervisor: Bob Babigian, MS/CAGS, NCSP

— Conducted and interpreted a variety of cognitive, academic, behavioral, and social/emotional assessments and wrote comprehensive reports
— Contributed to the formulation of Individualized Education Programs
— Consulted with teachers and other staff to help them better address the needs of students with special needs
— Provided individual weekly individual and group counseling to several students with a variety of social/emotional needs
— Contributed to the development of crisis intervention plans

Group Leader, Aspire Summer Program
Massachusetts General Hospital, Boston, MA (June-August 2013)

— Lead a group of six and seven-year-old children with Autism Spectrum Disorders and related disabilities through a therapeutic summer camp experience
— Developed individualized goals and supports for campers
— Utilized Social Thinking-based tools to teach social and emotional skills and understanding
— Supervised and mentored undergraduate assistant group leader
— Maintained a consultative relationship with parents of campers

RESEARCH EXPERIENCE

Stipended Graduate Research Assistant w/Tuition Remission
Northeastern University, Boston, MA (September 2011-August 2015)

• Project Play, PIs: Karin Lifter, PhD; Emmanuel Mason, EdD; & Takuya Minami, PhD
— Project Play is an Institute for Education Sciences-funded project examining the object play of young children ages 8 months to 5 years with and without disabilities. Goals include validation of the Developmental Play Assessment (Lifter, 2000) and the developmental sequence of play
— Administered the Battelle Developmental Inventory II—Screening Test (BDI-2 ST), Developmental Play Assessment (DPA), and Vineland II Adaptive Behavior Scales, Second Edition (VABS-II) to over 150 children
— Prepared poster and paper presentations for national conferences and events, and prepare manuscripts for publication
— Coded and entered data

• Analysis of the Psychological Effects of Poverty, PI: Emanuel Mason, EdD

— The main objective of the poverty research team is to utilize population representative datasets from private and governmental agency sources to examine the ecological and environmental factors related to poverty and their effects on academic performance, aspirations, social adjustment, careers, and lifespan adjustment
— Used data mining techniques to examine a large, nationally representative sample
— Developed and tested hypotheses about the effects of poverty on social/emotional adjustment and academic performance
— Prepared poster presentations for national conferences and manuscripts for publication

Research Assistant I
Kennedy Krieger Institute, Center for Autism and Related Disorders, Baltimore, MD (June 2009-July 2011)

• Study to Explore Early Development (SEED), Site Co-PIs: Rebecca Landa, PhD, CCC-SLP; Daniele Fallin, PhD

— SEED was a Centers for Disease Control funded national epidemiological study of autism risk factors and potential causes
— Worked directly with young children with autism, typically developing children, and children with other neurodevelopmental disabilities during each family’s visit to the clinic (ages 3-5)
— Developed new systems of managing data both electronically and in paper form
— Assisted with blood draws on young children
— Processed and packed biological samples for shipment

• Autism: Social and Communication Predictors in Siblings, PI: Rebecca Landa, PhD, CCC-SLP

— This federally funded project examined social and communicative factors predictive of later autism diagnosis among a group of at-risk children (i.e., those with an older sibling with autism)
— Coded imitation tasks and maintained reliability with other coders
— Conducted literature reviews and assisted in manuscript and grant development

• Study of Peer Relationships in Schools, PI: Connie Kasari, PhD (UCLA)

— This federally funded study examined the effect of the ENGAGE model of group therapy with children with autism. ENGAGE is designed to enrich the social development of the child with autism through engagement in play and conversation with typically developing children
— Conducted a twice-weekly lunch bunch group with 4 second grade students (1 with autism, 3 typically developing) at a Maryland elementary school
— Implemented the ENGAGE Model during lunch bunch
**Undergraduate Research Assistant**  
*University of Miami, Coral Gables, FL*

- **Autism-Emotion Lab.** (August 2008-May 2009) PI: Daniel Messinger, PhD
  - This lab worked on a variety of projects examining emotions in young children with and at-risk for Autism Spectrum Disorders
  - Rated typically developing and at-risk parent-child dyads during 18 month free-play interactions using the Mother-Child Structured Interaction Qualitative Rating Scales for Baby Sibs Study
  - Worked with post-doc and other raters to adjust the rating scale based on study specific operational definitions
  - Assisted with assessments of young children in accordance with study protocol

- **UM Joint Attention Intervention Study.** (August 2008-May 2009) PI Jennifer Durocher, PhD
  - This project sought to teach joint attention skills to young children with autism
  - Co-conducted 45 minute interventions for children with autism, ages 2-6 years
  - Closely observed and video recorded assessments including the ESCS, Mullen Scales, and ADOS

- **Head Start School Readiness Lab.** (December 2007-December 2008) PI: Daryl Greenfield, PhD
  - This project examined school readiness among head start children in the greater Miami area, and included the development of a preschool science assessment
  - Administered assessments to children in Head Start centers across Miami-Dade County
  - Entered data from assessments and performed basic administrative duties

**CONFERENCE PRESENTATIONS AND POSTERS**


PROFESSIONAL LICENSES AND CERTIFICATIONS

— Licensed School Psychologist, Massachusetts
— Nationally Certified School Psychologist

RELEVANT ADDITIONAL TRAINING

— Certification in ADOS-2 Modules 1-4
— Trauma-focused CBT certification from Medical University of South Carolina

PROFESSIONAL MEMBERSHIPS

— American Psychological Association (APA), Student Affiliate (January 2012-Present)
  o Division 40, Student Affiliate (January 2015-Present)
    ▪ Association of Neuropsychology Students in Training (ANST; January 2015-Present)
  o Division 16, Student Affiliate (January 2015-Present)
  o Division 7, Student Affiliate (January 2015-Present)
— Society for Research in Child Development (SRCD), Student Affiliate (January 2015-Present)
— National Association of School Psychologists (NASP), Student Affiliate (January 2012-Present)
— Association for Psychological Science (APS), Student Affiliate (January 2013-January 2014)
— Council for Exceptional Children (CEC), Student Affiliate (August 2012-September 2014)
— Division for Early Childhood (DEC) of the Council for Exceptional Children Student Affiliate (August 2012-September 2014)

HONORS, AWARDS, AND ACTIVITIES

— National Register of Health Service Psychologists Credentialing Scholarship (November 2016)
— Stipended Graduate Assistantship with full tuition remission, Northeastern University (September 2011-May 2015)
— Student Affiliates in School Psychology (SASP) Northeastern University Chapter
— Council for Exceptional Children Northeastern University Chapter
— Northeastern University Graduate Student Government, Senator (2011-2012)
— Phi Beta Kappa Society Member