Abstract

Restricted and repetitive behaviors (RRB) are a core diagnostic feature of autism spectrum disorders (ASD). Previous research has suggested that RRB are associated with symptoms of co-occurring psychiatric disorders in individuals with ASD, but the nature of this relationship is not well understood. This study’s objective was to clarify the relationship of RRB to symptoms of psychiatric disorders, including anxiety and mood disorders, as well as attention deficit hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD). Parents of children and adolescents, age 5 to 17 and diagnosed with an ASD, completed all measures, reporting on the presence and severity of RRB and psychiatric symptoms on the Repetitive Behavior Scale-Revised (RBS-R) and an abridged version of the Child Symptom Inventory – 4 (CSI-4). Level of functioning was assessed on the Conceptual Domain of the Adaptive Behavior Assessment System, Second Edition (ABAS-II), and ASD diagnosis was confirmed on the Social Communication Questionnaire (SCQ).

Approximately 1150 flyers were distributed to potentially eligible families via local school districts and other support services. A total of 88 parents completed study materials; 71 participants met eligibility criteria and had usable data on all rating scales. On average, children were 11 years old, and 87% were male; 80% of the respondents were the children’s biological mothers. Results from hierarchical multiple regression analyses indicated that ritualistic and sameness behaviors positively predicted anxiety (β
Stereotypic behaviors positively predicted ADHD symptom severity ($\beta = 0.517, p < .001$) and self-injurious behavior approached significance as a positive predictor of ODD symptom severity ($\beta = 0.237, p < .1$). Restricted interests were a negative predictor of mood symptom severity ($\beta = -0.301, p < .05$). Lastly, level of functioning emerged as a significant moderator of the relationship between self-injurious behavior and both anxiety ($\beta = 0.447, p < .01$) and mood ($\beta = 0.495, p < .001$) symptom severity; for higher functioning individuals, self-injurious behavior positively predicted both anxiety and mood symptom severity. Level of functioning approached significance as a moderator of the relationship between ritualistic and sameness behavior and mood symptom severity ($\beta = -0.366, p < .01$); for lower functioning individuals, ritualistic and sameness behavior was a positive predictor of mood symptom severity.

This study found specific relationships between RRB and symptoms of psychiatric disorders in children and adolescents with ASD. This study helps clarify ASD phenotypes, and may have implications for future genetic and neurobiological research. It is possible that the relationships found between RRB and psychiatric symptoms suggest common underlying etiologies, which would further clarify the pathogenesis of RRB and, ultimately, of ASD. Additionally, it is possible that RRB are involved in the development of co-occurring psychiatric disorders, acting as risk or protective factors. Future research regarding the relationship of RRB and psychiatric symptoms in individuals with ASD is warranted to better understand the underlying causes of these associations.
Dedicated to my mother, Rebecca Stratis,

who has always pushed me to be all that I can be.
Acknowledgements

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Without the assistance of school district personnel and service providers who distributed study information to potential participants, this study would not have been possible. I would like to thank them as well as the family and caregivers who took the time out of their busy lives to complete and return the study materials.

This project was supported in part by the Nisonger Center Research Fund, for which I am quite grateful. Lastly, I would like to thank my family and friends for their constant encouragement and unwavering love and support.
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Fields of Study

Major Field: Psychology

Specializations: Intellectual and Developmental Disabilities; Child Clinical
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List of Abbreviations

AAIDD.......................... American Association on Intellectual and Developmental Disabilities
ABAS-II........................................... *Adaptive Behavior Assessment System, 2nd Edition*
ABC .......................................................... *Aberrant Behavior Checklist*
ADI-R .................................................... *Autism Diagnostic Interview – Revised*
ADHD ......................................................... Attention-Deficit Hyperactivity Disorder
ADOS .......................................................... *Autism Diagnostic Observation Schedule*
APA ............................................................ American Psychiatric Association
ASD ............................................................. Autism Spectrum Disorder
CBCL .............................................................. *Child Behavior Checklist*
CD ................................................................. Conduct Disorder
CDC .............................................................. Centers for Disease Control and Prevention
CSI-4 .............................................................. *Child Symptom Inventory – 4*
CY-BOCS ....................................................... *Children’s Yale-Brown Obsessive Compulsive Scale*
DISC-IV-P ....... *Diagnostic Interview Schedule for Children, 4th Edition, Parent Version*
DSM-5 ............................................................. *Diagnostic and Statistical Manual, 5th Edition*
GABA .......................................................... Gamma-Aminobutyric Acid
GAD .............................................................. Generalized Anxiety Disorder
HIPAA ........................................... Health Insurance Portability and Accountability Act
ID ................................................................. Intellectual Disability
KSADS ..................................... Kiddie Schedule for Affective Disorders and Schizophrenia
MDD ................................................................. Major Depressive Disorder
MF-PEP .................................................. Multi-Family Psychoeducation Psychotherapy
OCD ................................................................. Obsessive Compulsive Disorder
ODD ................................................................. Oppositional Defiant Disorder
PDD-NOS .................................. Pervasive Developmental Disorder, Not Otherwise Specified
RBS-R ............................................................ Repetitive Behavior Scale – Revised
RRB ................................................................. Restricted and Repetitive Behaviors
SCQ ................................................................. Social Communication Questionnaire
SSL ................................................................. Secure Sockets Layer
SSRI ................................................................. Selective Serotonin Reuptake Inhibitor
VABS ................................................................. Vineland Adaptive Behavior Scales
Chapter 1: Introduction

Individuals with autism spectrum disorders (ASD) and/or intellectual disability (ID) are at high risk of comorbid psychiatric disorders. The presence of restricted, repetitive and stereotyped behaviors, activities and interests is a defining feature of ASD but is poorly understood. In the typically developing population, these restricted and repetitive behaviors (RRB) are often related to several psychiatric disorders. It is unclear if this relationship between RRB and psychiatric diagnoses exists in the ASD population, and this will be the focus of the current study.

Autism Spectrum Disorders and Intellectual Disability

The American Psychiatric Association (APA) currently defines ASD to include both qualitative impairments in communication and social interaction, as well as the presence of restricted, repetitive and stereotyped behaviors, activities and interests (APA, 2000). In contrast with the domains of social and communication impairment, the domain of RRB has only recently begun to be extensively and systematically studied (Bishop, Richler & Lord, 2006; Carcani-Rathwell, Rabe-Hasketh & Santosh, 2006; Mirenda et al., 2010). ASD commonly co-occurs with ID. The American Association on Intellectual and Developmental Disabilities (AAIDD) and the APA (2000) characterize ID by significant limitations in intellectual and adaptive functioning. Adaptive behavior includes conceptual, social and/or practical skills that allow an individual to function in
his/her environment. Deficits in these skills are determined by comparison to peer groups.

Individuals with ID are more likely to be diagnosed with ASD than individuals without ID. For instance, Dekker and Koot (2003) reported that individuals with IQ less than 60 are 4.7 times more likely to be diagnosed with an ASD than individuals with IQ between 60 and 80. Estimates of the prevalence of ID in the ASD population vary. In a review of 20 published epidemiological studies, Fombonne (2003) estimated that about 30% of individuals with an ASD have no intellectual impairment (range 0 to 60%), 30% have mild to moderate intellectual impairment (range 6.6 to 100%) and 40% have severe to profound intellectual impairment (range 0 to 81.3%). Assessment tools varied across studies, as did the definitions for level of intellectual impairment, leading to the large range for each level of intellectual impairment. One epidemiological study showed that when including all ASD subtypes, the rate of ID is estimated to be approximately 23%, with rates highest for children with autistic disorder (69%; Chakrabarti & Fombonne, 2001).

**Restricted and Repetitive Behaviors**

RRB is quite broadly defined to include repetitive, nonfunctional activities that occur regularly and interfere with daily functioning (Gabriels, Cuccaro, Hill, Ivers, & Goldson, 2005; Turner, 1999). As defined by the *Diagnostic and Statistical Manual, Fourth Edition, Text Revision* (DSM-IV-TR; APA, 2000), the presence of RRB is confirmed by at least one of the following: a) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or
focus; b) apparently inflexible adherence to specific, nonfunctional routines or rituals; c) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements); d) persistent preoccupation with parts of objects. RRB will remain a core feature for a diagnosis of ASD in the Diagnostic and Statistical Manual, Fifth Edition (DSM-5). However, in contrast to the DSM-IV-TR, the proposed revisions for the DSM-5 add repetitive speech and sensory reactions to the RRB domain. The proposed revisions for the DSM-5 require the presence of at least two of the following RRB: a) stereotyped or repetitive speech, motor movements or use of objects; b) excessive adherence to routines, ritualized patterns of verbal or nonverbal behavior or excessive resistance to change; c) highly restricted, fixated interests that are abnormal in intensity or focus; d) hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment (APA, 2011).

RRB can be divided into two classes. Low-level RRB are characterized by repetition of movement and include behaviors such as stereotypical movement, repetitive manipulations of objects and repetitive self-injury (Cuccaro et al., 2003). Low-level RRB occur more frequently in younger children or individuals with lower intellectual functioning (Bishop et al., 2006; Carcani-Rathwell et al., 2006). High-level RRB refer to more complex behaviors related to restricted interests and strict adherence to rituals and routines. Behaviors included in this category include object attachments, repetitive language and circumscribed interests (Esbensen, Seltzer, Lam, & Bodfish, 2009). High-level RRB occur more frequently in older individuals and individuals with higher intellectual functioning (Bishop et al., 2006; Carcani-Rathwell et al., 2006). High-level
RRB related to restricted and narrow interests, such as odd object attachments or unusual object preoccupations, are more unique to autism than other disorders (Carcani-Rathwell et al., 2006; Lam, Bodfish, & Piven, 2008).

Prevalence rates of RRB are unclear. As it is a required diagnostic criteria, 100% of children with autism exhibit some form of RRB. The prevalence of RRB varies across the lifespan, with all types of RRB being more frequent and more severe in younger individuals with ASD. This pattern is consistent when controlling for gender, presence of ID and use of psychotropic medications. Across all ages, restricted interests are the most common RRB and repetitive self-injurious behaviors are the least common (Esbensen et al., 2009), although approximately one-third of children with autism exhibit self-injurious behavior (Bodfish, 2006). The relative frequency of stereotyped movements differs by age; in young children, stereotyped movements are more common than rituals and compulsions, but become less common than these other RRB in adulthood (Esbensen et al., 2009).

RRB appear to result from multiple, co-occurring etiological processes (Bodfish, 2006). Animal models have consistently shown that stereotypic behavior and self-injurious behavior often follow social isolation early in life (Lewis, Tanimura, Lee, & Bodfish, 2006). These behaviors have been seen in infants who were placed in orphanages at early ages and for long periods of time, experiencing deprived environments (Rutter et al., 1999). It is also hypothesized that RRB may be learned behaviors influenced by positive and negative reinforcement and may additionally serve as self-stimulatory or coping behaviors to modulate stress and arousal (Bodfish, 2006).
Several neurobiological factors are associated with RRB including early damage to the basal ganglia and fronto-striatal circuits (Bodfish & Lewis, 2002); studies of drug-induced stereotypic behavior have confirmed the role of the basal ganglia (Lewis et al., 2007). Additionally, several neurotransmitters mediate the expression of RRB, including dopamine, serotonin, opiate peptides, gamma-aminobutyric acid (GABA), acetylcholine and adenosine (Bodfish, 2006).

**Comorbid Psychiatric Disorders**

Individuals with ASD are at high risk of comorbid psychiatric disorders, including mood disorders, attention-deficit hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), and obsessive-compulsive disorder (OCD). Simonoff and colleagues (2008) assessed the 3-month prevalence of psychiatric disorders, using the *Child and Adolescent Psychiatric Assessment* parent interview, in a population-based sample of 112 children age ten to fourteen years diagnosed with an ASD. They found that 70% met criteria for at least one comorbid psychiatric diagnoses and 41% had two or more. The most prevalent comorbid diagnoses included social anxiety disorder (29.2%), ADHD (28.1%) and ODD (28.1%). Other common disorders included generalized anxiety disorder (GAD; 13.4%), panic disorder (10.1%) and enuresis (11%).

Leyfer and colleagues (2006) revised the *Kiddie Schedule for Affective Disorders and Schizophrenia* (KSADS) for individuals with autism, naming this revision the *Autism Comorbidity Interview-Present and Lifetime Version*. They assessed 109 children age five to seventeen years diagnosed with autism and found that 72% met criteria for at least
one comorbid DSM-IV-TR axis I disorder. The most common diagnoses were specific phobias (44%), OCD (37%), ADHD (31%) and major depressive disorder (MDD; 10%).

Another study of 94 children aged six to twelve years and diagnosed with pervasive developmental disorder, not otherwise specified (PDD-NOS) found that 80.9% had one or more comorbid psychiatric diagnoses and 54.3% had two or more comorbid diagnoses according to a semi-structured interview, the Diagnostic Interview Schedule for Children, Fourth Edition, Parent Version (DISC-IV-P). The most common diagnoses were ADHD (44.7%), simple phobia (38.3%), ODD (37.2%), social phobia (11.7%) and major depression (10.6%; de Bruin, Ferdinand, Meester, de Nijs & Verheij, 2007).

Gadow and colleagues (2005) compared children age 6 to 12 in four groups: diagnosed with an ASD (n = 284), non-ASD psychiatric clinic referrals (n = 189), regular education students (n = 385) and special education students (n = 61). Psychiatric symptoms were measured using the Child Symptom Inventory – 4 (CSI-4), a behavior rating scale based on the DSM. The severity of symptoms associated with specific phobia, obsessions, compulsions, motor and vocal tics, social phobia and encopresis was highest in the ASD group. Symptom severity for ADHD, ODD, GAD, separation anxiety disorder, depressive disorder and enuresis were similar in the ASD and non-ASD referral groups, with both groups higher than the regular education and special education students (Gadow, Devincent, Pomeroy, & Azizian, 2005).

Level of functioning additionally moderates the prevalence of psychiatric problems in individuals with ASD. Studies generally indicate that higher functioning individuals with ASD are more likely to experience co-occurring anxiety and mood
problems, whereas lower functioning individuals with ASD are more likely to experience symptoms of ADHD. For example, in a longitudinal study of 74 children with ASD, Estes, Dawson, Sterling, and Munson (2007) found that higher verbal IQ at age six predicted symptoms of anxiety and depression at age nine whereas lower nonverbal IQ at age six predicted ADHD symptoms at age nine, based on parent ratings on the Aberrant Behavior Checklist (ABC), Child Behavior Checklist (CBCL) and Conners Parent Rating Scales – Revised. In a clinic-based sample of 238 children with ASD (mean age 8.6 years), Gadow, DeVincent and Schneider (2008) found that higher IQ scores were significantly associated with more parent reported symptoms of ODD, MDD, GAD and specific phobia on the CSI-4. In terms of teacher ratings on the CSI-4, lower IQ scores were associated with more symptoms of social phobia and the inattentive subtype of ADHD. These studies indicate that children with ASD experience a high rate of comorbid psychiatric disorders, the type of which varies based on level of functioning.

**Restricted and Repetitive Behaviors in Other Populations**

RRB are not unique to autism, and have been associated with a variety of developmental and neurological disorders. RRB have a long history of being considered an important dimension of psychopathology (Lewis & Bodfish, 1998), occurring in a wide range of disorders, including ID, a variety of genetic syndromes, OCD, and tic disorders (Bodfish, Symons, Parker, & Lewis, 2000; Carcani-Rathwell et al., 2006).

**RRB in Typical Development.** RRB occur in early development, and typically include ritualistic play, repetitive behavioral patterns and superstitions. Repetitive behaviors appear during the first year of life, increase in frequency by three years of age
and decline after age four (Macdonald et al., 2007). As early as eighteen months of age, toddlers often require that things be done in a particular, routine-oriented manner, and have difficulty transitioning to activities that do not follow the typical routine. Toddlers often request to hear the same story or watch the same video over and over, reflecting ‘insistence on sameness’ behaviors (Evans et al., 1997). These ritualistic behaviors provide order and predictability for young children who have little control over their daily lives. However, these behaviors become maladaptive as children begin to master their environments. For example, high levels of ritualistic behaviors in a sample of 288 typically developing children, age 20 to 57 months, were associated with parent-reported fearfulness as well as shy and emotional temperaments (Zohar & Felz, 2001).

More subtle ritualized behaviors continue throughout development. Young school-aged children play group games, such as jump rope or hopscotch, which have built in rituals and repetitive behavior patterns. Children often collect objects, such as baseball cards and particular toys. Early adolescents often demonstrate restricted behaviors, such as excessive time playing a particular video game. Many adolescents show excessive preoccupation with grooming behaviors (Evans et al., 1997). However, these behaviors are not seen as pathological unless they significantly interfere with daily functioning (Zohar & Felz, 2001).

**RRB in Intellectual Disability.** Individuals with ID frequently exhibit RRB, including stereotyped movements, compulsive behaviors, restricted preferences and repetitive speech (Moss, Oliver, Arron, Burbidge, & Berg, 2009). In comparison to individuals with ASD, individuals with ID are less likely to, although still often do,
exhibit stereotypic motor movements, repetitive self-injurious behavior, compulsions, and tics. However, individuals with ID are more likely than individuals with ASD to exhibit dyskinesias (repetitive, jerky movements; Bodfish et al., 2000).

Repetitive behaviors are present in a variety of genetic syndromes associated with ID. For instance, many individuals with Cornelia de Lange Syndrome exhibit stereotypic motor movements, including body rocking and body postures, as well as compulsive behavior, restricted preferences, repetitive speech and difficulty with changes in routine. Individuals with Cri du Chat Syndrome frequently exhibit stereotyped motor movements (such as body rocking), restricted interests and repetitive speech. Individuals with Angelman Syndrome exhibit hand flapping and other stereotypic motor movements. Many individuals with Prader-Willi Syndrome exhibit compulsive behavior (including ordering, rituals and hoarding), repetitive speech, restricted interests and difficulty with changes in environment or routine. Individuals with Fragile X Syndrome often exhibit stereotyped motor movements, compulsive behavior, restricted interests, difficulty with changes in environment or routine, and repetitive speech (Moss et al., 2009). Finally, individuals with Lesch-Nyhan syndrome exhibit stereotyped movements and repetitive self-injury and aggression (Schretlen et al., 2005; Bodfish, 2006).

**RRB in Other Psychiatric Disorders.** Repetitive behavior, including obsessions and compulsions, is a defining component of OCD. Generally, obsessions are considered to be intrusive, repetitive thoughts that trigger anxiety, and compulsive acts are completed to reduce this anxiety. Additionally, other repetitive behaviors are common in OCD, with up to one third of children and adolescents with OCD also meeting the
diagnostic criteria for a tic disorder (Zandt, Prior, & Kyrios, 2007). Developmentally appropriate rituals appear to be similar in form to rituals seen in OCD, but have differing functions and end results. In OCD, rituals cause distress for the individual and often lead to social isolation, withdrawal and regressive behavior (Zohar & Felz, 2001).

Additionally, in a comparison of 17 children with OCD (mean age 12 years) and 19 children with ASD (mean age 11 years), Zandt, Prior and Kyrios (2007) found that the two groups exhibited similar frequency of RRB according to the Repetitive Behavior Questionnaire. According to the Children’s Yale-Brown Obsessive Compulsive Scale (CY-BOCS), children with OCD were more likely to engage in compulsions and obsessions than children with ASD. However, children with ASD did engage in more compulsions and obsessions than a group of 18 typically developing children (mean age 12 years).

Tourette’s Syndrome is characterized by repetitive motor or vocal tics, where tics are involuntary, sudden, repetitive and stereotyped behaviors. Between 20 and 60 percent of individuals with Tourette’s Syndrome additionally exhibit obsessive and compulsive behaviors (Singer, 2005). However, individuals with Tourette’s Syndrome also exhibit a variety of other RRB that are not related to obsessions and compulsions, including repetitive aggressive and neutral thoughts, touching behaviors and self-injurious behavior (Cath et al., 2001).

Relation between RRB and Psychopathology in ASD

Few studies have studied the relationship between RRB and comorbid psychiatric diagnoses in individuals with ASD, but several studies have compared RRB to the
presence of various symptoms listed for DSM-IV-TR diagnoses. Using the Repetitive Behavior Domain on the *Autism Diagnostic Interview-Revised* (ADI-R) with 226 children diagnosed with ASD (mean age 8.3 years), Lecavalier and colleagues (2006) found that RRB were positively correlated with three subscales of the ABC: stereotypy ($\rho = .24, p < .01$), hyperactivity ($\rho = .19, p < .01$) and inappropriate speech ($\rho = .21, p < .01$), as well as positively correlated with scores on the CY-BOCS ($\rho = .39, p < .001$). RRB, as measured by the ADI-R, were not significantly associated with the irritability or lethargy subscales of the ABC. The authors concluded that higher frequency of RRB in children with autism is strongly correlated with symptoms of psychopathology.

Gabriels and colleagues (2005) compared total scores on the *Repetitive Behavior Scale-Revised* (RBS-R) to ratings on the subscales of the ABC for a sample of 14 children with autism or PDD-NOS (mean age 10.6 years). The RBS-R total score was positively correlated with the irritability ($r = .74, p = .003$), lethargy ($r = .72, p = .004$) and hyperactivity ($r = .73, p = .003$) subscales, as well as with sleep difficulties ($r = .77, p = .001$). The RBS-R total score was not significantly associated with the stereotypy subscale of the ABC. After controlling for nonverbal IQ, only the hyperactivity subscale remained correlated with the RBS-R total score (partial $r = .58, p = .039$).

In a study validating the RBS-R, Lam (2004) examined the relationship of co-occurring psychiatric and behavioral problems with RBS-R scores in a sample of 307 individuals, age 3 to 48, diagnosed with an ASD. The author found that the severity of all assessed co-occurring psychiatric and behavioral problems (including anxiety, depression, ADHD, irritability and aggression, based on parent report on a demographics
form) had significant main effects on all five subscales of the RBS-R, with more severe psychiatric and behavioral problems being associated with higher RBS-R ratings. Similarly in another study validating the RBS-R, Mirenda and colleagues (2010) examined the correlation of RBS-R scores with scores on the CBCL in 287 preschool children diagnosed with an ASD (mean age 3.4 years). They found that all types of RRB, including stereotypy, repetitive self-injurious behavior, compulsive behavior, insistence on sameness behavior and restricted interests, were positively correlated with CBCL internalizing problems score ($\rho$ range: $0.38 - 0.62$, $p < .01$), externalizing problems score ($\rho$ range: $0.39 - 0.53$, $p < .01$) and total problems score ($\rho$ range: $0.49 - 0.64$, $p < .01$). While the authors concluded that this is support of the concurrent validity of the RBS-R, it is also supportive of the work previously discussed, which indicated that higher frequency of RRB is associated with higher ratings on measures of psychiatric symptoms. However, with the exception of Gabriels and colleagues (2005), who used a small sample, previous work has not looked at the influence of level of functioning on the relationship between RRB and psychiatric symptoms.

**The Current Study**

The current study will examine the relationship between the frequency of RRB and the presence of comorbid psychiatric symptoms among children with ASD. As RRB in ASD have only recently begun to be systematically investigated, there is limited knowledge about how associated symptoms in ASD may influence the presentation of RRB. Individuals with ASD are more likely to have co-occurring psychiatric disorders and symptoms, and previous research suggests strong associations between symptoms of
psychiatric disorders and RRB. A better understanding of the relationship between RRB and psychiatric disorders has implications for genetic and neurobiological research in ASD in that it could lead to refinement of ASD phenotypes, and ultimately a better understanding of pathogenesis. Additionally, understanding how co-occurring psychiatric symptoms may influence the presentation of RRB has implications for treatments and interventions designed to reduce the frequency and severity of RRB.

Psychiatric symptoms will be measured for several psychopathology domains, including anxiety disorders, mood disorders, ADHD and ODD. It is hypothesized that frequency of RRB will positively correlate with each of the psychiatric symptom categories. Specifically, it is hypothesized that anxiety symptoms will correlate most strongly with the RBS-R compulsive behavior and ritualistic behavior subscales, and that mood disorder symptoms will correlate most strongly with the RBS-R self-injurious behavior subscale. It is additionally hypothesized that ADHD symptoms will correlate most strongly with the RBS-R stereotypic behavior subscale. The second goal of this study will be to examine the impact of level of functioning on the relationship of RRB and psychiatric symptoms. It is hypothesized that different types of RRB will correlate with psychiatric symptoms based on the level of functioning of the individuals with ASD. Among individuals with average functioning to mild ID (based on adaptive behavior measures), we expect higher frequency of compulsive behaviors, ritualistic and sameness behaviors and restricted interests. As level of ID becomes more severe, we expect higher frequency of self-injurious behavior and stereotypic behavior.
Chapter 2: Methods

Participants

Participants were parents of children age 5 to 17 who are diagnosed with an ASD. Participants were drawn from Central Ohio school districts and autism schools as well as national parent associations. They were also recruited from the Groden Network of Programs in Providence, Rhode Island, a non-profit organization serving individuals with ASD, and programs and clinics at the Nisonger Center at the Ohio State University. Parents completed all measures. Eligibility was based on parent reported ASD diagnosis, parent-reported receipt of special education services and a cutoff score of 11 or higher on the Social Communication Questionnaire (SCQ). No other exclusionary criteria were applied.

Approximately 1150 flyers were distributed to families via local schools or other support services; information regarding the study was additionally posted on listservs as well as the Nisonger Center website. After reviewing the flyer, 149 families expressed interest in the study, and a total of 88 parents completed study materials. No families actively refused to participate after being sent study materials; rather, they did not complete and return the materials, which may indicate that they forgot to do so or did not consent to the study. Of the 88 families who returned study materials, 11 children did not meet the eligibility criteria according to parent report on the SCQ, 5 parents did not return
all study materials and 1 child was too young (2.5 years of age), leaving 71 participants for data analysis, which was slightly less than the desired sample size of 80.

Demographic information was provided by parents. Of the eligible participants, 80% were mothers, 7% were fathers and the remaining were legal guardians. On average, children were 11.0 years old (SD = 3.3), ranging from 5.5 to 17.8 years, and 87.3% \((n = 62)\) were male. Parents reported that 45 of the children were diagnosed with autistic disorder (63.4%), 13 with PDD-NOS (18.3%) and 10 with Asperger’s syndrome (14.1%); 3 parents (4.2%) reported multiple diagnoses on the autism spectrum. However, parent reported ASD subtypes were not used in data analysis as subtype diagnosis is unreliable (see Witwer & Lecavalier, 2008 for review) and subtypes will likely no longer exist with the publication of the DSM-5 (APA, 2011). According to parents, 52% \((n = 37)\) of the children took psychotropic medications, with the most common medications being atypical antipsychotics and psychostimulants. Parents reported that 12.7% \((n = 9)\) of the children have epilepsy or a history of seizures and 16.9% \((n = 12)\) have other medical conditions, with the most common being asthma \((n = 7)\) and allergies \((n = 3)\). Parents reported that 54.9% \((n = 39)\) of the children experienced sleep problems, with difficulty falling asleep \((n = 26)\) and difficulty staying asleep \((n = 20)\) being the most common concerns; many parents reported multiple sleep problems. According to parent report on the SCQ, 84.5% \((n = 60)\) of the children were able to talk using short phrases or sentences; no other information regarding verbal skills was collected. Additional demographic information, including ethnicity, comorbid diagnoses, classroom placement, level of functioning and family psychiatric history is presented in Table 1.
Table 1. Parent-Reported Child Demographic Information (n = 71)

<table>
<thead>
<tr>
<th>Ethnicity (n, %)(^a):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>48  (67.6%)</td>
</tr>
<tr>
<td>African American</td>
<td>14  (19.7%)</td>
</tr>
<tr>
<td>Hispanic American</td>
<td>2   (2.8%)</td>
</tr>
<tr>
<td>Multiracial</td>
<td>4   (5.6%)</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Comorbid Diagnoses (n, %):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intellectual Disability</td>
<td>12  (16.9%)</td>
</tr>
<tr>
<td>ADHD</td>
<td>26  (36.6%)</td>
</tr>
<tr>
<td>Anxiety Disorder</td>
<td>9   (12.7%)</td>
</tr>
<tr>
<td>Mood Disorder</td>
<td>10  (14.1%)</td>
</tr>
<tr>
<td>ODD or CD</td>
<td>3   (4.2%)</td>
</tr>
<tr>
<td>Other(^b)</td>
<td>7   (9.9%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classroom Placement (n, %):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>15  (21.1%)</td>
</tr>
<tr>
<td>Partial Mainstream</td>
<td>22  (31.0%)</td>
</tr>
<tr>
<td>Cognitive Disability</td>
<td>7   (9.9%)</td>
</tr>
<tr>
<td>Developmental Disability</td>
<td>16  (22.5%)</td>
</tr>
<tr>
<td>Multiple Handicapped</td>
<td>10  (14.1%)</td>
</tr>
<tr>
<td>Home-Schooled / Online</td>
<td>1   (1.4%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of Functioning (n, %):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average (IQ &gt; 80)</td>
<td>20  (28.2%)</td>
</tr>
<tr>
<td>Borderline (IQ 70 – 80)</td>
<td>5   (7.0%)</td>
</tr>
<tr>
<td>Mild Delays (IQ 55 – 70)</td>
<td>6   (8.5%)</td>
</tr>
<tr>
<td>Moderate Delays (IQ 40 – 55)</td>
<td>9   (12.7%)</td>
</tr>
<tr>
<td>Severe Delays (IQ 25 – 40)</td>
<td>10  (14.1%)</td>
</tr>
<tr>
<td>Profound Delays (IQ &lt; 25)</td>
<td>2   (2.8%)</td>
</tr>
<tr>
<td>Unsure / Don’t Know</td>
<td>19  (26.8%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family History in 1st Degree Relatives (n, %):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety Disorder</td>
<td>15  (22.4%)</td>
</tr>
<tr>
<td>Obsessive Compulsive Disorder</td>
<td>5   (7.5%)</td>
</tr>
<tr>
<td>Mood Disorder</td>
<td>14  (20.9%)</td>
</tr>
<tr>
<td>Bipolar Disorder</td>
<td>10  (14.9%)</td>
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<tr>
<td>ADHD</td>
<td>21  (31.3%)</td>
</tr>
<tr>
<td>ODD or CD</td>
<td>4   (6.0%)</td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>1   (1.5%)</td>
</tr>
<tr>
<td>ASD</td>
<td>15  (22.4%)</td>
</tr>
<tr>
<td>Learning Disability</td>
<td>8   (11.9%)</td>
</tr>
<tr>
<td>Intellectual Disability</td>
<td>5   (7.5%)</td>
</tr>
</tbody>
</table>

Note. ADHD = attention-deficit hyperactivity disorder; ODD = oppositional defiant disorder; CD = conduct disorder; ASD = autism spectrum disorder
\(^a\)ethnicity was not reported by 3 parents (4.2%)
\(^b\)includes sensory integration dysfunction (n = 4), global developmental delay (n = 2), dyslexia (n = 1), dyspraxia (n = 1), posttraumatic stress disorder (n = 1), fetal alcohol syndrome (n = 1) and tics (n = 1)
\(^c\)biological information is unknown for 4 adopted children; percentages are based on those with known biological information
Power Analyses

It is hypothesized that there will be a medium sized correlation ($F^2$ at least 0.18) for each set of regression. For the primary goal, regression analyses were used with 5 predictors. 77 children would be needed to obtain power of 0.80 when alpha is set at 0.05. For the secondary goal, regression analyses were used with 6 predictors. In this situation, 83 children would be needed to obtain power of 0.80 when alpha is set at 0.05. Therefore, the objective was to recruit about 80 children to have adequate power for both the primary (0.82) and secondary model (0.79; Faul, Erdfelder, Lang, & Buchner, 2007).

Measures

**Demographic Form.** A demographic form (see Appendix A) for each child was completed with all other measures. This form requested information about age, gender, current diagnosis, school placement, IQ range, medications, sleep problems and family history of psychiatric disorders.

**Repetitive Behavior Scale-Revised (RBS-R; Bodfish, Symons, & Lewis, 1999).**
Parents completed the RBS-R (see Appendix B), a caregiver-completed measure of RRB. The RBS-R consists of 43 items, rated on a 4-point Likert scale ranging from (0) “behavior does not occur” to (3) “behavior occurs and is a severe problem.” Raters are asked to refer to the previous month when answering each item (Bodfish, Symons, & Lewis, 1999).

The authors of the RBS-R conceptually grouped the questions into six subscales: stereotyped behavior, self-injurious behavior, compulsive behavior, ritualistic behavior, sameness behavior and restricted behavior. Bodfish and Lewis (2002) confirmed these
categories using a principal component analysis on 124 completed RBS-R forms. This analysis generally supported the conceptual grouping of the RBS-R, but some items did not load most heavily on their hypothesized subscales. By examining the factor analytic structure of the RBS-R in 307 individuals with ASD, Lam and Aman (2007) chose a 5-factor solution: ritualistic/sameness behaviors, self-injurious behavior, stereotypic behavior, compulsive behavior and restricted interests (α range: .78 - .91 across factors). Lam and Aman (2007) chose a 5-factor solution: ritualistic/sameness behaviors, self-injurious behavior, stereotypic behavior, compulsive behavior and restricted interests (α range: .78 - .91 across factors). Lam and Aman (2007) chose a 5-factor solution: ritualistic/sameness behaviors, self-injurious behavior, stereotypic behavior, compulsive behavior and restricted interests (α range: .78 - .91 across factors). Lam and Aman (2007) chose a 5-factor solution: ritualistic/sameness behaviors, self-injurious behavior, stereotypic behavior, compulsive behavior and restricted interests (α range: .78 - .91 across factors). Mirenda and colleagues (2010) found a similar 5-factor solution (α range: .72 - .90 across factors); however, they also found that the scale additionally produces an adequate 3-factor solution consisting of stereotypy/restricted behavior, self-injurious behavior, and compulsive/ritualistic/sameness behavior (α range: .81 - .91 across factors). The 5-factor solution found by Mirenda and colleagues (2010) appears to be quite similar to the 5 factor solution proposed by Lam and Aman (2007), and this solution was used to score each participant’s RBS-R in the current study. The maximum possible score on the RBS-R is 114, with 27 on the stereotypic behavior subscale, 24 on the self-injury subscale, 18 on the compulsive subscale, 36 on the ritualistic/sameness behavior subscale and 9 on the restricted interests subscale.

*Child Symptom Inventory – 4 (CSI-4; Gadow & Sprafkin, 2002).* The CSI-4 (see Appendix C) is a level one screening tool, completed by parents or teachers. Items are designed to correspond with DSM-IV-TR symptoms, and are rated on a 4-point Likert scale (0 = never, 1 = sometimes, 2 = often, 3 = very often). The CSI-4 can be scored based on symptom severity or symptom count; symptom severity uses the Likert ratings, whereas symptom count disregards these ratings and focuses on the presence or absence
of symptoms. There are subscales for a variety of psychiatric symptoms, including ADHD, ODD, conduct disorder (CD), GAD, specific phobia, obsessions, compulsions, post-traumatic stress disorder, motor tics, verbal tics, schizophrenia, MDD, dysthymic disorder, autistic disorder, Asperger’s syndrome, social phobia, separation anxiety disorder, enuresis and encopresis. The CSI-4 has satisfactory psychometric properties, as demonstrated by numerous studies summarized in the screening manual (Gadow & Sprafkin, 2002).

For the current study, parents completed an abridged version of the CSI-4. The four anxiety disorder subscales, GAD, specific phobia, social phobia and separation anxiety disorder, were combined into one domain of anxiety disorders. Additionally, the two mood disorder subscales, MDD and dysthymic disorder, were combined into one domain of mood disorders. Parents also completed the subscales for ADHD and ODD. This abridged version retained 56 items of the original 97 items. The anxiety disorder domain includes 21 questions, with possible scores ranging from 0 to 63. The mood disorder domain contains 12 questions, with possible scores ranging from 0 to 32. The ADHD subscale contains 18 questions, with possible scores ranging from 0 to 54. Lastly, the ODD subscale consists of 8 questions, with possible scores ranging from 0 to 24. The anxiety disorders domain shares one question with the ADHD subscale; the mood disorders domain and the anxiety disorders domain share two questions.

**Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003).**

The SCQ (see Appendix D) is a level two autism screening tool. The SCQ is designed for individuals age 4 to 40 and parents answer 40 yes/no questions, which takes less than
ten minutes to complete. One question is not used towards the final score; thus, the maximum possible score on the SCQ is 39. The SCQ is divided into four factors: social interaction, communication, abnormal language and stereotyped behavior. It is available in both a lifetime format, to be used for screening and assessment of autism, and a current format, used to assess change over time. Several studies have demonstrated that the SCQ has satisfactory psychometric properties (Rutter, Bailey, & Lord, 2003).

In a review of level two autism screening instruments, Norris and Lecavalier (2010) found that the SCQ has the most supporting research and has been subject to the most evaluation. By examining 11 studies investigating the screening properties of the SCQ, they noted sensitivities ranging from .54 to .96 when comparing children with ASD or autistic disorder to other groups, including non ASD, other ASD and ID. Specificity ranged from .52 to .92. The predictive value of a positive test ranged from .47 to .93; the predictive value of a negative test ranged from .45 to .98. The authors noted that sensitivity and specificity improve in older samples (over age 5) and as well as when the cutoff score is lowered from from 15, as specified by the authors of the SCQ, to 11 (Norris & Lecavalier, 2010). The cutoff score of 11 was used in this study to determine participant eligibility.

*Adaptive Behavior Assessment System – Second Edition (ABAS-II; Harrison & Oakland, 2003).* The ABAS-II (see Appendix E) is a standardized, parent or teacher rated measure of adaptive behavior. The ABAS-II measures ten adaptive behavior skill areas across three domains. The conceptual domain includes communication skills, functional academics and self-direction; the social domain includes social and leisure
skills; and the practical domain includes self-care, home or school living, community use, health and safety and work (for working-age youth and adults). On a 4-point scale, raters indicate whether, and how frequently, the individual performs each activity. The ten skill areas and three domains were standardized across 3,300 individuals in 31 age groups. Additionally, a total score, the General Adaptive Composite, can be computed and has standardized scores, age-based percentiles and age equivalents (Harrison & Oakland, 2003).

The ABAS-II has satisfactory psychometric properties, with good internal consistency and test-retest reliability. The parent-completed, school-age form was normed on a representative sample of 1,670 children, including children with ID (Harrison & Oakland, 2003). The ABAS-II is frequently used with individuals with ID as adaptive behavior deficits are an integral part of the ID diagnosis. This study used the parent-completed, school age (age 5-21) form. For this study, the conceptual skills domain was used to characterize level of functioning; parents completed only this domain, consisting of 72 items.

**Procedures**

**Recruitment.** Participants were primarily recruited through Central Ohio public school districts as well as schools serving individuals with ASD (including Haugland Learning Center, Step by Step Academy and the Groden Network of Programs). Information regarding the study was provided to schools (see Appendix F). Schools agreeing to participate were provided with copies of a flyer describing the study as well as a form to indicate interest, with a postage-paid return envelope (see Appendix G).
Based on feedback from schools, two additional versions of the flyer were created and approved by the Institutional Review Board; one version stated that the project is not sponsored nor endorsed by the school district (see Appendix H), and the other version stated that participation in the study is voluntary (see Appendix I). Each of these versions was available to schools upon request. Schools distributed this flyer to all potentially eligible students and had no further involvement in any other aspect of the study. Parents who were interested in participating then contacted the investigator by phone or email, or returned the interest form in the mail, indicating if they preferred to complete the study on-line or be sent hard copies of all study materials. Parents who wished to participate on-line were provided the appropriate link to the study on surveygizmo.com, a Health Insurance Portability and Accountability Act (HIPAA) compliant online survey tool with secure socket layers (SSL) connection. Parents who preferred paper copies of the materials were sent a packet of materials. Both the on-line survey and the packets of materials included a cover letter with a brief description of the study for parents (see Appendices J and K), information regarding the incentive (discussed below), and all study measures. Packets of the paper copy materials additionally included a postage-paid return envelope. After parents received the packets or information regarding participating online, they either consented to participate (by completing and returning all materials) or did not consent by not completing study materials and simply discarded the materials in the case of paper copies.

Additional parents were recruited through parent associations for ASD, Nationwide Children’s Hospital’s Multi-Family Psychoeducation Psychotherapy (MF-
PEP) group for High Functioning Autism, the Nisonger Center’s Child Behavior Support Services, the Nisonger Center Research Registry and word of mouth. Flyers were distributed at all locations, and parents interested in participating contacted the investigators.

**Consent.** Documentation of consent was waived for this study, with approval from the Institutional Review Board. Parents implied consent by completing and returning study measures; this was outlined in the cover letter in each packet of study materials (see Appendices J and K). Parents who did not wish to participate simply discarded the materials. Study measures were numerically coded and investigators remained blind to participant identity.

**Incentive.** To encourage participation, an incentive of a $10.00 gift card to Target or Walmart for completion of study materials was offered to parents. All packets included an incentive form (see Appendix L). This form was not numerically coded with other study measures so that personally identifiable information could not be tied to any specific set of measures. Upon receipt of the incentive form and completed study measures, a $10.00 gift card to the parent’s choice of Target or Walmart was mailed to the parent.

**Eligibility Determination.** Inclusion criteria for all participants included parent-reported use of special education services and parent-reported ASD diagnosis. Additionally, the SCQ was used to determine eligibility; participants who did not meet the cutoff score of 11 on the SCQ were excluded from data analyses.
Data Analyses

Multiple regressions were used to investigate the relationship between each of the four psychiatric symptom domains on the abridged CSI-4 (mood, anxiety, ODD and ADHD) and the five subscales of the RBS-R. Partial correlations were used to examine the independent effect of each predictor on the outcome when the effects of other predictors in the model were removed. For the secondary goal, the conceptual adaptive behavior standard score on the ABAS-II was added. As an exploratory analysis, the conceptual standard score on the ABAS-II was additionally entered as a moderator to determine if the relationship between RRB and psychiatric symptoms varies across levels of functioning. This hierarchical multiple regression analysis examined the relationship between each of the four psychiatric symptom domains on the abridged CSI-4 (mood, anxiety, ODD and ADHD) and (a) conceptual adaptive behavior standard score on the ABAS-II, (b) the five subscales of the RBS-R and (c) the two-way interaction between the conceptual adaptive behavior standard score on the ABAS-II and each of the five RBS-R subscales.
Chapter 3: Results

On the anxiety, mood and ODD domains of the CSI-4, one participant was missing more than 10% of the items and is excluded from all analyses involving that domain; no participant was missing more than 10% of the items on multiple domains. When a participant had less than 10% missing data within a domain of the CSI-4 or RBS-R, the participant’s average score on the remaining items within that domain was used to replace the missing data. Average scores for each of the measures used in this study are presented in Table 2 and correlations among measures are presented in Table 3.

Table 2. Average Scores on the SCQ, RBS-R, CSI-4 and ABAS-II

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCQ</td>
<td>20.6 (5.6)</td>
<td>11 – 34</td>
</tr>
<tr>
<td><strong>RBS-R Total Score</strong></td>
<td>32.0 (20.0)</td>
<td>2 – 103</td>
</tr>
<tr>
<td>Stereotypic Behavior</td>
<td>7.7 (5.0)</td>
<td>0 – 26</td>
</tr>
<tr>
<td>Self-Injurious Behavior</td>
<td>3.9 (4.2)</td>
<td>0 – 19</td>
</tr>
<tr>
<td>Compulsive Behavior</td>
<td>4.3 (4.1)</td>
<td>0 – 18</td>
</tr>
<tr>
<td>Ritualistic/Sameness Behavior</td>
<td>11.7 (8.1)</td>
<td>0 – 36</td>
</tr>
<tr>
<td>Restricted Interests</td>
<td>4.5 (2.7)</td>
<td>0 – 9</td>
</tr>
<tr>
<td><strong>CSI-4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety&lt;sup&gt;a&lt;/sup&gt;</td>
<td>18.1 (9.2)</td>
<td>3 – 41</td>
</tr>
<tr>
<td>Mood&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.3 (4.1)</td>
<td>0 – 14</td>
</tr>
<tr>
<td>ADHD</td>
<td>26.9 (9.7)</td>
<td>8 – 48</td>
</tr>
<tr>
<td>ODD&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.3 (5.4)</td>
<td>0 – 24</td>
</tr>
<tr>
<td><strong>ABAS-II Conceptual Domain Composite</strong></td>
<td>65.0 (14.9)</td>
<td>49 – 104</td>
</tr>
<tr>
<td>Communication</td>
<td>3.3 (2.8)</td>
<td>1 – 13</td>
</tr>
<tr>
<td>Functional Academics</td>
<td>4.8 (3.4)</td>
<td>1 – 12</td>
</tr>
<tr>
<td>Self-Direction</td>
<td>3.0 (2.7)</td>
<td>1 – 12</td>
</tr>
</tbody>
</table>

Note. SCQ = Social Communication Questionnaire; RBS-R = Repetitive Behavior Scale, Revised; CSI-4 = Child Symptom Inventory – 4; ABAS-II = Adaptive Behavior Assessment System – II
<sup>a</sup> <i>n</i> = 70 (all others, <i>n</i> = 71)
<table>
<thead>
<tr>
<th></th>
<th>RBS-R Stereotypic</th>
<th>RBS-R Self-Injurious</th>
<th>RBS-R Compulsive</th>
<th>RBS-R Ritualistic/Sameness</th>
<th>RBS-R Restricted Interests</th>
<th>RBS-R Total Score</th>
<th>CSI-4 Anxiety(^a)</th>
<th>CSI-4 Mood(^a)</th>
<th>CSI-4 ADHD</th>
<th>CSI-4 ODD(^a)</th>
<th>ABAS-II Conceptual Domain Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBS-R Stereotypic</td>
<td>.582*</td>
<td>.548*</td>
<td>.551*</td>
<td>.359*</td>
<td>.760*</td>
<td>.412*</td>
<td>.461*</td>
<td>.563*</td>
<td>.305*</td>
<td>-.261*</td>
<td></td>
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<tr>
<td>RBS-R Self-Injurious</td>
<td>.544*</td>
<td>.591*</td>
<td>.388*</td>
<td>.762*</td>
<td>.415*</td>
<td>.418*</td>
<td>.410*</td>
<td>.449*</td>
<td></td>
<td>-.039</td>
<td></td>
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<tr>
<td>RBS-R Compulsive</td>
<td></td>
<td>.806*</td>
<td>.558*</td>
<td>.862*</td>
<td>.503*</td>
<td>.470*</td>
<td>.258*</td>
<td>.391*</td>
<td></td>
<td>.040</td>
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<tr>
<td>RBS-R Ritualistic/Sameness</td>
<td>.675*</td>
<td>.927*</td>
<td>.599*</td>
<td>.566*</td>
<td>.355*</td>
<td>.542*</td>
<td></td>
<td></td>
<td></td>
<td>.008</td>
<td></td>
</tr>
<tr>
<td>RBS-R Restricted Interests</td>
<td></td>
<td></td>
<td>.696*</td>
<td>.292*</td>
<td>.217</td>
<td>.219</td>
<td>.284*</td>
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<tr>
<td>RBS-R Total Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.576*</td>
<td>.560*</td>
<td>.455*</td>
<td>.510*</td>
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<tr>
<td>CSI-4 Anxiety(^a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.716*</td>
<td>.168</td>
<td>.296*</td>
<td></td>
<td>.030</td>
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<tr>
<td>CSI-4 Mood(^a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.336*</td>
<td>.504*</td>
<td></td>
<td>-.019</td>
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</tr>
<tr>
<td>CSI-4 ADHD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>.518*</td>
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<tr>
<td>CSI-4 ODD(^a)</td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

Note. RBS-R = Repetitive Behavior Scale, Revised; CSI-4 = Child Symptom Inventory – 4; ABAS-II = Adaptive Behavior Assessment System – II; ADHD = attention-deficit hyperactivity disorder; ODD = oppositional defiant disorder
\(^a\)n = 70 (all others, n = 71); \(* p < .05\)
The Relationship of RRB and Psychiatric Symptoms

The primary goal of this study was to investigate the relationship between each of the four psychiatric symptom domains on the abridged CSI-4 (mood, anxiety, ADHD and ODD) and the five subscales of the RBS-R. Prior to regression analyses, all predictor and outcome variables were standardized. Table 4 presents the results of the primary hypothesis for all outcome variables. For anxiety symptom severity, the five RBS-R subscales predicted a total of 39.3% of the variance in the outcome, which was statistically significant ($R^2 = .393, F(5, 64) = 8.279, p < .001$). Ritualistic and sameness behavior was a significant, positive predictor of anxiety symptom severity ($pr = .378, t(64) = 3.268, p = .002$) and had a medium effect ($f^2 = .20$). No other predictors were statistically significant.

For mood symptom severity, the five RBS-R subscales predicted a total of 40.3% of the variance in the outcome, which was statistically significant ($R^2 = .403, F(5, 64) = 8.646, p < .001$). Ritualistic and sameness behavior was a significant, positive predictor of mood symptom severity ($pr = .385, t(64) = 3.333, p < .001$) and had a medium effect ($f^2 = .21$). Restricted interests were a significant, negative predictor of mood symptom severity ($pr = -.276, t(64) = -2.293, p = .025$) and had a small effect ($f^2 = .09$). No other predictors were statistically significant.

For ADHD symptom severity, the five RBS-R subscales predicted a total of 34.9% of the variance in the outcome, which was statistically significant ($R^2 = .349, F(5, 65) = 6.979, p < .001$). Stereotypic behavior was a significant, positive predictor of...
ADHD symptom severity \( (pr = .438, t(65) = 3.929, p < .001) \) and had a medium effect \( (f^2 = .31) \). No other predictors were statistically significant.

For ODD symptom severity, the five RBS-R subscales predicted a total of 34.7\% of the variance in the outcome, which was statistically significant \( (R^2 = .347, F(5, 64) = 6.814, p < .001) \). Ritualistic and sameness behavior was a significant, positive predictor of ODD symptom severity \( (pr = .385, t(64) = 3.335, p < .001) \) and had a medium effect \( (f^2 = .21) \). Self-injurious behavior approached significance as a positive predictor of ODD symptom severity \( (pr = .214, t(64) = 1.753, p = .084) \) and had a small effect \( (f^2 = .05) \). No other predictors were statistically significant.

In summary, without considering level of functioning, the ritualistic and sameness behavior subscale of the RBS-R positively predicted anxiety, mood and ODD symptom severity. Additionally, the restricted interests subscale negatively predicted mood symptom severity. The stereotypic behavior subscale positively predicted ADHD symptom severity and the self-injurious behavior subscale positively predicted ODD symptom severity.
<table>
<thead>
<tr>
<th></th>
<th>Anxiety Symptom Severity&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Mood Symptom Severity&lt;sup&gt;a&lt;/sup&gt;</th>
<th>ADHD Symptom Severity&lt;sup&gt;b&lt;/sup&gt;</th>
<th>ODD Symptom Severity&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \beta ) [95% CI]</td>
<td>( \beta ) [95% CI]</td>
<td>( \beta ) [95% CI]</td>
<td>( \beta ) [95% CI]</td>
</tr>
<tr>
<td><strong>Stereotypic Behavior</strong></td>
<td>0.096 [-0.160, 0.351]</td>
<td>0.193 [-0.060, 0.446]</td>
<td>0.517*** [0.254, 0.780]</td>
<td>-0.059 [-0.325, 0.206]</td>
</tr>
<tr>
<td></td>
<td>.093</td>
<td>.187</td>
<td>.438***</td>
<td>-.056</td>
</tr>
<tr>
<td><strong>Self-Injurious Behavior</strong></td>
<td>0.032 [-0.234, 0.297]</td>
<td>0.050 [-0.208, 0.309]</td>
<td>0.130 [-0.138, 0.399]</td>
<td>0.237† [-0.033, 0.508]</td>
</tr>
<tr>
<td></td>
<td>.030</td>
<td>.048</td>
<td>.119</td>
<td>.214†</td>
</tr>
<tr>
<td><strong>Compulsive Behavior</strong></td>
<td>0.028 [-0.309, 0.365]</td>
<td>-0.015 [-0.350, 0.319]</td>
<td>-0.257 [-0.603, 0.090]</td>
<td>-0.146 [-0.496, 0.204]</td>
</tr>
<tr>
<td></td>
<td>.021</td>
<td>-.011</td>
<td>-.180</td>
<td>-.104</td>
</tr>
<tr>
<td><strong>Ritualistic/Sameness Behavior</strong></td>
<td>0.649** [0.252, 1.045]</td>
<td>0.645*** [0.259, 1.032]</td>
<td>0.211 [-0.188, 0.610]</td>
<td>0.673*** [0.270, 1.077]</td>
</tr>
<tr>
<td></td>
<td>.378**</td>
<td>.385***</td>
<td>.130</td>
<td>.385***</td>
</tr>
<tr>
<td><strong>Restricted Interests</strong></td>
<td>-0.212 [-0.478, 0.054]</td>
<td>-0.301* [-0.563, -0.039]</td>
<td>-0.017 [-0.288, 0.254]</td>
<td>-0.174 [-0.454, 0.107]</td>
</tr>
<tr>
<td></td>
<td>-.195</td>
<td>-.276*</td>
<td>-.015</td>
<td>-.153</td>
</tr>
</tbody>
</table>

*Note. CI = confidence interval

<sup>a</sup> \( N = 70 \)

<sup>b</sup> \( N = 71 \)

* \( p < .05 \); ** \( p < .01 \); *** \( p < .001 \); † \( p < .1 \)
The Impact of Adaptive Behavior on the Relationship between Psychiatric
Symptoms and RRB

The secondary goal of this study was to examine the impact of adaptive behavior on the relationship of RRB and psychiatric symptoms and further evaluate the potential moderating effect of adaptive behavior. Correlations among the ABAS-II Conceptual Domain Composite, RBS-R subscales and the interaction terms are presented in Table M1 (located in Appendix M) and show no evidence of multicollinearity.

Table 5 presents the results when severity of anxiety symptoms is the outcome variable. The ABAS-II Conceptual Domain Composite was entered in the first step and did not predict a significant amount of variance in the outcome ($R^2 < .001$, $F(1, 68) = 0.061, p = .805$). The five RBS-R subscales were entered in the second step, and accounted for an additional 39.2% of the variance in the outcome, which was statistically significant ($\Delta R^2 = .392, F(5, 63) = 8.148, p < .001$). Ritualistic and sameness behavior was a significant, positive predictor of anxiety symptom severity ($pr = .373, t(63) = 3.195, p = .002$) and had a medium effect ($f^2 = .19$). No other predictors were statistically significant.

The interaction terms between the RBS-R subscales and the ABAS-II Composite were entered in the third step and accounted for an additional 12.5% of the variance in anxiety symptoms, which was statistically significant ($\Delta R^2 = .125, F(5, 58) = 3.005, p = .018$). The interaction term between self-injurious behavior and the ABAS-II Conceptual Domain Composite emerged as a significant, positive predictor of anxiety symptoms ($pr = -.105, t(58) = 3.246, p = .002$) and had a medium effect ($f^2 = .22$). The nature of this
two-way interaction was probed using Preacher, Curran and Bauer’s (2006) web utility and is presented in Figure 1. When the ABAS-II Conceptual Domain Composite falls at the sample mean, the simple slope of the regression line is not statistically significant at 0.03 ($t(58) = 0.23, p = .82$). When the ABAS-II Conceptual Domain Composite falls one standard deviation above the sample mean, the simple slope of the regression line is significant at 0.48 ($t(58) = 2.30, p = .03$), indicating a significant, positive relationship between self-injurious behavior and anxiety symptom severity for higher functioning individuals. When the ABAS-II Conceptual Domain Composite falls one standard deviation below the sample mean, the simple slope of the regression line is significant at -0.42 ($t(58) = -2.37, p = .02$), indicating a significant, negative relationship between self-injurious behavior and anxiety symptom severity for lower functioning individuals. No other interaction terms were significant predictors.

### Table 5. The Impact of Adaptive Behavior on the Relationship between RRB and Anxiety Symptom Severity ($n = 70$)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>β</th>
<th>95% CI for β</th>
<th>Partial Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong>: ABAS-II Conceptual Composite</td>
<td>0.030</td>
<td>[-0.212, 0.272]</td>
<td>.030</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Stereotypic Behavior</td>
<td>0.107</td>
<td>[-0.168, 0.382]</td>
<td>.097</td>
</tr>
<tr>
<td></td>
<td>Self-Injurious Behavior</td>
<td>0.030</td>
<td>[-0.238, 0.298]</td>
<td>.028</td>
</tr>
<tr>
<td></td>
<td>Compulsive Behavior</td>
<td>0.021</td>
<td>[-0.323, 0.366]</td>
<td>.016</td>
</tr>
<tr>
<td></td>
<td>Ritualistic/Sameness Behavior</td>
<td>0.643**</td>
<td>[0.241, 1.045]</td>
<td>.373**</td>
</tr>
<tr>
<td></td>
<td>Restricted Interests</td>
<td>-0.204</td>
<td>[-0.481, 0.073]</td>
<td>-.182</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Stereotypic Behavior Interaction</td>
<td>-0.137</td>
<td>[-0.477, 0.204]</td>
<td>-.105</td>
</tr>
<tr>
<td></td>
<td>Self-Injurious Behavior Interaction</td>
<td>0.447**</td>
<td>[0.171, 0.723]</td>
<td>.392**</td>
</tr>
<tr>
<td></td>
<td>Compulsive Behavior Interaction</td>
<td>0.003</td>
<td>[-0.389, 0.394]</td>
<td>.002</td>
</tr>
<tr>
<td></td>
<td>Ritualistic/Sameness Behavior Interaction</td>
<td>-0.029</td>
<td>[-0.477, 0.420]</td>
<td>-.017</td>
</tr>
<tr>
<td></td>
<td>Restricted Interests Interaction</td>
<td>-0.075</td>
<td>[-0.411, 0.262]</td>
<td>-.058</td>
</tr>
</tbody>
</table>

*Note.* CI = confidence interval; ABAS-II = Adaptive Behavior Assessment System – II

**p < .01
Table 6 presents the results when severity of mood symptoms is the outcome variable. The ABAS-II Conceptual Domain Composite was entered in the first step and did not predict a significant amount of variance in the outcome ($R^2 < .001$, $F(1, 68) = 0.024$, $p = .877$). The five RBS-R subscales were entered in the second step, and accounted for an additional 40.3% of the variance in mood symptom severity, which was statistically significant ($\Delta R^2 = .403$, $F(5, 63) = 8.510$, $p < .001$). Ritualistic and sameness behavior was a significant, positive predictor of mood symptom severity ($pr = .385$, $t(63) = 3.308$, $p = .002$) and had a medium effect ($f^2 = .21$). Restricted interests were a significant, negative predictor of mood symptom severity ($pr = -.272$, $t(63) = -2.243$, $p = .028$) and had a small effect ($f^2 = .09$). No other predictors were statistically significant.
The interaction terms between each of the RBS-R subscales and the ABAS-II Conceptual Domain Composite were entered in the third step, and accounted for an additional 14.9% of the variance in the outcome, which was statistically significant ($\Delta R^2 = .149, F(5, 58) = 3.869, p = .004$). The interaction term between self-injurious behavior and the ABAS-II Conceptual Domain Composite emerged as a significant, positive predictor of mood symptoms ($pr = .442, t(58) = 3.748, p < .001$) and had a medium effect ($f^2 = .32$); the nature of this two-way interaction is presented in Figure 2. When the ABAS-II Conceptual Domain Composite falls at the sample mean, the simple slope of the regression line is not significant at 0.05 ($t(58) = 0.40, p = .69$). When the ABAS-II Conceptual Domain Composite falls one standard deviation above the sample mean, the simple slope of the regression line is significant at 0.55 ($t(58) = 2.72, p = .009$), indicating a significant, positive relationship between self-injurious behavior and mood symptom severity for higher functioning individuals. When the ABAS-II Conceptual Domain Composite falls one standard deviation below the sample mean, the simple slope of the regression line is significant at -0.44 ($t(58) = -2.62, p = .01$), indicating a significant, negative relationship between self-injurious behavior and mood symptom severity for lower functioning individuals.

The interaction term between ritualistic and sameness behavior and the ABAS-II conceptual domain composite approached significance as a negative predictor of mood symptoms ($pr = -.215, t(58) = -1.678, p = .099$) and had a small effect ($f^2 = .05$); the nature of this two-way interaction is presented in Figure 3. When the ABAS-II Conceptual Domain Composite score falls at the sample mean, the simple slope of the
regression line is significant at 0.65 ($t(58) = 3.31, p = .002$), indicating a significant, positive relationship between ritualistic and sameness behavior and mood symptom severity for these individuals. This relationship is additionally significant and positive for lower functioning individuals with an ABAS-II Conceptual Domain Composite Score falling one standard deviation below the sample mean, with a simple slope of 1.01 ($t(58) = 4.07, p < .001$). Lastly, when the ABAS-II Conceptual Domain Composite Score falls one standard deviation above the sample mean, the simple slope of the regression line is non-significant at 0.28 ($t(58) = 0.85, p = .40$). No other interaction terms were significant predictors.

Table 6. The Impact of Adaptive Behavior on the Relationship between RRB and Mood Symptom Severity ($n = 70$)

<table>
<thead>
<tr>
<th>Step 1: ABAS-II Conceptual Composite</th>
<th>β</th>
<th>95% CI for β</th>
<th>Partial Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stereotypic Behavior</td>
<td>0.186</td>
<td>[-0.085, 0.458]</td>
<td>.170</td>
</tr>
<tr>
<td>Self-Injurious Behavior</td>
<td>0.052</td>
<td>[-0.210, 0.313]</td>
<td>.050</td>
</tr>
<tr>
<td>Compulsive Behavior</td>
<td>-0.011</td>
<td>[-0.353, 0.331]</td>
<td>-.008</td>
</tr>
<tr>
<td>Ritualistic/Sameness Behavior</td>
<td>0.648**</td>
<td>[0.256, 1.039]</td>
<td>.385**</td>
</tr>
<tr>
<td>Restricted Interests</td>
<td>-0.306*</td>
<td>[-0.578, -0.033]</td>
<td>-.272*</td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stereotypic Behavior Interaction</td>
<td>-0.225</td>
<td>[-0.549, 0.099]</td>
<td>-.180</td>
</tr>
<tr>
<td>Self-Injurious Behavior Interaction</td>
<td>0.495***</td>
<td>[0.231, 0.759]</td>
<td>.442***</td>
</tr>
<tr>
<td>Compulsive Behavior Interaction</td>
<td>0.195</td>
<td>[-0.181, 0.572]</td>
<td>.135</td>
</tr>
<tr>
<td>Ritualistic/Sameness Behavior Interaction</td>
<td>-0.366†</td>
<td>[-0.802, 0.070]</td>
<td>-.215†</td>
</tr>
<tr>
<td>Restricted Interests Interaction</td>
<td>-0.080</td>
<td>[-0.403, 0.244]</td>
<td>-.065</td>
</tr>
</tbody>
</table>

Note. CI = confidence interval; ABAS-II = Adaptive Behavior Assessment System – II
* $p < .05$; ** $p < .01$; *** $p < .001$; † $p < .1$
**Figure 2.** Two-Way Interaction between Self-Injurious Behavior and ABAS-II Composite Score Predicting Mood Symptom Severity

Note. Interaction was probed using Preacher, Curran and Bower’s (2006) web utility; ABAS = Adaptive Behavior Assessment System

**Figure 3.** Two-Way Interaction between Ritualistic/Sameness Behavior and ABAS-II Composite Score Predicting Mood Symptom Severity

Note. Interaction was probed using Preacher, Curran and Bower’s (2006) web utility; ABAS = Adaptive Behavior Assessment System
Table 7 presents the results when ADHD symptom severity is the outcome. The ABAS-II Conceptual Domain Composite was entered in the first step and did not predict a significant amount of variance in the outcome ($R^2 = .031$, $F(1, 69) = 2.226, p = .140$). The five RBS-R subscales were entered in the second step, accounting for an additional 31.9% of the variance in ADHD symptom severity, which was statistically significant ($\Delta R^2 = .319$, $F(5, 64) = 6.283, p < .001$). Stereotypic behavior was a significant, positive predictor of ADHD symptom severity ($pr = .406$, $t(64) = 3.551, p < .001$) and had a medium effect ($f^2 = .25$). No other predictors were statistically significant. The interaction terms between each of the RBS-R subscales and the ABAS-II Conceptual Domain Composite were entered in the third step, and did not account for a significant amount of additional variance in ADHD symptoms ($\Delta R^2 = .059$, $F(5, 59) = 1.171, p = .334$). No interaction terms emerged as significant predictors.

Table 7. The Impact of Adaptive Behavior on the Relationship between RRB and ADHD Symptom Severity ($n = 71$)

<table>
<thead>
<tr>
<th>Step 1: ABAS-II Conceptual Composite</th>
<th>β</th>
<th>95% CI for β</th>
<th>Partial Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereotypic Behavior</td>
<td>-0.177</td>
<td>[-0.413, 0.060]</td>
<td>-.177</td>
</tr>
<tr>
<td>Self-Injurious Behavior</td>
<td>0.133</td>
<td>[-0.138, 0.405]</td>
<td>.122</td>
</tr>
<tr>
<td>Compulsive Behavior</td>
<td>-0.248</td>
<td>[-0.602, 0.106]</td>
<td>-.172</td>
</tr>
<tr>
<td>Ritualistic/Sameness Behavior</td>
<td>0.217</td>
<td>[-0.187, 0.621]</td>
<td>.133</td>
</tr>
<tr>
<td>Restricted Interests</td>
<td>-0.027</td>
<td>[-0.308, 0.255]</td>
<td>-.024</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stereotypic Behavior Interaction</td>
<td>-0.221</td>
<td>[-0.591, 0.150]</td>
<td>-.153</td>
</tr>
<tr>
<td>Self-Injurious Behavior Interaction</td>
<td>-0.018</td>
<td>[-0.319, 0.283]</td>
<td>-.016</td>
</tr>
<tr>
<td>Compulsive Behavior Interaction</td>
<td>-0.178</td>
<td>[-0.607, 0.250]</td>
<td>-.108</td>
</tr>
<tr>
<td>Ritualistic/Sameness Behavior</td>
<td>0.224</td>
<td>[-0.271, 0.719]</td>
<td>.117</td>
</tr>
<tr>
<td>Restricted Interests Interaction</td>
<td>-0.077</td>
<td>[-0.443, 0.290]</td>
<td>-.054</td>
</tr>
</tbody>
</table>

Note. CI = confidence interval; ABAS-II = Adaptive Behavior Assessment System – II

*** $p < .001$
Table 8 presents the results when ODD symptom severity is the outcome. The ABAS-II Conceptual Domain Composite was entered in the first step and did not predict a significant amount of variance in the outcome ($R^2 < .001$, $F(1, 68) = 0.001, p = .977$). The five RBS-R subscales were entered in the second step, accounting for an additional 34.8% of the variance in the outcome, which was statistically significant ($\Delta R^2 = .348$, $F(5, 63) = 6.711, p < .001$). Ritualistic and sameness behavior was a significant, positive predictor of ODD symptom severity ($pr = .384, t(63) = 3.306, p = .002$), with a medium effect ($f^2 = .21$). Self-injurious behavior approached significance as a positive predictor ($pr = .214, t(63) = 1.743, p = .086$), with a small effect ($f^2 = .05$). The interaction terms between the RBS-R subscales and the ABAS-II Composite were entered in the third step and did not account for a significant amount of additional variance in the outcome ($\Delta R^2 = .065$, $F(5, 58) = 1.287, p = .282$). No interaction terms emerged as significant predictors.

### Table 8. The Impact of Adaptive Behavior on the Relationship between RRB and ODD Symptom Severity ($n = 70$)

<table>
<thead>
<tr>
<th>Step 1: ABAS-II Conceptual Composite</th>
<th>$\beta$</th>
<th>95% CI for $\beta$</th>
<th>Partial Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereotypic Behavior</td>
<td>-0.065</td>
<td>[-0.351, 0.220]</td>
<td>-0.057</td>
</tr>
<tr>
<td>Self-Injurious Behavior</td>
<td>0.239†</td>
<td>[-0.035, 0.512]</td>
<td>0.214†</td>
</tr>
<tr>
<td>Compulsive Behavior</td>
<td>-0.143</td>
<td>[-0.500, 0.214]</td>
<td>-0.100</td>
</tr>
<tr>
<td>Ritualistic/Sameness Behavior</td>
<td>0.676**</td>
<td>[0.267, 1.084]</td>
<td>0.384**</td>
</tr>
<tr>
<td>Restricted Interests</td>
<td>-0.177</td>
<td>[-0.467, 0.113]</td>
<td>-0.152</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereotypic Behavior Interaction</td>
<td>-0.047</td>
<td>[-0.421, 0.327]</td>
<td>-0.033</td>
</tr>
<tr>
<td>Self-Injurious Behavior Interaction</td>
<td>0.113</td>
<td>[-0.190, 0.417]</td>
<td>0.098</td>
</tr>
<tr>
<td>Compulsive Behavior Interaction</td>
<td>-0.217</td>
<td>[-0.647, 0.213]</td>
<td>-0.131</td>
</tr>
<tr>
<td>Ritualistic/Sameness Behavior</td>
<td>0.037</td>
<td>[-0.464, 0.538]</td>
<td>0.019</td>
</tr>
<tr>
<td>Restricted Interests Interaction</td>
<td>-0.215</td>
<td>[-0.599, 0.169]</td>
<td>-0.146</td>
</tr>
</tbody>
</table>

Note. CI = confidence interval; ABAS-II = Adaptive Behavior Assessment System – II

** $p < .01$; † $p < .1$
The secondary goal of this study examined the impact of level of functioning on the relationship between RRB and psychiatric symptoms. Level of functioning did not emerge as a significant predictor of any of the four psychiatric symptom domains, and the significant relationships between RRB and psychiatric symptoms did not change after controlling for level of functioning. However, level of functioning acted as a moderator in the relationship between self-injurious behavior and both mood and anxiety symptom severity, where self-injurious behavior was positive predictor of these psychiatric symptoms for higher functioning individuals and a negative predictor for lower functioning individuals. Additionally, level of functioning approached significance as a moderator in the relationship between ritualistic and sameness behavior and mood symptom severity, where ritualistic and sameness behavior was a positive predictor of mood symptoms for lower functioning individuals, but did not act as a significant predictor for higher functioning individuals.
Chapter 4: Discussion

The presence of RRB is a core diagnostic criterion for ASD; RRB additionally occur as part of typical development and in the course of several psychiatric disorders, including OCD and Tourette’s Syndrome. Individuals with ASD are more likely than typically developing individuals to have co-occurring psychiatric disorders and symptoms. Understanding the relationship between RRB and psychiatric disorders can ultimately lead to a better understanding of pathogenesis through refinement of ASD phenotypes used in genetic and neurobiological research.

Consistent with previous research, this study suggested relationships between RRB and psychiatric symptom severity. Like previous research (e.g., Lam, 2004; Mirenda et al., 2010), when considering zero-order correlations, this study found relationships between most types of RRB and psychiatric symptoms. However, these relationships were clarified by the use of multiple regression to identify which domains of RRB were most predictive of psychiatric symptom severity. Previous research has used varying measures of psychiatric symptoms (including parent report of a co-morbid diagnosis, the ABC, CBCL and CY-BOCS), primarily focusing on broader domains of behavior potentially associated with psychopathology, such as irritability, hyperactivity and internalizing or externalizing problems. This is the first study to consider specific symptoms of DSM-IV-TR diagnoses using a standardized rating scale, leading to clear and specific relationships between various types of RRB and symptoms of psychiatric
disorders. As previously discussed, most of the previous research has not considered the impact of level of functioning on the relationship between RRB and psychiatric symptoms. Overall, this study clarified the relationship between RRB and psychiatric symptoms by identifying relationships between specific types of RRB and specific domains of psychiatric symptoms.

Surprisingly, anxiety, mood, ADHD and ODD symptom severity on the CSI-4 were unrelated to level of functioning as measured by the ABAS-II Conceptual Domain. This is inconsistent with previous research showing relationships between IQ and the presence of psychiatric disorders (e.g., Estes et al., 2007; Gadow et al., 2008); however, the lack of a relationship between psychiatric symptom severity and adaptive behavior was recently observed in a study using a similar design in individuals with ID (Kaat, 2011). Further research is needed to fully understand the relationship between IQ, adaptive behavior and co-occurring psychiatric disorders in both ASD and ID populations.

This study additionally found that the majority of the measured domains of RRB were unrelated to level of functioning, as measured on the conceptual domain of the ABAS-II, which is inconsistent with previous research (e.g., Bishop et al., 2006; Carcani-Rathwell et al., 2006). There was a significant, negative relationship between stereotypic behavior and the ABAS-II Conceptual Domain composite scores in this study, which is consistent with previous research showing that stereotypic movement is a low-level RRB, occurring more frequently in lower functioning individuals. However, this study failed to identify repetitive self-injury as a low-level RRB or restricted interests, ritualistic and
sameness behavior and compulsive behavior as high-level RRB as has been shown in previous research. Previous research has used measures of IQ, such as the *Differential Ability Scales* and *Wechsler Intelligence Scales for Children*, to evaluate level of functioning, and has not considered adaptive behavior, which could potentially lead to the differences in these results. However, Gabriels and colleagues (2005) found that overall adaptive behavior, as assessed on the *Vineland Adaptive Behavior Scales* (VABS), showed a strong, negative correlation with the total score on the RBS-R, which was not found in this study. However, as this study only used the conceptual domain of the ABAS-II, the range of possible scores is limited, especially on the lower end (minimum possible standard score is 49), which may impact the ability to find associations between these scores and RBS-R scores. Further research is needed to better understand the relationship between IQ, adaptive behavior and RRB in the ASD population.

**RRB and Anxiety Symptoms**

Anxiety symptom severity was positively associated with the presence of ritualistic and sameness behavior as hypothesized. High levels of ritualistic behavior in typically developing children are known to be associated with fearfulness and shy and emotional temperaments and cause impairment in daily functioning (e.g., Zohar & Felz, 2001). Additionally, cognitive-behavioral models of anxiety highlight the role of safety behaviors in the onset and maintenance of anxiety and anxiety-related cognitions (for review, see Helbig-Lang & Petermann, 2010). These safety behaviors related to anxiety can look quite similar to ritualistic behaviors in individuals with ASD, such as insistence on sameness and objecting to visiting new places. Studies investigating these behaviors
in children and adolescents with ASD have found strong associations between the presence of insistence on sameness behaviors and anxiety (e.g., Rodgers, Glod, Connolly, & McConachie, 2012), and have found that anxiety often motivates the broad category of RRB (Joosten, Bundy, & Einfeld, 2009). Future research should consider whether anxiety specifically motivates ritualistic and sameness behaviors in children and adolescents with ASD.

Surprisingly, anxiety symptom severity was not associated with the presence of repetitive compulsive behaviors as was hypothesized. The compulsive behavior subscale of the RBS-R includes items such as excessively cleaning certain body parts, repeatedly checking doors and counting items or objects, which are behaviors commonly seen in individuals with OCD. However, OCD symptoms were not assessed using the CSI-4 for this study as the DSM-5 proposal indicates that OCD will likely be removed as an anxiety disorder and listed under a new category of obsessive-compulsive and related disorders. Had OCD symptoms been measured using the CSI-4 or another instrument, it is likely that the compulsive subscale of the RBS-R would show a positive correlation with OCD symptom severity.

RRB and Mood Symptoms

The results of this study additionally indicated that mood symptom severity was positively associated with ritualistic and sameness behavior, which was not hypothesized, but makes sense given the high co-occurrence of mood and anxiety symptoms in the general population (e.g., Kessler et al., 1996), which has also been observed in typically developing children and adolescents (e.g., Cole et al., 1998). This study also found a
high correlation between the CSI-4 anxiety and mood domains ($r = 0.716$). However, adaptive behavior approached significance as a moderator for the relationship between ritualistic and sameness behavior and mood symptom severity, with this relationship being strongest for lower functioning individuals. It is unclear why this relationship would be stronger in lower functioning individuals. Further research is needed to understand why ritualistic and sameness behavior is associated with mood symptoms and to clarify the potential moderating role of level of functioning in this relationship.

Mood symptom severity was negatively correlated with the restricted interests subscale of the RBS-R, which was not hypothesized. In a small-scale study focusing on restricted interests, Mercier, Mottron and Belleville (2000) conducted semi-structured interviews consisting of open-ended questions with six individuals with high-functioning autism (IQ above 75; ranging in age from 19 to 52) and their caregivers. The results suggested that restricted interests have a negative impact on interpersonal relationships, such as the individual with ASD frequently talking at length about their interest and, as a result, getting on the nerves of others. However, the results of these interviews also suggested that restricted interests positively influenced the lives of the individuals with ASD, providing a sense of well-being, a source of self-validation, a way of occupying one’s time and incentive to develop knowledge. While this was a small-scale study, it provided preliminary evidence that restricted interests may serve as a protective factor against the development of psychopathology; additionally, the current study found that higher levels of restricted interests were associated with lower levels of mood symptoms. More research is needed to understand the relationship between restricted interests and
mood symptoms and to understand if restricted interests serve as a protective factor against the development of mood and other psychiatric disorders in individuals with ASD.

It was hypothesized that mood symptom severity would be most strongly associated with repetitive self-injury, which was not a significant association. However, in the exploratory models considering the moderating effect of adaptive behavior, adaptive behavior significantly moderated the relationship of repetitive self-injury with both mood and anxiety symptom severity. For both the mood and anxiety domains, repetitive self-injury was positively associated with psychiatric symptom severity for higher functioning individuals whereas it was negatively associated with psychiatric symptom severity for lower functioning individuals. Self-injury in ASD, often biting, hitting or scratching oneself, typically takes a different form than self-injury in mood and other psychiatric disorders (typically cutting or burning oneself), and this does not seem to explain the relationship of self-injury with depression and anxiety in individuals with ASD.

Case studies regarding depression in ASD has suggested that increases or other changes in self-injurious behavior may co-occur with the onset of depression, suggesting a relationship between self-injury and depression (for review, see Stewart et al., 2006). Selective serotonin reuptake inhibitor (SSRI) medications, commonly prescribed for depression, have been used as a treatment for self-injury in individuals with ASD; however, research on this treatment has been inconsistent. A recent meta-analysis found that there is no effect of SSRI on reducing self-injury after controlling for publication
bias (Carrasco, Volkmar, & Bloch, 2012). However, this study suggests the potential for differing relationships between self-injury and mood symptoms based on level of functioning, suggesting that this could be considered in future research, including research considering the use of SSRI medications to treat self-injury.

**RRB and ADHD Symptoms**

Consistent with the initial hypothesis, ADHD symptom severity was positively associated with the presence of stereotypic behavior. The relationship between stereotypic motor movements and ADHD has been observed in typically developing children. For example, in a sample of 100 typically developing children with motor stereotypies, 30% were diagnosed with ADHD, which was the most common co-occurring condition (Harris, Mahone, & Singer, 2008), which is higher than the national estimated prevalence of 9.5% (Centers for Disease Control and Prevention [CDC], 2010). In an ASD population, Gabriels and colleagues (2005) found that total score on the RBS-R was strongly correlated with hyperactivity as measured by the ABC. The authors do not report the correlations of the RBS-R subscales with hyperactivity, so it is unknown if stereotypic behavior was strongly associated with hyperactivity in this sample. However, the authors argued that repetitive stereotypic movements may be associated with an overall higher activity level seen in ADHD. Additionally, animal models have shown that stereotypic movement and hyperactivity may both be related to striatal disinhibition, suggesting a common underlying etiology between this RRB and a psychiatric disorder (Garner & Mason, 2002).
RRB and ODD Symptoms

For ODD, ritualistic and sameness behavior was a significant, positive predictor of symptom severity and repetitive self-injury approached significance as a positive predictor. While other studies have found a relationship between the broad domain of RRB and ODD symptoms in children with ASD and co-occurring ODD and ADHD (e.g., Gadow, DeVincent, & Drabick, 2008), previous research has not investigated the specific relationships of self-injury and ritualistic and sameness behavior with ODD symptoms. Further research is warranted to investigate this relationship in other samples of children with ASD and to understand the nature of this relationship.

Limitations

Several limitations should be considered when interpreting the results of this study. The primary limitations occurred during recruitment. School district personnel were informed of the eligibility criteria for the study, but not all school districts followed these criteria. Several families called stating they were interested in participating, but that their child was not diagnosed with an ASD. Additionally, one mother completed and returned all study materials even though her child was younger than the age range indicated. It is impossible to know if all flyers were ultimately distributed to eligible families nor how many families received study information via email listservs or other on-line postings, thus making it quite difficult to calculate a response rate. Based on the number of flyers given to schools and service providers, approximately 13% of contacted families expressed interest in the study and approximately 7.6% of contacted families completed study materials; this is well below the desired 20% to 30% response rate. This
suggests that the ultimate sample may not be representative of the larger population of children and adolescents with ASD. However, demographic information, including classroom placement, parent-reported IQ and medication use, is consistent with previous research in the ASD population.

The sample size was lower than desired, which resulted in power levels slightly lower than the desired level of 0.80. For the primary hypothesis, with five predictors, a sample size of 71 provided a power of 0.75 when alpha is set at 0.05. For the secondary hypothesis, with six predictors, the sample size of 71 provided a power of 0.72 when alpha is set at 0.05. For the exploratory hypothesis, looking at level of functioning as a moderator, power was much lower than desired, at 0.57, with the given sample size, indicating that there are potentially moderating effects that were not identified in this study. Effect sizes were examined to identify potential moderating effects that did not reach statistical significance, such as the moderating effect of level of functioning on the relationship between ritualistic and sameness behavior and mood symptom severity. Additionally, many associations were explored in this study; the primary hypothesis investigated 20 different associations while the secondary hypothesis investigated 44 associations, raising the risk associated with type I error. As all statistical tests were planned a priori, a type I error correction was not employed; however, these results should be interpreted with caution until replicated in other, potentially larger, samples.

The secondary and exploratory hypotheses considered whether level of functioning impacted the relationship between RRB and psychiatric symptoms. Adaptive behavior was used to characterize level of functioning for this sample; however, it is
possible that a child’s adaptive behavior is significantly higher or lower than his or her IQ. IQ is strongly associated with adaptive behavior in individuals with ASD; for example, in a study of 1089 children with ASD (mean age 9.2 years), the zero-order correlation between IQ scores and the composite score on the VABS was .54. However, due to the core deficits in communication and socialization associated with ASD, scores on standardized adaptive behavior measures are typically lower than IQ scores (Kanne et al., 2011). As approximately 25% of parents reported that they did not know their children’s IQ, it is impossible to acquire this information without individual, standardized IQ testing. Although adaptive behavior is one aspect to consider when characterizing level of functioning, IQ scores should also be considered.

Conclusions

This study demonstrated relationships between several types of RRB and psychiatric symptom severity, further clarifying the relationship of RRB to these associated symptoms in individuals with ASD. Individuals with high levels of ritualistic and sameness behavior are more likely to show more severe symptoms of anxiety disorders, mood disorders and ODD. High levels of restricted interests are associated with less severe symptoms of mood disorders. Individuals with high levels of stereotypic behavior have more severe symptoms of ADHD, while individuals with high levels of self-injurious behavior have more severe symptoms of ODD. Level of functioning did not affect these relationships. However, level of functioning acted as a moderator in the relationship of self-injurious behavior and mood and anxiety symptoms. For higher functioning individuals, high levels of self-injury are predictive of more severe mood and
anxiety symptoms, whereas high levels of self-injury are predictive of less severe mood and anxiety symptoms for lower functioning individuals. Lastly, level of functioning approached significance as a moderator of the relationship of ritualistic and sameness behavior and mood symptom severity; for lower functioning individuals, high levels of ritualistic and sameness behavior predict more severe mood symptoms, while there is not a significant relationship for higher functioning individuals.

These results help clarify the presentation of ASD phenotypes, suggesting that different types of RRB are predictive of co-occurring psychiatric disorders in ASD. This has implications for genetic and neurobiological research in ASD; varying genetic bases of ASD may be identified in different samples based on the samples’ associated features, including RRB and co-occurring psychiatric symptoms. Further understanding of these associated features in ASD helps genetic and neurobiological researchers to identify more homogeneous samples as well as raises the potential for differing underlying genetic and neurobiological factors based on symptom presentation, including RRB and co-occurring psychiatric symptoms. Additionally, RRB and associated psychiatric symptoms may share common etiologies, raising the possibility that known interventions for psychiatric symptoms may additionally ameliorate RRB in individuals with ASD. The possibility that psychiatric symptoms could motivate RRB, such as anxiety motivating ritualistic behavior, or that RRB could act as a protective factor against the development of psychiatric symptoms, such as restricted interests protecting against the development of mood symptoms, should be explored in future research to further clarify the relationship between RRB and psychiatric symptoms.
Further research on the relationship between RRB and psychiatric symptoms is warranted. These associations should be confirmed in other samples of individuals with ASD, including adults with ASD and high functioning individuals with ASD. Attempts to replicate the findings of this study should consider using alternative measures. For example, the combination of standardized IQ testing with measures of adaptive behavior would better characterize the level of functioning of participants. Additionally, this study used a parent-completed rating scale to measure psychiatric symptoms and RRB. The use of semi-structured interviews, whether to characterize co-occurring psychiatric symptoms or RRB, allow clinicians to probe for clarifying information, which was not possible in this study due to the use of rating scales. Semi-structured interviews, such as the KSADS and ADI-R, could be used to assess co-occurring psychiatric symptoms and RRB. Observational methods, such as the *Autism Diagnostic Observation Schedule* (ADOS), allow clinicians to directly observe RRB, but are limited to the time sample used and the behaviors that were emitted during that time period; thus, observational methods should be supplemented with caregiver report through a rating scale or interview (Leekam, Prior, & Uljarevic, 2011).
References


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APPENDIX A: CHILD DEMOGRAPHIC FORM
Child Demographic Information

Today's date: _____ / _____ / _____

Child Information:

Your Child's Date of Birth (month/year): _____ / _____

Child's Age in Years: ________

Child's Gender: □ Male □ Female

Child's Ethnicity: □ White □ Asian-American
□ African-American □ Prefer not to answer
□ Hispanic □ Other: ____________________________

Please check your child’s most recent diagnosis on the autism spectrum:
□ Autism
□ PDD-NOS
□ Asperger’s Syndrome

Please indicate any other known diagnoses for your child:
□ Intellectual Disability (Mental Retardation)
□ ADHD
□ Anxiety Disorders (e.g. Obsessive-Compulsive Disorder, Generalized Anxiety Disorder)
□ Mood Disorders (e.g. Depression, Bipolar Disorder)
□ Conduct Disorder / Oppositional Defiant Disorder
□ Other: ______________________________________

Please indicate any medical conditions your child has:
□ Epilepsy / Seizures
□ Other: ______________________________________

What type of classroom does your child attend?
□ Regular Classroom □ Developmentally Handicapped
□ Partial Mainstream □ Multiple Handicapped
□ Cognitive Disability

What is your child’s level of intellectual functioning (IQ)?
□ Average (IQ greater than 80) □ Severe delays (IQ between 25 and 40)
□ Borderline (IQ between 70 and 80) □ Profound delays (IQ less than 25)
□ Mild delays (IQ between 55 and 70) □ Unsure / Don’t know
□ Moderate delays (IQ between 40 and 55)

Please continue to next page
Does your child currently take any prescription medications to help with behavior, mood or sleep problems (such as Ritalin, Risperdal, Prozac, melatonin or others)? ☐ Yes ☐ No
If yes, please list medications, as indicated on the medication bottle:
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Does your child have any sleep problems? ☐ Yes ☐ No
If yes, please indicate what the problem is:
☐ Has difficulty falling asleep
☐ Has difficulty staying asleep / frequent waking during the night
☐ Wakes up early
☐ Has difficulty waking up
☐ Other: ____________________________________________________________

Does the child have any first-degree relatives (parents or brothers/sisters) diagnosed with any of the following disorders? Please check all that apply
☐ Anxiety Disorders (e.g. generalized anxiety disorder)
☐ Obsessive Compulsive Disorder (OCD)
☐ Mood Disorders (e.g. depression)
☐ Bipolar Disorder
☐ Attention Deficit Disorder (ADD or ADHD)
☐ “Behavior Problem” [Oppositional Defiant Disorder (ODD)]
☐ Schizophrenia
☐ Autism, PDD-NOS or Asperger’s Syndrome
☐ Learning Disability
☐ Intellectual Disability / Mental Retardation

What is your relationship to the child?
☐ Mother ☐ Guardian
☐ Father ☐ Other: __________________________________________________________
APPENDIX B: *REPETITIVE BEHAVIOR SCALE, REVISED* (RBS-R)

[COPYRIGHTED MATERIAL – WITHHELD]
APPENDIX C: CHILD SYMPTOM INVENTORY – 4 (CSI-4)

[COPYRIGHTED MATERIAL – WITHHELD]
APPENDIX D: SOCIAL COMMUNICATION QUESTIONNAIRE (SCQ)

[COPYRIGHTED MATERIAL – WITHHELD]
APPENDIX E: ADAPTIVE BEHAVIOR ASSESSMENT SYSTEM – SECOND EDITION (ABAS-II): CONCEPTUAL DOMAIN

[COPYRIGHTED MATERIAL – WITHHELD]
APPENDIX F: STUDY INFORMATION FOR SCHOOL DISTRICTS
Dear «Name»,

I am a graduate student in Psychology at the Ohio State University, specializing in Intellectual and Developmental Disabilities and Clinical Psychology. For my master’s thesis, I am investigating the relationship between restricted and repetitive behaviors and psychiatric symptoms in children and adolescents with autism spectrum disorders (ASD). Dr. Luc Lecavalier, my faculty advisor, is supervising this study.

Restricted and repetitive behaviors are a defining feature of ASD. They also occur in typically developing children and as part of several psychiatric disorders. Additionally, children and adolescents with ASD exhibit high rates of psychiatric symptoms. Understanding the relationship between restricted and repetitive behaviors and psychiatric symptoms in children and adolescents will help to clarify the clinical presentation of ASD and ultimately assist in understanding the causes of ASD.

We are asking for your assistance in this study. We would like to distribute information about this study to parents of children with ASD in classrooms in your district. This information can be placed in the child’s backpack to go home. Parents who do not wish to participate can simply discard this information. Parents who choose to participate will complete a demographics form and four questionnaires, and will be compensated for their time. Information regarding participants will be kept confidential and anonymous.

We need the help of your district to reach these families.

We appreciate your assistance with this study. The study would not be possible without the help from school districts like yours! If you have any questions or concerns, please contact one of the investigators listed below.

Sincerely,

Elizabeth Stratis, B.A.  
Graduate Student  
I/DD and Clinical Psychology  
Nisonger Center, room 279  
The Ohio State University  
1581 Dodd Drive, Columbus OH 43210  
Elizabeth.Stratis@osumc.edu  
(614) 247-8028

Luc Lecavalier, Ph.D.  
Associate Professor  
Psychology and Psychiatry  
Nisonger Center, room 305  
The Ohio State University  
1581 Dodd Drive, Columbus OH 43210  
Luc.Lecavalier@osumc.edu  
(614) 292-2378
APPENDIX G: RECRUITMENT FLYER AND INTEREST FORM
The Relationship between Restricted and Repetitive Behaviors and Psychiatric Symptoms in Children with ASD

What is the study about?
This study will investigate the relationship between restricted and repetitive behaviors and psychiatric symptoms in children and adolescents with autism spectrum disorders.

What does the study involve?
Parents of children and adolescents with ASD are asked to complete a demographics form and 4 questionnaires about their child. These forms will be available in paper copies or online, and can be completed at the parents’ leisure. It is estimated that it will take approximately 75 minutes to complete all materials.

Who can participate?
Parents of children and adolescents, age 5 to 17, currently diagnosed with an ASD (including autism, Asperger’s Syndrome and PDD-NOS) are asked to participate. No other exclusionary criteria will be applied.

Participants in this study will receive a $10 gift card

Where can I get more information?
Complete and return the attached interest sheet, or contact Elizabeth Stratis, graduate student (614-247-8028 or Elizabeth.Stratis@osumc.edu) or Luc Lecavalier, Ph.D., faculty advisor (614-292-2378 or Luc.Lecavalier@osumc.edu).
Research Opportunity

The Relationship between Restricted and Repetitive Behaviors and Psychiatric Symptoms in Children with ASD

If you are interested in participating in this study, please complete this form, or contact Elizabeth Stratis, graduate student (614-247-8028 or Elizabeth.Stratis@osumc.edu) or Luc Lecavalier, Ph.D., faculty advisor (614-292-2378 or Luc.Lecavalier@osumc.edu)

☐ I would like to complete study materials online.
   Please provide your email address and we will send you the link to participate:

________________________________________________________________________

☐ I would like to complete paper copies of the study materials.
   Please provide the following information so that we can mail you the study materials:

First and last name: _________________________________________________________
Street Address: _____________________________________________________________
City, State, Zip: ___________________________________________________________

Please return this completed form to:
Elizabeth Stratis
279 McCampbell Hall
1581 Dodd Drive
Columbus, OH 43210
APPENDIX H: RECRUITMENT FLYER AND INTEREST FORM ("NOT ENDORSED BY THE SCHOOL DISTRICT")
The Relationship between Restricted and Repetitive Behaviors and Psychiatric Symptoms in Children with ASD

What is the study about?
This study will investigate the relationship between restricted and repetitive behaviors and psychiatric symptoms in children and adolescents with autism spectrum disorders.

What does the study involve?
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The opinions, products, activities and/or services of this organization are neither sponsored nor endorsed by the school district.
Research Opportunity

The Relationship between Restricted and Repetitive Behaviors and Psychiatric Symptoms in Children with ASD

If you are interested in participating in this study, please complete this form, or contact Elizabeth Stratis, graduate student (614-247-8028 or Elizabeth.Stratis@osumc.edu) or Luc Lecavalier, Ph.D., faculty advisor (614-292-2378 or Luc.Lecavalier@osumc.edu)

☐ I would like to complete study materials online.

Please provide your email address and we will send you the link to participate:

________________________________________________________________________

☐ I would like to complete paper copies of the study materials.

Please provide the following information so that we can mail you the study materials:

First and last name: _______________________________________________________

Street Address: __________________________________________________________

City, State, Zip: ________________________________________________________

Please return this completed form to:
Elizabeth Stratis
279 McCampbell Hall
1581 Dodd Drive
Columbus, OH 43210
APPENDIX I: RECRUITMENT FLYER AND INTEREST FORM

(“PARTICIPATION IS VOLUNTARY”)
Research Opportunity

The Relationship between Restricted and Repetitive Behaviors and Psychiatric Symptoms in Children with ASD

What is the study about?
This study will investigate the relationship between restricted and repetitive behaviors and psychiatric symptoms in children and adolescents with autism spectrum disorders.

What does the study involve?
Parents of children and adolescents with ASD are asked to complete a demographics form and 4 questionnaires about their child. These forms will be available in paper copies or online, and can be completed at the parents’ leisure. It is estimated that it will take approximately 75 minutes to complete all materials.

Who can participate?
Parents of children and adolescents, age 5 to 17, currently diagnosed with an ASD (including autism, Asperger’s Syndrome and PDD-NOS) are asked to participate. No other exclusionary criteria will be applied.

Participants in this study will receive a $10 gift card

Where can I get more information?
Complete and return the attached interest sheet, or contact Elizabeth Stratis, graduate student (614-247-8028 or Elizabeth.Stratis@osumc.edu) or Luc Lecavalier, Ph.D., faculty advisor (614-292-2378 or Luc.Lecavalier@osumc.edu).

Participation in this study is voluntary and can be discontinued at any time without prejudice to the participant.
Research Opportunity

The Relationship between Restricted and Repetitive Behaviors and Psychiatric Symptoms in Children with ASD

If you are interested in participating in this study, please complete this form, or contact Elizabeth Stratis, graduate student (614-247-8028 or Elizabeth.Stratis@osumc.edu) or Luc Lecavalier, Ph.D., faculty advisor (614-292-2378 or Luc.Lecavalier@osumc.edu)

☐ I would like to complete study materials online. Please provide your email address and we will send you the link to participate:

________________________________________________________________________

☐ I would like to complete paper copies of the study materials. Please provide the following information so that we can mail you the study materials:

First and last name: ________________________________

Street Address: _________________________________________

City, State, Zip: _______________________________________

Please return this completed form to:
Elizabeth Stratis
279 McCampbell Hall
1581 Dodd Drive
Columbus, OH 43210
APPENDIX J: STUDY INFORMATION (EMAIL) FOR PARENTS WHO ELECT TO COMPLETE ON-LINE
Dear Parent:

Thank you for your interest in this research study. I am a graduate student in Clinical Psychology at the Ohio State University, specializing in Intellectual and Developmental Disabilities. For my master’s thesis, I am investigating the relationship between restricted and repetitive behaviors and psychiatric symptoms in children and adolescents with autism spectrum disorders (ASD). Dr. Luc Lecavalier, my faculty advisor, is supervising this study.

Restricted and repetitive behaviors are a defining feature of ASD. They also occur in typically developing children and as part of several psychiatric disorders. Additionally, children and adolescents with ASD exhibit high rates of psychiatric symptoms. Understanding the relationship between restricted and repetitive behaviors and psychiatric symptoms in children and adolescents will help to clarify the clinical presentation of ASD and ultimately assist in understanding the causes of ASD.

We are seeking your assistance for this important study. Please carefully read over the following information as you consider participating in the study.

If you choose to participate in this study, we would like you to complete a demographics form and four questionnaires about your child. We estimate that this will take about 75 minutes of your time; please be aware that the forms will need to be completed in one sitting on the website. If you choose to participate, please complete and submit the study materials, using the link provided at the end of the letter.

You will be compensated for participating in this study. For completing and returning the study materials enclosed in this packet, we will provide you with a $10.00 gift card to your choice of Target or Walmart.

Your participation is voluntary. We hope that after reading this information, you will choose to complete and submit the materials. If you decide not to participate, there will be no penalty or loss of benefits to which you are otherwise entitled. You may choose not to participate in this study and close your web browser window at any time. Additionally, you may choose to skip any questions or stop participating at any time.

As this study involves research, there is some risk involved. While we believe that this study presents no more than minimal risk to you, there is concern for unauthorized disclosure of your information. Although every effort to protect confidentiality will be made, no guarantee of internet survey security can be given as, although unlikely, transmissions can be intercepted and IP addresses can be identified. However, we have taken steps to prevent this from occurring as much as is possible. Additionally, no information will be linked to your child’s personally identifiable information, such as his or her name. If you have any concerns or feel harmed by this study, please contact one of the researchers listed below. For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not directly involved with the study, you may contact the Office of Responsible Research Practices at 1 (800) 678-6251 or (614) 688-8457.

We are asking you to provide your child’s date of birth, current diagnoses, and current medications and your contact information. We are requesting that you provide this information to ensure that your child is eligible for the study, to accurately score questionnaires and to ensure
that you receive your incentive gift card. This information will not be shared or disclosed with individuals who are not involved with the study. If you choose to complete this study and would later like to revoke the authorization to use this information, please contact one of the study investigators listed below.

To maintain confidentiality, we will maintain strict control of all information collected. However, in certain circumstances, this information must be released. For example, information regarding this study may be disclosed if required by state law. Also, the information you provide may be reviewed by the following groups: the Office for Human Research Protections or other federal, state, or international regulatory agencies; The Ohio State University Institutional Review Board; or the Office of Responsible Research Practices.

We hope that you will take the time to complete and submit the following questionnaires. If you choose to participate, please follow this link https://edu.surveygizmo.com/s3/575306/OSUAutismStudy to begin completing the questionnaires. This study would not be possible without your help! If you have questions or would like more information regarding the study, please contact one of the investigators below. We appreciate your help as we investigate the relationship between restricted and repetitive behaviors and psychiatric symptoms. Thank you.

Sincerely,

Elizabeth Stratis, B.A.
Graduate Student, I/DD and Clinical Psychology
Nisonger Center, room 279
The Ohio State University
1581 Dodd Drive, Columbus OH 43210
Elizabeth.Stratis@osumc.edu
(614) 247-8028

Luc Lecavalier, Ph.D.
Associate Professor, Psychology and Psychiatry
Nisonger Center, room 305
The Ohio State University
1581 Dodd Drive, Columbus OH 43210
Luc.Lecavalier@osumc.edu
(614) 292-2378
APPENDIX K: STUDY INFORMATION (LETTER) FOR PARENTS WHO ELECT TO COMPLETE PAPER COPIES
Dear Parent:

Thank you for your interest in this research study. I am a graduate student in Clinical Psychology at the Ohio State University, specializing in Intellectual and Developmental Disabilities. For my master’s thesis, I am investigating the relationship between restricted and repetitive behaviors and psychiatric symptoms in children and adolescents with autism spectrum disorders (ASD). Dr. Luc Lecavalier, my faculty advisor, is supervising this study.

Restricted and repetitive behaviors are a defining feature of ASD. They also occur in typically developing children and as part of several psychiatric disorders. Additionally, children and adolescents with ASD exhibit high rates of psychiatric symptoms. Understanding the relationship between restricted and repetitive behaviors and psychiatric symptoms in children and adolescents will help to clarify the clinical presentation of ASD and ultimately assist in understanding the causes of ASD.

We are seeking your assistance for this important study. Please carefully read over the following information as you consider participating in the study.

If you choose to participate in this study, we would like you to complete a demographics form and four questionnaires about your child. We estimate that this will take about 75 minutes of your time. If you choose to participate, please complete and return the enclosed study materials.

You will be compensated for participating in this study. For completing and returning the study materials enclosed in this packet, we will provide you with a $10.00 gift card to your choice of Target or Walmart.

**Your participation is voluntary.** We hope that after reading this information, you will choose to complete and return the materials in this packet. If you decide not to participate, there will be no penalty or loss of benefits to which you are otherwise entitled. You may choose not to participate in this study and discard all study materials. Additionally, you may choose to skip any questions or stop participating at any time.

As this study involves research, there is some risk involved. While we believe that this study presents no more than minimal risk to you, there is concern for unauthorized disclosure of your information. However, we have taken steps to prevent this from occurring as much as is possible. Additionally, no information will be linked to your child’s personally identifiable information, such as his or her name. If you have any concerns or feel harmed by this study, please contact one of the researchers listed below. For questions about your rights as a participant in this study or to
discuss other study-related concerns or complaints with someone who is not directly involved with the study, you may contact the Office of Responsible Research Practices at 1 (800) 678-6251 or (614) 688-8457.

We are asking you to provide your child’s date of birth, current diagnoses, and current medications and your contact information. We are requesting that you provide this information to ensure that your child is eligible for the study, to accurately score questionnaires and to ensure that you receive your incentive check. This information will not be shared or disclosed with individuals who are not involved with the study. If you choose to complete this study and would later like to revoke the authorization to use this information, please contact one of the study investigators listed below.

To maintain confidentiality, we will maintain strict control of all information collected. However, in certain circumstances, this information must be released. For example, information regarding this study may be disclosed if required by state law. Also, the information you provide may be reviewed by the following groups: the Office for Human Research Protections or other federal, state, or international regulatory agencies; The Ohio State University Institutional Review Board; or the Office of Responsible Research Practices.

We hope that you will take the time to complete and return the enclosed questionnaires. This study would not be possible without your help! If you have questions or would like more information regarding the study, please contact one of the investigators below. We appreciate your help as we investigate the relationship between restricted and repetitive behaviors and psychiatric symptoms. Thank you.

Sincerely,

Elizabeth Stratis, B.A.
Graduate Student
I/DD and Clinical Psychology
Nisonger Center, room 279
The Ohio State University
1581 Dodd Drive, Columbus OH 43210
Elizabeth.Stratis@osumc.edu
(614) 247-8028

Luc Lecavalier, Ph.D.
Associate Professor
Psychology and Psychiatry
Nisonger Center, room 305
The Ohio State University
1581 Dodd Drive, Columbus OH 43210
Luc.Lecavalier@osumc.edu
(614) 292-2378
APPENDIX L: INCENTIVE FORM
Incentive Form

If you choose to participate in this study, you are entitled to receive a $10.00 gift card. However, in order to provide you with this incentive, we need to collect some basic information. If you do not wish to receive the $10.00 gift card, please do not complete this form.

Where should the gift card be sent?

First and Last Name: _______________________________________________________

Street Address: ___________________________________________________________

City, State, Zip: ___________________________________________________________

Please indicate if you would prefer a Target or Walmart gift card:

☐ Target
☐ Walmart

You should receive your gift card within a few weeks after submitting this form. If you have any questions regarding this incentive, or any other aspect of the study, please contact either of the study investigators:

Elizabeth Stratis, B.A.  Luc Lecavalier, Ph.D.
Graduate Student  Associate Professor
I/DD and Clinical Psychology  Psychology and Psychiatry
Nisonger Center, room 279  Nisonger Center, room 305
The Ohio State University  The Ohio State University
1581 Dodd Drive, Columbus OH 43210  1581 Dodd Drive, Columbus OH 43210
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APPENDIX M: TABLE M1. ZERO-ORDER CORRELATIONS AMONG ABAS-II
COMPOSITE, RBS-R SUBSCALES AND INTERACTION TERMS
Table M1. Zero-Order Correlations among ABAS-II Composite Score, RBS-R Subscales and Interaction Terms

<table>
<thead>
<tr>
<th></th>
<th>Stereotypic Interaction</th>
<th>Self-Injurious Interaction</th>
<th>Compulsive Interaction</th>
<th>Ritualistic/Sameness Interaction</th>
<th>Restricted Interests Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABAS-II Conceptual Composite</td>
<td>.254*</td>
<td>.215</td>
<td>.140</td>
<td>.119</td>
<td>-.094</td>
</tr>
<tr>
<td>RBS-R Stereotypic</td>
<td>-.298*</td>
<td>-.119</td>
<td>-.071</td>
<td>-.192</td>
<td>-.212</td>
</tr>
<tr>
<td>RBS-R Self-Injurious</td>
<td>-.131</td>
<td>-.138</td>
<td>-.044</td>
<td>-.155</td>
<td>-.156</td>
</tr>
<tr>
<td>RBS-R Compulsive</td>
<td>-.069</td>
<td>-.038</td>
<td>-.168</td>
<td>-.201</td>
<td>-.206</td>
</tr>
<tr>
<td>RBS-R Ritualistic/Sameness</td>
<td>-.175</td>
<td>-.128</td>
<td>-.191</td>
<td>-.313*</td>
<td>-.244*</td>
</tr>
<tr>
<td>RBS-R Restricted Interests</td>
<td>-.181</td>
<td>-.120</td>
<td>-.183</td>
<td>-.228</td>
<td>-.250*</td>
</tr>
<tr>
<td>Stereotypic Interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Injurious Interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compulsive Interaction</td>
<td>.711*</td>
<td>.647*</td>
<td>.628*</td>
<td>.256*</td>
<td></td>
</tr>
<tr>
<td>Ritualistic/Sameness Interaction</td>
<td>.654*</td>
<td>.605*</td>
<td>.384*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restricted Interests Interaction</td>
<td>.815*</td>
<td>.502*</td>
<td>.650*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Correlations that are redundant from Table 3 are omitted from this correlation matrix. Interaction terms are the identified RBS-R subscale with the ABAS-II conceptual domain composite. RBS-R = Repetitive Behavior Scale, Revised; ABAS-II = Adaptive Behavior Assessment System – II

* p < .05