AN EXAMINATION OF REPETITIVE AND RESTRICTED BEHAVIOR AND ASSOCIATED CHARACTERISTICS AMONG THOSE WITH AN AUTISM SPECTRUM DISORDER

By

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To my family, friends, and teachers

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Restricted and repetitive behaviors or interests (RRBIs) are considered a key feature among those diagnosed with an Autism Spectrum Disorders (ASD). To date, most of the research on ASDs has focused on social and communication deficits with less attention on RRBIs. Recently, an increase in research has been conducted to better understand RRBIs within the ASD population. Given the significance of RRBIs, further research and refinement of previous research is needed to better understand their development, expression, assessment, related clinical features (e.g., cognitive ability, adaptive functioning, and hyperactivity), and treatment. One area that has attracted attention is the structure of RRBIs among those with an ASD. Factor analytic studies using rating scales measuring RRBIs have found that RRBIs represent a heterogeneous category. Currently, factor analytic studies conceptualize RRBIs as representing between two and six different types of behavior.

The purpose of this study was to examine the types of RRBIs among those with an ASD. In addition, associated clinical features were examined including the role of

intelligence, age, adaptive functioning, and hyperactivity to measure their relationship to RRBI subtypes as well as overall repetitive behavior.

Results of this study found that a five types of RRBIs, which consisted of the following domains: Stereotyped Behavior, Self-Injurious Behavior, Compulsive Behavior, Ritualistic/Sameness Behavior, and Restricted Behavior. Internal consistency values for each of the factors were adequate. Results from the multiple regression analyses indicated that intelligence, adaptive functioning, and hyperactivity were the only variables to predict RRBIs. Future research is needed to replicate the findings in this research study.

CHAPTER 1
LITERATURE REVIEW

In 1943, Leo Kanner, was the first to distinguish ‘early infantile Autism’ from schizophrenia. Kanner identified several behaviors that were particular to Autism in his seminal paper titled “Autistic Disturbances of Affective Contact.” The term Autism was derived from the Greek term autos, meaning ‘self,’ after a critical examination of 11 case studies of individuals who displayed behaviors that were consistent with what he felt to be an inherent lack of interest in other people. Some of the salient behaviors he identified included an inability to relate to others, failure to use language in a meaningful way, a strong desire for things to stay the same, a lack of imaginative play, strong aptitude for rote memory, and repetitive motor behaviors and questioning (Kanner, 1943). Furthermore, abnormalities were present early in development, which made Autism different from previous descriptions of psychosis and schizophrenia.

A year later, Hans Asperger wrote “Autistic Psychopathy in Childhood,” which described four case studies with average intelligence or better who had difficulty with communication, social skills, and empathy. Asperger called these individuals “little professors,” because he felt they possessed exceptional academic achievement and cognitive abilities (Asperger, 1944). Later, Michael Rutter conducted a review of the literature related to Autism and highlighted four distinct areas associated with the disorder, including communication impairment, social interaction impairment, repetitive behavior, and onset of symptoms prior to the age of three (Rutter, 1978). Since the work of Kanner, Asperger, and Rutter, copious research has been conducted to better understand the characteristics, etiology, and development of an Autism Spectrum Disorder (ASD).

ASDs are considered neurodevelopmental disorders that occur early in development and are considered to have strong genetic underpinnings (Levitt & Campbell, 2009). Based on mono- and dizygotic twin studies, the estimated heritability rate of ASD symptoms ranges between .64 and .92 (Bailey et al., 1995; Ronald et al., 2006; Steffenburg et al., 1989). Prevalence rates in the United States indicate that on average, one in 88 individuals have an ASD (Center for Disease Control, 2012). Since the inception of ASDs as unique psychiatric conditions, significant increases in prevalence rates have been reported (Prior, 2003). The reason for the increase of ASD diagnoses is unknown at this time. While environmental factors may impact the development of ASDs, other factors such as changes in diagnostic methodology, increased awareness of ASD symptomology, or both, may have contributed to the upsurge of individuals diagnosed with an ASD (Gernsbacher, Dawson, & Goldsmith, 2005).

Classification Systems

The Diagnostic Statistical Manual (DSM) and the International Classification of Diseases (ICD) represent the most widely used classification systems to diagnose psychiatric conditions, including ASDs. The International Classification of Diseases is the standard classification system for establishing a diagnosis internationally; whereas the Diagnostic Statistical Manual is the standard classification system used in the United States. Both systems for classification have made significant revisions regarding the definition of Autism and related conditions. These changes have impacted how clinicians identify and treat those with an ASD.

In the International Classification of Diseases, Ninth Edition (World Health Organization, 1978), Autism and disintegrative disorders were considered a psychiatric

condition and were nested in the category of childhood psychotic conditions along with schizophrenia. The categorization of Autism and disintegrative disorders as a psychotic condition reflected the prevailing view at that time, which viewed Autism as a predictor of psychosis (Laufer & Gair, 1969).

The Diagnostic Statistical Manual, Third Edition (American Psychiatric Association, 1980) classification system was a major advancement in the diagnosis of ASDs. For the first time, ASDs were introduced under the umbrella term Pervasive Developmental Disorders to capture the developmental nature and pervasive impact on overall functioning. In addition, the ASD diagnosis was recognized as a separate condition from childhood psychoses. The definition used in the DSM-III utilized Kanner's (1943), Asperger's (1944), and Rutter's (1978) research to outline the criteria used to determine the presence of a Pervasive Developmental Disorder.

There were some shortcomings with the DSM-III classification system. For example, the definition in the DSM-III was highly specific but was not sensitive to determining the presence of an ASD, which led to significant revisions in the Diagnostic Statistical Manual, Third Edition, Revised (DSM-III-R; Volkmar, Cohen, & Paul, 1986). The DSM-III-R criteria expanded the diagnostic definition to account for differences in age and development and eliminated a specific age of onset as a core diagnostic feature despite significant reports indicating early onset as a hallmark feature of ASD. The criteria set forth for a diagnosis within the DSM-III-R were also found to be unsatisfactory because many individuals who were diagnosed with an ASD using the DSM-III-R were found to be false positives (Rutter & Schopler, 1992). In addition, those that had lower cognitive ability were more likely to receive a diagnosis, whereas those

who were higher functioning were less likely to be identified as having an ASD (Siegel, Vukicevic, & Spitzer, 1990). As a result of concerns regarding the accuracy of the criteria outlined in the DSM-III-R when determining an ASD diagnosis, further refinement of the diagnostic criteria was conducted through an extensive field trial and alignment of the criteria with the definition set forth in the International Classification of Diseases, Tenth Edition (ICD-10).

The criteria established in the Diagnostic and Statistical Manual, Fourth Edition (DSM-IV; American Psychological Association, 1994) was intended to improve the accuracy of an ASD diagnosis. Although the DSM-IV ASD criteria share features of the ICD-10, in order to create a universally accepted definition, they are not entirely the same. For example, the ICD-10 incorporates different criteria depending on the purpose of the diagnosis (i.e., research versus clinical). The DSM-IV was slightly modified and was renamed the DSM-IV-TR (American Psychological Association, 2000), which is the most recent version of the DSM.

Currently, the disorders that comprise ASDs include Autism, Asperger's syndrome (AS), and Pervasive Developmental Disorder, Not Otherwise Specified (PDD NOS). Although the defining characteristics of each disorder differ to some degree, according to the DSM-IV-TR, Autism is differentiated from other disorders through the presence of impairments in three core areas: communication, social skill functioning, and RRBIs. Communication impairment is characterized by either a delay in development or complete lack of spoken language; for those who can use speech, a significant impairment in sustaining conversations with others; and a lack of imaginative or imitative play. Social skill impairments are characterized by the failure to engage in

nonverbal interactions (e.g., making eye contact); develop age appropriate friendships; engage in social or emotional reciprocity. Restricted and repetitive behavior or interests are characterized by strict adherence to routines or rituals; preoccupation with a restricted behavior that is abnormal in terms of its intensity; preoccupation with parts of objects; and stereotyped and repetitive motor behaviors (e.g., hand flapping).

To receive a diagnosis of having Autism, an individual must exhibit six domains, with at least two social skill impairments, one communication impairment, and one RRBI. To receive a diagnosis of Asperger's syndrome, an individual cannot have a significant cognitive or communication impairment and must have at least two social skill impairments and one RRBI. To receive a diagnosis of PDD NOS, an individual must exhibit at least two criteria, with one social skill impairment, and one communication impairment or RRBI. In order to receive a diagnosis for an ASD, these behaviors must be present prior to the age of three (American Psychiatric Association, 2000).

Although these areas have been widely accepted as key features of ASDs, the identification of these three areas as three distinct areas has been based primarily on clinical observations and case studies rather than empirical research (Szatmari et al., 2006). Thus, it is possible that using these three separate core areas to determine whether a diagnosis is present may not adequately reflect the phenotypic nature of ASDs. Results of research examining the structure of ASD symptoms have been discrepant; however, many factor analytic studies suggest social and communication deficits are highly correlated and should be collapsed as a single factor (Frazier et al., 2008; Lord et al., 2006; Snow, Lecavalier, & Houts, 2009) and RRBIs should represent

a separate factor. In a review of 13 papers examining the factor structure of ASD symptomology, the majority of analyses resulted in the authors recommending a conceptualization of social and communication deficits as being collapsed into a social-communication factor and RRBIs as being a separate factor (Kuenssberg, McKenzie, & Jones, 2011).

Proposals for the ASD diagnostic criteria in the upcoming DSM-V, due for publication in 2013, have suggested changes that are in accord with previous research studies regarding the structure of ASDs. The DSM-V Task Force is proposing that a diagnosis of ASD should be based on two domains, Social-Communication Deficits and RRBIs (American Psychiatric Association, 2012). In addition, a proposal has been made to classify the disorder solely as “Autism Spectrum Disorder” rather than Pervasive Developmental Disorders. Elimination of other diagnostic terms is likely, such as PDD NOS or Asperger’s Syndrome. At this time, the diagnostic criteria for the DSM-V are in the process of being revised and have not been finalized.

The following sections will describe each core area in detail; however, it is important to note that these areas do not often occur in isolation and can overlap. For example, social interactions are impacted by nonverbal and verbal communication and vice versa. In addition, repetitive forms of communication may be considered a form of repetitive behavior.

Communication Deficits

Information about the development of language is essential to understanding ASDs. When compared to typically developing children, those with an ASD tend reach speech and language milestones later, and their language development tends to have abnormal features; however, there is significant variation in patterns of language

acquisition for those with ASD. For example, those with Asperger Syndrome have no communication delays or mild impairments, while some diagnosed with Autism or PDD NOS may never develop speech and language (American Psychiatric Association, 2000). Recent reports indicate that the rate of those who do not acquire speech with ASD is decreasing, which is possibly a result of improvements in early detection and intervention (Goldstein, 2002). Developmental delays in the area of speech and communication tend to be one of the most salient features of ASD and are the most frequently reported feature of ASD by parents (Di Giacomo & Frombonne, 1998; Short & Schopler, 1988).

During infancy, those with Autism tend to demonstrate nonverbal communication behaviors that deviate from what is expected based on age related norms. Typically developing infants engage in a wide variety of methods to communicate nonverbally before acquiring speech. For example, typically developing infants will reach towards an object to suggest a desire for something or push something away to suggest refusal. These methods of nonverbal communication reflect the desire to interact and communicate as well as an understanding of appropriate communication. Those diagnosed with Autism engage in these behaviors less frequently, which has been related to impairments in joint attention and the inability to imitate others (Osterling, Dawson, & Munson, 2002). In addition to displaying less frequent nonverbal methods of communication, prelinguistic children diagnosed with Autism frequently display abnormal speech production. For example, in a study comparing children with and without an ASD, those with an ASD engaged in babbling behavior at a similar rate to

those without an ASD; however, those with an ASD had more speech distortions and were more likely to squeal, growl, and yell (Sheinkopf, Mundy, Oller, & Steffens, 2000).

The nature of speech and language difficulties can change over the course of one's development, with approximately 25% of children with an ASD showing language regression between the ages of 12 and 18 months (Kurita, 1985). Another salient feature of Autism is the frequent presence of echolalia. Researchers have indicated two types of echolalia, immediate and delayed (Rydell & Miranda, 1996). Immediate echolalia occurs when one repeats what others have said using similar intonation or when one repeats words or phrases in a persistent manner immediately after hearing the stimulus. Delayed echolalia occurs several hours to days later and occurs repeatedly.

Individuals with higher levels of functioning tend to have less severe communication impairments; however, most have difficulty in the area of pragmatic language development, or the ability to use appropriate language based on the social context. Even those with very mild speech and language impairments are unable to use language that is consistent with the social milieu (Ramberg, Ehlers, Nyden, Johanssen, & Gillberg, 1996). For example, those who have difficulty with pragmatic language may have difficulty engaging in a conversation which alternates in a back and forth manner; may have difficulty establishing a joint frame of reference for the interaction; may make insensitive comments because of a lack of awareness regarding social norms; may not be able to take the listener's feelings into account; and may not be aware of how close they should stand near someone else during a conversation (Baltaxe, 1977; Ramberg et

al., 1996). These deficits also have a significant impact the ability to create and sustain meaningful social interactions.

Social Skills

Since Kanner's (1943) paper, social deficits have been considered the hallmark feature of Autism (Volkmar et al., 2005). Individuals diagnosed with an ASD exhibit impairments in various aspects of social processing, including eye contact, joint attention, play and leisure time, and peer relationships.

In terms of eye contact, typically developing infants prefer stimuli resembling the human eye as well as the human face, particularly the primary caregiver's face (Hainline, 1978). Those diagnosed with Autism tend to fail to establish eye contact patterns similar to typically developing infants (Volkmar & Mayes, 1990). This lack of eye contact appears to be significantly impaired in infants with Autism when compared to those with developmental delays or those with intellectual disability (Jones, Carr, & Klin, 2008). Parents with children diagnosed with Autism have reported that during early childhood avoidance of eye contact is common and often under reported, as indicated in retrospective research using home videos (Clifford & Dissanayake, 2009). These behaviors, in turn, negatively impact the nature of the caregiver-child relationship. As a result of limited eye contact between the caregiver and the child, it is difficult to establish shared emotional experiences and accurately infer others' mental states. Failure to develop quality interactions also impacts the ability to engage in communication that includes the exchange of information that includes additional variables within the environment. For example, an infant may cry and point to their bottle to signal that they are hungry, and then alternately gaze at their bottle to their caregiver. Engaging in these types of behaviors requires joint attention, which tends to be impaired in those

diagnosed with Autism and interferes with every domain of social interaction, including the ability to imitate appropriate social skills, develop social interactions, and engage in reciprocal play (Charman & Baron-Cohen, 1994).

A research study evaluating how children play indicated those with an ASD tend to play with toys and others in a markedly different manner compared to typically developing peers, including rigid repetitive and stereotyped play (Sherman, Shapiro, & Glassman, 1983). For example, a child may line toys up and then repeat this behavior several times. If this play is disrupted or altered, it can engender feelings of anxiety and frustration within the child with Autism. In addition, children with Autism tend to select toys on the basis of how they taste, feel, or move rather than for symbolic play. When engaging with others, those with Autism tend to be passive or odd in their approach with peers. In a study of 235 adolescents and adults with Autism, almost half of the participant's caregivers reported that their child had no peer relationships (Orsmond, Krauss, Seltzer, 2004, as cited in Volkmar et al., 2005).

Research examining differences between those with Asperger Syndrome versus those with Autism have found that individuals with Asperger Syndrome tend to be socially isolated. A major difference in social interaction between those with Asperger Syndrome versus those with Autism is that they are more likely to approach others but do so in an odd or inappropriate way. For example, those with Asperger Syndrome tend to engage in one-sided conservation about a circumscribed interest. In addition, those with Asperger Syndrome tend to approach others in an awkward fashion and may not be able to pick up on social cues (e.g., a yawn may indicate boredom; Klin & Volkmar, 1997, as cited in Volkmar et al., 2005).

Recent theory suggests that those with an ASD may have difficulty engaging in quality social interactions as a result of difficulty reading the emotions of others. Those with an ASD often have difficulties identifying emotional states of others which researchers have attributed to the failure to develop the ability to recognize how others are feeling, in terms of their beliefs, desires, and intentions (Volkmar et al., 2005). The inability to read other's cues limits the ability to develop meaningful relationships with others thus leading to poor socialization and communication.

Restricted and Repetitive Behavior

Although the presence of restricted and repetitive behaviors is one of the core features of ASD, they have been the subject of less attention than social and communication impairments (Lewis & Bodfish, 1998; Turner, 1999). As a result, many equivocal conclusions and unanswered questions exist regarding RRBIs within the ASD population. Until recently, RRBIs were often considered a result of social interaction and communication deficits (Baren-Cohen, Tager-Flusberg, & Cohen, 2000). However, there is evidence that RRBIs are distinctive from social and communicative performance. For example, those with high functioning Autism (HFA) or Asperger's syndrome, which is characterized by mild symptoms of social and communication deficits, can have significant impairments in the area of RRBI (Szatmari, Bryson, Boyle, Streiner, & Duku, 2003). Furthermore, individuals without an ASD diagnosis who have disorders that are characterized by social impairments, language impairments (e.g., specific language impairment and social anxiety), or both, do not necessarily display RRBIs. Conversely, those without an ASD diagnosis who have disorders that are characterized by RRBIs (e.g., Obsessive-Compulsive Disorder) do not necessarily display communication or social deficits. Family studies examining the heritability of ASDs suggest that genes

controlling RRBIs are likely independent of genes controlling social or communication deficits (Ronald et al., 2006; Silverman et al., 2002).

Comparative studies examining RRBIs between those diagnosed with an ASD, developmental disability (e.g., intellectual disability), psychiatric disorders (e.g., Obsessive-Compulsive Disorder), or neurologically based conditions (e.g., Tourette's syndrome) have been conducted to shed light on how RRBIs manifest in those with ASD relative to other impairments (Lewis & Bodfish, 1998).

In a study comparing stereotypic behaviors among 185 adults diagnosed with severe intellectual disability with ASD versus 1,060 adults diagnosed with severe intellectual disability without ASD using the Diagnostic Assessment for Severe Handicaps, Second Edition (DASH-II; Matson, 1995), 75% of those with ASD and intellectual disability had stereotypy behavior that exceeded the cutoff score on the stereotypy subscale whereas only 7% of those diagnosed with intellectual disability alone displayed stereotypy behaviors that exceeded the stereotypy subscale cutoff score (Matson et al., 1996). Similar results were found in a study comparing repetitive behavior between those with Autism versus those with intellectual disability matched on relevant subject characteristics (i.e., age, gender, and intelligence; Evans & Gray, 2000). Overall, research comparing those with ASD versus those with intellectual disability has found that those with ASD had higher levels of repetitive behaviors than those with intellectual disability. Additionally, those with an ASD reported greater levels of severity in the following domains: compulsions, self-injurious behavior, and stereotyped motor behavior. In terms of sameness behaviors and ritualistic behavior, those diagnosed with ASD tend to display more frequent insistence on sameness and

ritualistic behaviors compared to those without an ASD diagnosis (Bodfish, Symons, Parker, & Lewis, 2000).

Research has also compared obsessive and compulsive behavior among those with Autism versus those with Obsessive-Compulsive Disorder (OCD), an anxiety disorder characterized by unwanted thoughts and feelings that lead to feeling driven to perform a behavior in order to reduce anxious thoughts and feelings (American Psychiatric Association, 2000). A research study comparing those with Autism versus OCD found those with Autism were more likely to hoard, touch in patterns, engage in self-injurious behavior and were less likely to engage in checking behavior, report thoughts related to aggression, and desire symmetry. In addition, those with Autism displayed less complex obsessions, and reported higher levels of obsessions than compulsions (McDougle et al., 1995).

In a study comparing ASD to Prader-Willi Syndrome, a rare genetic disorder characterized by hypotonia, an insatiable appetite, and low levels of sex hormones, both groups shared similar levels of RRBIs (Greaves, Prince, Evans, & Charman, 2006). When examining individual items, those with ASD were more likely to line up objects, focus on minor details, and have specific food preferences whereas those with PWS were more likely to collect and store items. Although RRBIs are not specific to ASD, generally those with ASD tend to display a greater number and more severe levels of repetitive and restrictive behaviors when compared to other disorders (Bodfish et al., 2000; Greaves et al., 2006; Matson et al., 1996; McDougle et al., 1995).

The examination of RRBIs in research has been subject to limitations as a result of a lack of consensus in terminology, operational definitions, and validated assessment

tools to measure RRBIs (Lewis & Bodfish, 1998). Generally, among those diagnosed with an ASD, RRBIs include a wide variety of maladaptive behaviors including, but not limited to, stereotyped behavior, compulsions, obsessions, rituals, sameness behaviors, self-injurious behavior, and a narrow set of interests (Lewis & Bodfish, 1998). Stereotypies are repetitive motor movements that may not serve a clear purpose (e.g., hand flapping, spinning, and rocking); compulsions are repetitive behaviors that one feels driven to perform in order to reduce anxiety or distress; obsessions are pervasive thought patterns that can engender anxiety; rituals are repetitive behaviors that are governed by rules without a clear purpose (e.g., touching in patterns); sameness behaviors reflects a strong desire for things to be the same (e.g., wanting the furniture to stay in the same location); self-injurious behaviors are repetitive behaviors that cause harm or have the potential to cause harm to the individual (e.g., head banging or skin picking); and circumscribed interests or having a narrow interest and perseveration on that particular topic (e.g., an intense interest in natural disasters that deviates from typically developing children).

The expression of RRBIs varies in the frequency, typology, and level of intensity across individuals with an ASD. According to the DSM-IV-TR, this domain is defined as "restricted, repetitive, and stereotyped patterns of behavior, interests, and activities" (American Psychiatric Association, 2000, p. 75). To determine whether this criteria is met, clinicians are responsible for determining whether the client has displayed at least one of the following behaviors:

> (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; or (d) persistent preoccupation with parts of objects.

Although the behaviors outlined in the DSM-IV-TR are varied, they share similar characteristics, including repetition, persistence, inflexibility, and developmental inappropriateness. In addition, these behaviors tend to co-occur rather than occur in isolation and are more pervasive for those with severe ASD symptoms (Bodfish & Lewis, 2002). Recently, research has begun to evaluate the phenotype of RRBIs among those diagnosed with an ASD.

Types of Restricted and Repetitive Behavior

Debate exists over the number of RRBI subtypes that exist within those diagnosed with an ASD. In order to identify the phenotypic structure of RRBIs, studies have used Factor Analysis methodology to determine the number of RRBI subtypes. Factor analysis methodology allows researchers to examine whether items on the rating scale are correlated to form an underlying latent construct that are reflected in the measured variables (Field, 2009). Factor analysis allows researchers to possibly reduce a set from a group of interrelated variables to a smaller set of factors.

Factor analytic studies with samples diagnosed with ASD describe the RRBI domain as having multiple factors, thus suggesting that RRBIs represent a heterogeneous category (Cuccaro et al., 2003; Georgiades, Papageorgiou, & Anagnostou, 2010; Mirenda et al., 2010; Mooney, Gray, Tonge, Sweeney, & Taffe, 2009; Snow et al., 2009; Szatmari et al., 2006).

To date, most factor analytic studies used the Autism Diagnostic Interview, Revised (ADI-R; Le Couteur, Lord, & Rutter, 2003) a measure consisting of 111 items. The ADI-R is administered in a semi-structured interview format with a parent or

caregiver. The ADI-R is designed to help clinicians differentiate ASD from other conditions (e.g., intellectual disability), by collecting information on the core areas of impairment present in ASDs (i.e., social interaction, communication, restricted and repetitive behaviors) in addition to age of onset. Although the ADI-R was not intended to serve as a comprehensive measure of RRBIs, there are several items related to the RRBI domain that have been used in factor analytic studies. The majority of these studies have found two factors, including restricted and repetitive sensory motor behavior (RMSB) and insistence on sameness (IS) (Cuccaro et al., 2003; Mooney et al., 2009; Richler, Huerta, Bishop, & Lord, 2010; Shao et al., 2003; Szatmari et al., 2006). In addition, these studies have found that RSMB and IS account for approximately 32% to 36% of the variance in RRBIs.

Specifically, Cuccaro et al. (2003) used Principal Component Analysis (PCA) and Factor Analysis (FA) with promax rotation to estimate the number of factors using 12 items from the ADI-R. The sample consisted of 207 individuals between the ages of 3 and 21. A two-factor model was selected, which consisted of repetitive and sensory motor behaviors and insistence on sameness. Shao et al. (2003) conducted a PCA with a sample size of 221 between the ages of 3 and 21. Results also yielded a two-factor model, including repetitive and sensory motor behaviors and insistence on sameness. Szatmari et al. (2006) used PCA with a varimax rotation to determine the presence of two-, three-, and four-factor solutions using 11 items from the ADI-R. The sample consisted of 339 individuals with a mean age of 8.4 years. A two-factor model was selected and item loadings were almost identical to Cuccaro et al.'s (2003) findings. Mooney et al. (2009) used Exploratory Factor Analysis (EFA) and applied Principal

Factoring as the extraction method with12 ADI-R items. Results also yielded a two-factor model. Richler, Bishop, Kleinke, and Lord (2007) used Confirmatory Factor Analysis (CFA) to examine items from the ADI-R and also found support for a two-factor model.

Lam, Bodfish, and Piven (2008) added three items (i.e., unusual preoccupations, unusual attachments, and circumscribed interests) from the ADI-R using an initial PCA with a varimax rotation. Subsequently, information from the PCA was used to guide the EFA using the generalized least squares discrepancy function with a target rotation. Results indicated a three-factor model, including the repetitive motor behavior factor, insistency on sameness, and circumscribed interests. These three domains accounted for 52 % of the variance. Lam et al.'s (2008) study draws attention to a significant issue regarding the issue of having a limited number of items when examining the factor structure of RRBIs. A major limitation to using the ADI-R is the lack of items measuring RRBI behaviors. Because the ADI-R was not intended serve as a comprehensive measure of RRBIs, it is possible that the ADI-R does not adequately measure RRBIs for those with an ASD.

To address this limitation, factor analytic studies have begun to use the Repetitive Behavior Scale-Revised (RBS-R; Bodfish, Symons, & Lewis, 1999), a rating scale intended to capture a wide range of RRBIs for those with ASD (Georgiades et al., 2010; Lam & Aman, 2007; Mirenda et al., 2010). The RBS-R is comprised of 43 items, which compose six sub-scales: Stereotyped Behavior (i.e., movements that have no clear purpose and occur repeatedly); Self-injurious Behavior (i.e., behaviors that have the potential to harm one-self); Compulsive Behavior (i.e., behavior that an individual feels

driven to perform and must occur in a specific way); Ritualistic Behavior (i.e., performing a particular behavior in the same way with particular rules set by the individual); Sameness Behavior (i.e., insisting that things stay the same); and Restricted Behavior(i.e., limited interests; Bodfish et al., 2000).

Factor analytic studies using the RBS-R have yielded varied findings regarding the factor structure of RRBIs. For example, Georgiades et al. (2010) conducted Principal Factor Analysis (PFA) to examine the factor structure of RRBIs using the RBS-R in a sample that ranged between the ages of 2 and 48 years. Two factors similar to the RSMB and IS factors that have been found when analyzing the factor structure of the ADI-R were identified. The first factor, which resembled the RSMB domain, included self-injurious behavior and stereotyped behavior whereas the second factor, which resembled the IS domain, included compulsions, rituals, sameness, and restricted behavior.

Lam and Aman (2007) conducted Exploratory Factor Analysis (EFA) in a sample ranging between the ages of 3 and 48 and found five factors: (Factor 1) ritualistic and sameness behavior combined; (Factor 2) stereotyped behavior; (Factor 3) self-injurious behavior; (Factor 4) compulsive behavior; and (Factor 5) restricted behavior. Both Georgiades et al. (2010) and Lam & Aman (2007) used a wide age range to examine the factor structure of RRBIs.

Mirenda et al. (2010) is the only published study that has examined the factor structure of RRBIs as measured by the RBS-R with a narrow age using Confirmatory Factor Analysis (CFA), including 287 preschool-aged children between the ages of two and five with ASD. An evaluation of six competing models was conducted and based on

previous research. The first model included all RBS-R subtypes: stereotyped behavior, self-injurious behavior, compulsive behavior, ritualistic behavior, and restricted behavior. The second model included (Factor 1) stereotyped behavior, self-injurious behavior, restricted behavior; and (Factor 2) compulsive behavior, ritualistic behavior, and insistence on sameness. The third model included (Factor 1) stereotyped behavior and restricted behavior; (Factor 2) self-injurious behavior; and (Factor 3) ritualistic behavior, compulsive behavior, and insistence on sameness behavior. The fourth model included (Factor 1) stereotyped and restricted behavior; (Factor 2) self-injurious behavior; (Factor 3) compulsive behavior; and (Factor 4) ritualistic behavior and insistence on sameness. The fifth model included (Factor 1) stereotyped behavior; (Factor 2) self-injurious behavior; (Factor 3) compulsive behavior; (Factor 4) restricted behavior; and (Factor 5) ritualistic behavior and insistence on sameness. The sixth model included (Factor 1) stereotyped behavior; (Factor 2) self-injurious behavior; (Factor 3) compulsive behavior; (Factor 4) ritualistic behavior; (Factor 5) restricted behavior; and (Factor 6) insistence on sameness.

It is important to note that it is unclear how the three-factor and four-factor models were derived. The three factor model deviates from the only study to yield a three factor model using the ADI-R: Repetitive Sensory Motor Behaviors, Circumscribed Interests, and Insistence on Sameness (Lam et al., 2008). In addition, research studies to date have not selected a four-factor model. Mirenda et al. (2010) found support for a three- and five-factor model on the basis of model fit and parsimony. The structure of the five-factor model supports Lam and Aman's (2007) findings. Mirenda et al. (2010)

recommend the use of the three-factor model for genetics research and the five-factor model for research evaluating treatment effects.

In sum, factor analysis research suggest those with an ASD have multiple RRBIs. Results from the ADI-R suggest a two- or three-factor model. These results are limited because the ADI-R may not adequately sample RRBIs. As a result, factor-analytic studies using the RBS-R, a comprehensive measure of RRBIs, suggest a two-, three-, or five-factor model. Possible explanations for the variability in determining the number of factors include differences in the measurement of RRBIs, type of factor analytic method employed, and sample characteristics.

Although variability in the number of RRBI subtypes exists, research has begun to examine whether subject characteristics are related to RRBI subtypes. Similar to the two-factor model identified in many factor analytic studies, Turner (1999) proposed two categories of RRBIs related to cognitive ability, which are categorized as “lower-order” (e.g., stereotyped body movements, dyskinesias, self-injurious behavior, and repetitive manipulation of objects) and “higher-order” (e.g., insistence on sameness, ritualistic behavior, strong attachments to objects, and circumscribed interests) repetitive behaviors. The basis for the theoretical organization of RRBIs was based on the review of the literature examining RRBIs and cognitive ability. Turner (1999) suggests that lower-order RRBIs may be influenced by lower cognitive ability and higher-order RRBIs may be influenced by higher cognitive ability. The next section will explore research studies examining the relationship between intellectual functioning and RRBIs.

Intelligence and RRBI

Research studies evaluating the cognitive aspect of RRBIs have found some support for Turner’s (1999) theoretical categorization of RRBIs. To illustrate, in a study

comparing RRBIs among those with Autism versus those with Asperger Syndrome or PDD NOS, those with Autism had significantly higher RSMB behaviors whereas those with Asperger Syndrome had significantly higher IS behaviors (Szatmari et al., 2006). Lam (2004), found those with stereotypic behaviors and self-injurious behaviors were more likely to have severe/profound ID. Those demonstrating restricted behavior were more likely to have mild to moderate levels of intellectual impairment. A limitation to the study was the measurement of cognitive ability, which was measured by asking the parent or caregiver to identify whether the severity of mental retardation was mild, moderate, severe/profound, or don't know. It is possible that the individual completing the questionnaire did not know their child's intellectual functioning or answered in biased manner.

Militerni, Bravaccio, Falco, Fico, and Palermo (2002) studied RRBIs among 121 participants between the ages of 2 and 11 using items from the Yale-Brown Obsessive Compulsive Scale (Y-BOCS; Goodman et al., 1989), the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1986), the Aberrant Behavior Checklist (ABC; Aman & Singh, 1986), the Stereotyped Behavior Scale, and an "estimated" IQ score using the Griffiths Scale of Mental Development (Griffiths, 1976) or the Wechsler Intelligence Scale for Children, Third Edition (WISC-III, Wechsler, 1991).

Those who were between the ages of 2 and 4 were administered the Griffiths Scale of Mental Development whereas those between the ages of 7 and 11 were administered the WISC-III. The entire sample was divided into three subgroups, low IQ (<35), medium IQ (36-70), and high IQ (>70). They found that sensory and repetitive motor behaviors in Autism occurred more frequently in those with low levels of cognitive

functioning whereas complex repetitive activities and echolalia were more common in those with high levels of cognitive functioning. However, IS and a need for routines were not related to cognitive functioning. A limitation to the study included the measurement of intelligence. Combining intelligence tests in a single study and dividing the tests into three different groups presents measurement error. Furthermore, administration of intelligence tests on those between the ages of 2 and 4 may not accurately measure their intelligence. Intellectual functioning tends to become stable around the age of five (Bayley, 1949).

Bishop, Richler, and Lord (2006) compared the nonverbal intelligence quotient (NVIQ) and verbal intelligence quotient (VIQ) on the severity of RSMB versus IS behavior. The NVIQ and VIQ were established using the Mullen Scales of Early Learning (MSEL; Mullen, 1995) or the Differential Ability Scales (DAS; Elliot, 1990). Repetitive behavior was measured using the ADI-R (Le Couteur et al., 2003). They found that RSMBs were negatively related to NVIQ and VIQ; however, IS was not related to NVIQ or VIQ. Similar findings were reported in a study by Richler et al. (2010), which utilized a longitudinal approach using different intelligence tests depending on the severity of ASD symptoms. For those that were two-years-old or did not have the language ability to be administered the WISC-3 (Wechsler, 1991) or the DAS (Elliot, 1990), were administered the MSEL. Because the MSEL does not yield a separate NVIQ and VIQ score, the authors derived these scores using an extrapolation procedure (see Richler et al., 2007 for a complete description). Findings indicated that NVIQ was more strongly and negatively related to RSMB behaviors than IS behaviors (Richler et al., 2010). In a separate study comparing those with ASD versus those with

ASD with an intellectual disability (ID), those with a comorbid diagnosis of ASD and ID had greater levels of stereotyped movements and self-injurious behaviors. Having a comorbid diagnosis of ASD and ID was not related to IS, CI, or compulsive behaviors (Esbensen, Seltzer, Lam, & Bodfish, 2009).

Gabriels, Cuccaro, Hill, Ivers, and Goldson (2005) conducted a study of 14 participants to evaluate RRBIs using the RBS-R and their relationship with cognitive ability using the Leiter-R. These researchers examined RRBIs in those with low NVIQ scores, which was defined as an intelligence quotient (IQ) score equal to or less than 56 (N = 6), versus those with high IQ scores, which was defined as an IQ score of equal to or greater than 97 (N = 8). Their findings indicated that those with low NVIQs had higher levels of RRBIs (Gabriels et al., 2005). There were no significant differences between high versus low NVIQ among the six different subtypes of RBBIs with the exception of sameness behaviors. Those with lower NVIQ had significantly higher rates of sameness behaviors. A major limitation of this study was the small sample size of fourteen children and youth. It is quite possible that the small number of participants limited the ability to detect differences. The significant relationship between lower NVIQ and higher sameness behavior contradicts research suggesting that intelligence was not related to sameness behavior as measured by the Y-BOCS or ADI-R (Bishop et al., 2006; Esbensen et al., 2009; Militerni et al., 2002). However, these results support Bartak and Rutter's (1976) study, which found that insistence on sameness occurred in 82% of their sample diagnosed with Autism and Intellectual disability as compared to 42% of their sample diagnosed with Autism only.

In sum, research investigating the relationship between lower cognitive ability and lower-order RRBIs and higher cognitive ability and higher-order RRBIs provide conflicting results. Generally, findings do not support Turner's (1999) theoretical categorization of RRBIs. A major limitation to the studies examining the role of intelligence on RRBI subtypes has been the measurement of cognitive functioning. Presently, research studies primarily use categorical methods to measure cognitive functioning by asking raters to indicate the severity of cognitive impairment or quantify IQ by using a mixture of different intelligence tests (Bishop et al., 2006; Esbensen et al., 2009; Lam, 2004; Militerni et al., 2002; Richler et al., 2010). The problem with using a myriad of IQ tests is that little is known whether IQ performance among those with ASD is correlated across different measures of intelligence. Only one study to date has used a single IQ measure along with the RBS-R; however, their small sample size of 14 participants may have limited the statistical power to determine whether differences were present (Gabriels et al., 2005). Furthermore, most studies examining the relationship between IQ and RRBI expression has emphasized RSMB and IS behaviors, with little attention to other RRBI domains.

Another area of exploration is the examination of adaptive functioning on the manifestation of RRBIs. Research studies have consistently found that those with ASD have significantly lower adaptive functioning as compared to cognitive functioning (Liss et al., 2001; Volkmar et al., 1993). The relationship between IQ and adaptive functioning tends to be strongest for those with low IQ scores (Carpentieri & Morgan, 1996; Liss et al., 2001). Very few studies have examined the relationship between adaptive

functioning and restricted and repetitive behaviors. The next section describes the current literature examining the relationship between adaptive functioning and RRBIs.

Adaptive Functioning and RRBIs

Evans and Gray (2000) conducted a study comparing RRBIs in typically developing children along with those with Down syndrome matched on developmental level measured by the Vineland Adaptive Behavior Scales Screener and found that both groups showed the same levels of repetitive, ritualistic, and compulsive behavior. These results suggest that adaptive functioning may also impact the severity of RRBIs.

Liss et al. (2001) compared Autistic children who had low IQ scores or scores less than 80 versus those with high IQ scores, or scores equal to or greater than 80. They found that those who had high IQ scores had adaptive behaviors that were negatively correlated with total score of restricted and repetitive behaviors as measured by the Wing checklist (Wing, 1985). In a study examining risk factors for self-injurious behavior, those with lower adaptive functioning were more likely to engage in self-injurious behaviors (Baghdadli, Pascal, Grisi, & Aussilloux, 2003).

Recent research examining restricted and repetitive behavior subtypes using the ADI-R found that adaptive functioning as measured by the Vineland Adaptive Behavior Scales, Second Edition (VABS-II; Sparrow, Cicchetti, & Balla, 2005) had a significant negative correlation with RSMBs. In other words, those with higher levels of adaptive functioning had lower levels of RSMBs. However, adaptive functioning was not significantly correlated with IS (Cuccaro et al., 2003; Szatmari et al., 2006). There is evidence to suggest that while RSMBs are more closely related to developmental level, IS behaviors tend to have a familial basis and tend to be related to communication deficits (Szatmari et al., 2006). Similar to the research examining intelligence and

repetitive behavior, future research is needed to examine the relationship between adaptive functioning and RRBI subtypes. In addition, using scales that measure comprehensive RRBI behaviors may also improve our understanding of RRBIs among those with an ASD. The following section examines co-morbid conditions that are often observed in those diagnosed with an ASD.

Co-morbid Psychiatric Behavioral Problems and RRBIs

Those diagnosed with ASDs often experience psychiatric and behavioral symptoms beyond the core characteristics used to determine a diagnosis. Actual rates of mental health problems are not available because much of our understanding of co-morbid psychiatric conditions has been determined via clinical case reports or studies with small sample sizes. Estimates of those with ASD and mental health problems range between 4% and 58% (Lainhart, 1999). In a population-based study of youth and young adults, approximately 40% of those with Autism reported having at least one mental health breakdown (Bryson & Smith, 1998). Psychiatric conditions often reported in those with ASDs include depression (Howlin, 2000), anxiety disorders (Green et al., 2006), and bipolar disorder (Howlin, 2000). In a review of psychiatric conditions of 200 individuals diagnosed with ASD, over half of the sample was diagnosed with depression or anxiety disorders (Howlin, Goode, Hutton, & Rutter, 2004).

Mental health problems affect both low-and high-functioning individuals with ASD. However, identifying psychiatric disorders are difficult because of the manifestation of core symptoms. For example, those with low cognitive functioning, communication deficits, or both, may have difficulty expressing their symptoms. In addition, those with obsessions, hypersensitivity, flat affect, and echolalia may be misidentified as having symptoms of psychopathology. In terms of behavioral problems, those with ASD tend

to have high levels of inattention, irritability, and hyperactivity (Gabriels et al., 2005). In a study examining the influence of inattention, irritability, and hyperactivity, after controlling for IQ and adaptive functioning, hyperactivity was the only behavior significantly related to total RRBI scores on the RBS-R. These researchers did not examine the influence of hyperactivity on RRBI subtypes. In a study by Hattori et al. (2006), those with ASD were compared to those with Attention Deficit Hyperactivity Disorder (ADHD). The results indicated that they had similar levels of restricted and repetitive behaviors. Future research is needed to better understand the unique role hyperactivity may have on the severity of RRBIs. Furthermore, it is also important to consider the unique role development may have on the expression of RRBIs. The next section includes research examining the trajectory of RRBIs and subtypes over time.

The Relationship of Age and RRBIs

Cross-sectional and longitudinal studies suggest that age is associated with differences in RRBI manifestation in those with ASD (Esbensen et al., 2009; Mirenda et al., 2010; Richler et al., 2010). Cross-sectional research examining age-related changes have generally found that RRMB tend to abate as individuals become older (Esbensen et al., 2009; Lam & Aman, 2007) and are negatively related to adaptive functioning (Cuccaro et al., 2003; Szatmari et al., 2006); however, the trajectory of IS behavior is not as clear. For example, Bishop et al. (2006) and Mirenda et al. (2010) reported that IS behaviors increase with age, whereas Esbensen et al. (2009) reported a decline. It is possible that the research design may have been responsible for these differences.

Bishop et al. (2006) and Mirenda et al. (2010) used a younger sample with a narrower age range, while Esbensen et al. (2009) used a sample between the ages of 2 and 62. The only longitudinal study to date examining age-related patterns, using data

collected from the ADI-R at ages two, three, five, and nine. Results indicated that RRMB were elevated at a young age and remained elevated over time, and IS behavior were reported low at a young age and increased over time (Richler et al., 2010).

Purpose of Current Research Study

Although recent research has begun to explore the area of RRBIs, further research is needed to expand our understanding of RRBIs as well as associated features related to RRBIs. Research examining the factor structure of RRBIs using the ADI-R has found two (i.e., RSMBs and IS; Cuccaro et al., 2003; Mooney et al., 2009; Richler et al., 2010; Szatmari et al., 2006) and three factors (i.e., RSMBS, IS, and CI) (Lam et al., 2008). Research using the RBS-R has found two (Georgiades et al., 2010), three (Mirenda et al., 2010), and five factors (Lam & Aman, 2007; Mirenda et al., 2010). These inconsistencies have been associated varying statistical procedures and instruments used to measure of the structure of RRBIs as well as the use of a wide age ranges. Therefore, the primary purpose of this investigation is to determine the number of RRBI subtypes when using the RBS-R by examining which CFA model is the best-fitting with a school age sample ranging between the ages of 5 to 21 using CFA procedures.

The models used in the study were based on results from previous factor analytic research using the ADI-R and RBS-R and theory. The one-factor model included all six subscales in order to test the null hypothesis. The two-factor model consisted of: (Factor 1) stereotyped behavior, restricted behavior, and self-injurious behavior; and (Factor 2) compulsive, ritualistic, and sameness behavior. The three-factor model consisted of: (Factor 1) stereotyped behavior and self-injurious behavior; (Factor 2) compulsive, ritualistic, and sameness behavior; and (Factor 3) restricted behavior. This study

examined the three-factor model based on Lam et al.'s (2008) findings. The five-factor model consisted of: (Factor 1) stereotyped behavior; (Factor 2) self-injurious behavior; (Factor 3) compulsive behavior; (Factor 4) ritualistic and sameness behavior; and (Factor 5) restricted behavior. The six-factor model was based on the theoretical model created by the authors of the RBS-R and consisted of: (Factor 1) stereotyped behavior; (Factor 2) sameness behavior; (Factor 3) self-injurious behavior; (Factor 4) compulsive behavior; (Factor 5) ritualistic behavior; (Factor 6) restricted behavior.

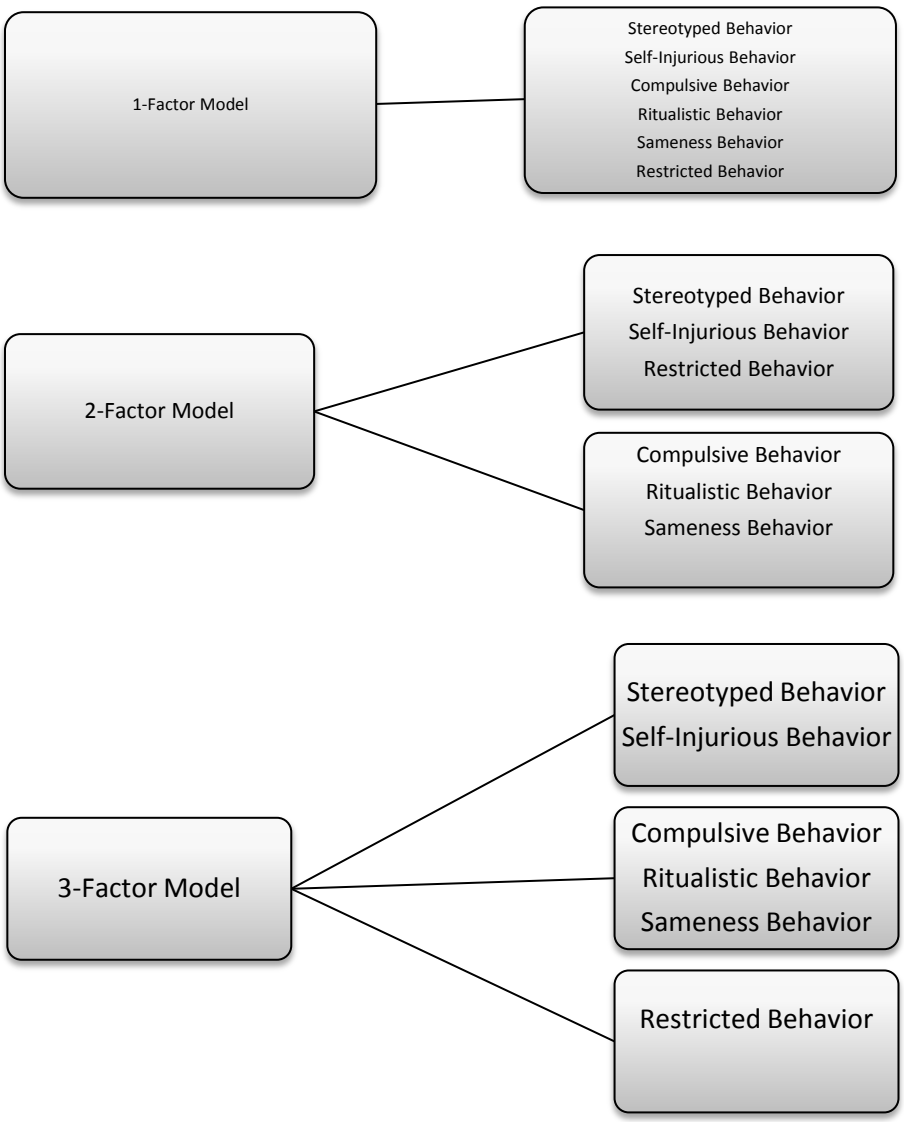
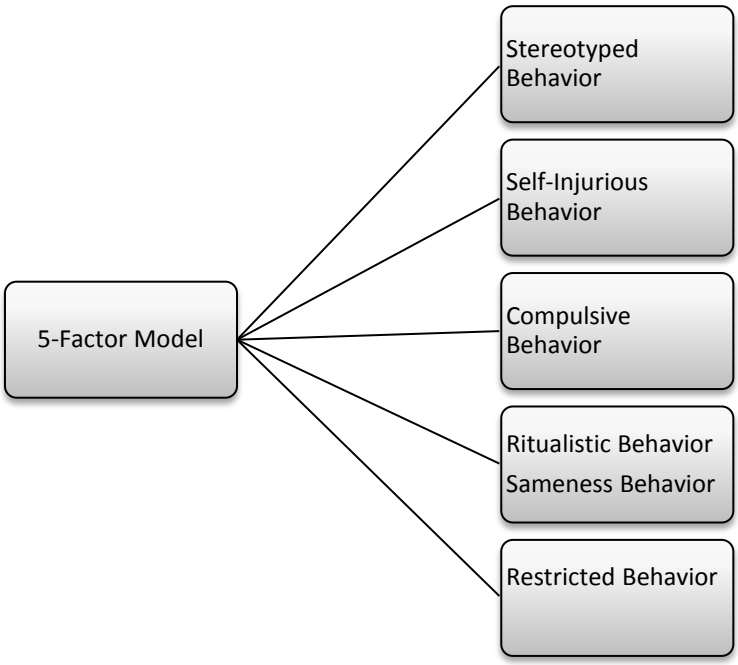


Figure 1-1 Rival Models Evaluated



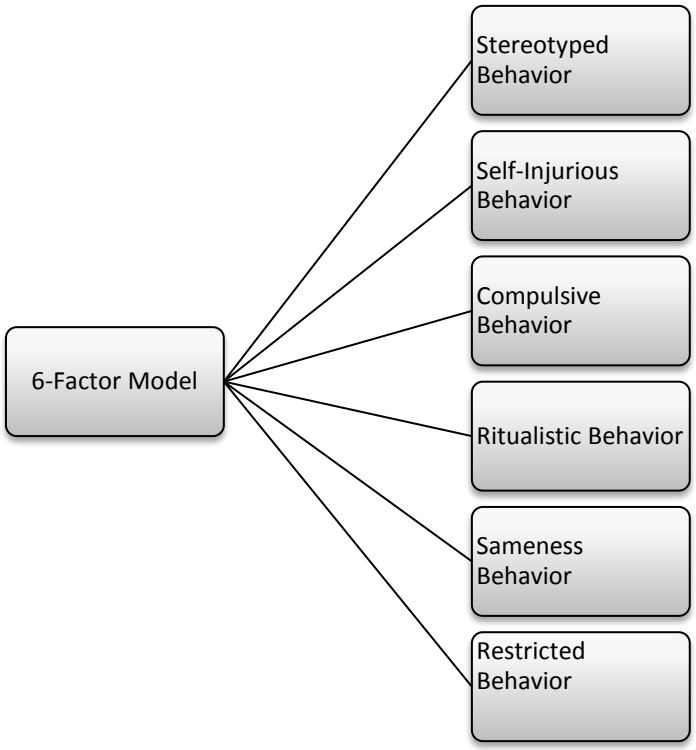


Figure 1-1 Continued

A secondary purpose of this study was to examine whether intelligence, adaptive functioning, hyperactivity, and age predict RRBI subtypes and overall repetitive behavior after determining the number of RRBI subtypes. A subset of the sample was used because not all of the participants were administered an intelligence test. The purpose of evaluating the role of intelligence, adaptive functioning, hyperactivity, and age was to address how individual characteristics may be related to RRBIs. Having an understanding of associated characteristics and their relationship to RRBIs may help improve our knowledge of RRBIs and inform intervention methods.

In terms of intelligence, this study examined Turner's (1999) categorization of higher-order and lower-order RRBIs on the basis of cognitive ability using a single intelligence measure in a moderately large sample. A major limitation to previous research examining the role of cognitive ability has been the measurement of intelligence. Previous research has quantified IQ by asking parents to check off their child's functioning while other studies have included a mixture of intelligence tests (Bishop et al., 2006; Esbensen et al., 2009; Lam, 2004; Militerni et al., 2002). In addition, many studies have treated IQ has a categorical variable rather than treating it as a continuous behavior. Only one study to date has used a single nonverbal intelligence measure along with the RBS-R; however, this research study had a small sample size of 14 and treated intelligence as being either high, equal to or greater than 97, or low, equal to or less than 56.

The present research study used a single nonverbal intelligence test, the Leiter-Revised (Roid & Miller, 1997). In addition, intelligence was measured as a continuous variable. Based on previous findings, it is hypothesized that lower cognitive ability will

predict higher levels of lower-order RRBIs (Bishop et al., 2006; Esbensen et al., 2009; Militerni et al., 2002). Previous findings have not consistently found significant and positive relationships between higher cognitive ability and increased levels of higher-order RRBIs; therefore, it is unclear whether higher cognitive functioning will be related to higher-order RRBIs. However, based on Turner's (1999) theoretical model, this study predicts that higher cognitive ability will be related to increased endorsements of higher-order RRBIs.

In addition to intelligence, this study will examine the relationship between adaptive functioning and RRBIs. Lower adaptive functioning is predicted to be related to higher overall repetitive behavior. To date, research has not examined the role of adaptive functioning on a wide-variety of RRBI subtypes. This study hopes to clarify whether adaptive functioning is related to RRBI subtypes using a comprehensive measure of RRBIs.

In terms of hyperactivity, it is hypothesized that hyperactivity will predict a greater frequency of RRBIs based on the work of Gabriels and colleagues (2005). However, research to date has not examined the role of hyperactivity on RRBI subtypes; therefore, this research study hopes to clarify whether hyperactivity has a differential impact on RRBI subtypes. In line with previous findings regarding the relationship between age and RRBIs, it is hypothesized that lower-order RRBIs would decrease as age increased; however, it is hypothesized that the inverse of this relationship will occur for higher-order RRBIs.

CHAPTER 2
METHODS

Participants

Participants consisted of 205 individuals between the ages, in months of 60 and 246. The average age was 122 months (SD = 41.4), with approximately half of the sample being between the ages of 60 and 108 months. There were more males (80.5%) than females (19.5%). The ratio of males to females is consistent with the Center for Disease Control (2012) finding, which estimates that ASD prevalence rates are 4 to 5 times higher for males as compared to females. The ethnic background was 83.4% non-Hispanic and 16.6% Hispanic. A majority of the participants reported their racial background was white (82.4%), followed by black (6.8%), and other (10.8%). The subsample consisted of 78 individuals with a mean age, in months, of 119.91 (SD = 41.4). There were 87.2% males and 12.8% females. The ethnic background of the subsample consisted of 90.7% non-Hispanic and 9.3% Hispanic. The racial breakdown was 78.2% white and 21.8% other. It should be noted that black, Asian, American Indian/Alaska Native, Native Hawaiian/Other Pacific Islander and the 'other' category were combined and labeled as 'other' due to the small number of participants in each category. Participants were selected based on their participation in at least one out of three ASD research studies at the University of Florida. In order to qualify for participation in these studies, participants must have had a clinical diagnosis of an ASD prior to participation. Participants were recruited primarily through their participation in the Center for Autism and Related Disabilities (CARD) and through the Psychiatry department at the University of Florida. This sample is primarily drawn from a rural area in the southeast area and may not reflect urban or other regional populations.

Participants were excluded from participating in the study if they reported having cerebral palsy or other neuromotor conditions as well as sensory conditions (i.e., blindness or deafness) because these conditions are also associated with RRBIs.

The University of Florida's Internal Review Board (IRB) approved these research studies and participants were treated in accord with the American Psychological Association's (2002) "Ethical Principles of Psychologists and Code of Conduct." Each study varied in terms of the data collected; however, there was significant overlap in methodology. For example, all participants had a parent or caregiver fill out rating scales related to restricted and repetitive behavior, adaptive functioning, hyperactivity, and social communication. In addition, a subset of the sample was administered intelligence tests. Table 3-1 presents descriptive data regarding participants.

Instruments

Health History Questionnaire

Parent's filled out a two-page questionnaire designed by the researchers to collect demographic, educational, and health history information, including the participant's age, gender, ethnicity, race, classroom type, interventions, the type of ASD diagnosis, the name of the clinician who made the diagnosis, whether other clinical diagnoses were present, the type of medication prescribed within the last three months, and whether family members have been diagnosed with ASD and/or co-morbid medical conditions.

Restricted and Repetitive Behaviors or Interests

The Repetitive Behavior Scale-Revised (RBS-R; Bodfish et al., 2000) was administered to capture a wide range of RRBIs. The RBS-R has a total of 43 items, which comprise six subscales, including stereotyped behavior, self-injurious behavior,

compulsive behavior, ritualistic behavior, sameness behavior, and restricted behavior. The items are rated on a Likert scale ranging from zero (i.e., the behavior does not occur) to three (i.e., the behavior occurs and is a severe problem). The subscales and items were conceptually grouped based on clinical experience. According to Lam's interview of Bodfish (2004), the authors of the rating scale conducted Principal Components Analysis and found support for six components corresponding to the original subscales based on the following criteria: scree test, eigenvalues >1, coefficient alpha >.60, salient loading >.30, item-total correlations between .20 and .70 (Bodfish, 2004, as cited in Lam, 2004). Inter-rater reliability ranged between .55 (Sameness Behavior) to .78 (Self-Injurious Behavior) and test retest coefficients ranged between .52 (Ritualistic Behavior) and .96 (Restricted Behavior). In a separate study, internal consistency of factors ranged between .78 (Restricted Behavior) and .91 (Ritualistic/Sameness Behavior; Lam & Aman, 2007).

Intellectual Functioning

In 1997, Roid and Miller revised the Leiter International Performance Scale to create the Leiter International Performance Scale-Revised (Leiter-R), a measure used to assess the cognitive functioning for those between the ages of 2 and 20 years, 11 months. The Leiter-R is administered in a non-verbal format where the examiner and examinee communicate without using speech, allowing for the assessment of children for whom traditional, verbally loaded intelligence tests may not be appropriate. This includes students who are hearing impaired, have limited English proficiency, and have moderate to severe speech or language impairments. The Leiter-R is particularly useful for those with an ASD because there are minimal to no language requirements, all subtests are untimed, and the structure of the test is similar across subtests, which may

make it easier for those who display insistence on sameness behaviors to transition into new activities (Tidmarsh & Volkmar, 2003). For this study, four subtests that comprise the Brief IQ Screener composite were administered: Figure Ground, Form Completion, Sequential Order, and Repeated Patterns. The tasks that comprise the Leiter-R include identifying a figure embedded in a larger picture, recognizing an object based on an array of its segmented parts, putting picture cards in sequential order, and selecting a picture that completes a sequence.

To obtain an IQ score, the sum of subtest scaled scores are converted to a scaled score (M = 100; SD = 15). The test was normed on a sample of 1, 719 individuals. The sample was carefully selected to be representative of individuals at these ages in the United States. The demographic background of the sample was diverse in terms of socio-economic background, ethnic background, and geographic location, and was based on 1993 population survey collected by the United States Census Bureau. Internal consistency reliabilities from the Brief IQ Screener ranged from .88 to .90 and test-retest reliability coefficients ranged from .88 to .96. Test-retest reliability coefficients on subtest performance ranged from .70 to .88.

In a study examining concurrent validity between the original Leiter and the Leiter-R among 26 individuals diagnosed with an ASD, there was a high correlation of .87 for the Brief IQ score (Tsatsanis et al., 2003). A separate study evaluating the profile of scores within those with an ASD as well as comparisons with those who are typically developing or developmentally delayed without an ASD found that those with an ASD demonstrated relative strengths in the ability to select objects from a larger picture and focus on process information focusing on specific details and relative weaknesses in the

areas of abstract thought and concept formation (Kuschner, Bennetto, & Yost, 2007). This contrasted with patterns of nearly equivalent abilities in the comparison groups and supports theories such as having weak central coherence, or limited ability to view an entire perspective because of attention given to smaller details. Further information regarding the psychometric properties of this instrument can be found in the Leiter-R Examiner's Manual (Roid & Miller, 1997).

Adaptive Functioning

Sparrow et al. (2005) created the Vineland Adaptive Behavior Scales, Second Edition (VABS-II), a norm-referenced measure, to assess the adaptive functioning for those between the ages of zero and 90. The VABS-II allows caregivers and teachers to rate an individual's adaptive functioning. The Survey Interview Form and the Parent/Caregiver Rating Form collects information from the primary caretaker to obtain an overall composite of adaptive functioning along with subscale scores in a variety of domains, including communication, daily living skills, socialization, and motor development. The two forms differ in the format in which they are administered (i.e., interview versus rating scale). This research study utilized parent's ratings of their child's adaptive functioning using the Parent/Caregiver Rating Form.

The test was normed on a random sample of 760 individuals. The demographics of the norm sample were based on the Current Population Survey, March 2001. Within each age group, there were approximately equal proportions of males to females matched on important demographic characteristics: race/ethnicity, socio-economic status, and geographic location. In addition, the norm sample was stratified on educational placement to ensure the proportional representation of those with disabilities. Internal consistency reliabilities, using the split-half method, were generally

high, with more than half of the Pearson correlation coefficients being above .90 and only 6% being below .80. When examining the correlations between the Survey Interview Form and the Parent/Caregiver Rating Form, median correlation coefficients ranged between .75 and .98. The VABS-II had sufficient test-retest reliabilities and inter-rater reliability across different age ranges. The utility of the VABS-II is also apparent when evaluating those with an ASD. Individuals with autism generally have lower adaptive functioning scores as compared to the normative sample. The lowest scores were in the areas of socialization as well as skills associated with expressiveness and leisure (Sparrow et al., 2005). Validity of the VABS-II was based on test content, evaluation of response-bias, test structure, criterion-related validity, and an analysis of clinical subgroup functioning. Further information regarding the psychometric properties of this instrument can be found in the VABS-II Examiner's Manual (Sparrow et al., 2005).

Hyperactivity

The Aberrant Behavior Checklist (Aman, Singh, Stewart, & Field, 1985) is a 58-item checklist with five domains: (1) Irritability, Agitation, Crying; (2) Lethargy, Social Withdrawal; (3) Stereotypic Behavior; (4) Hyperactivity; and (5) Inappropriate Speech. Parents or caregivers are asked to rate items on a four-point Likert scale ranging from zero (i.e., not at all a problem) to three (i.e., the problem is severe in nature). The hyperactivity composite from the ABC was used to measure hyperactivity, which consists of 16 items.

The structure of the ABC was developed using factor analysis, which has been supported in independent validation studies (Aman et al., 1985; Brinkley et al., 2007). The authors of the ABC reported Cronbach's alpha coefficients ranging from .86 to .94

across all subscales and indicated sufficient internal consistency (Aman et al., 1985). In addition, confirmatory factor analysis yielded a moderate fit for a five-factor model within a sample of 275 individuals with an ASD (Brinkley et al., 2007). The five-factors were labeled Irritability, Lethargy, Stereotypy, Hyperactivity, and Inappropriate Speech. Factor loadings ranged from .46 to .83. Convergent validity was established by comparing the ABC with respect to an analogous scale, the Behavior Problems Inventory (BPI; Peterson & Zill, 1986). Multiple regression analyses indicated the BPI predicted ABC subscale scores (Hill, Powlitch, & Furniss, 2008). In addition, the ABC has been found to be sensitive to measuring behavioral interventions using pharmacological interventions (Aman et al., 2003; Aman, Binder, & Turgay, 2004). In a randomized controlled study examining the effects of Risperidone, an anti-psychotic medication, improvements in disruptive behavior and hyperactivity were identified following treatment (Aman et al., 2004).

Statistical Analyses

Data were screened prior to conducting the analyses in order to examine whether there were any violations of assumptions as well as the presence of outliers. Descriptive statistics were conducted for all demographic, outcome, and predictor variables.

To examine the main objective of this study, a CFA was conducted for all rival models (i.e., one-, two-, three-, five-, and six-factor model) using the Mplus statistical software program (Muthén & Muthén, 1998-2010). After establishing the covariance between each of the variables, a model-fitting procedure was conducted using the Weighted Least Squares Mean and Variance Adjusted (WLSMV) estimator. In accordance with recommendations from previous literature (Hu & Bentler, 1999), model fit was evaluated using multiple methods, including an absolute fit index (i.e., chi-square

test), a parsimony correction index (i.e., root mean square error of approximation), and comparative fit indices (i.e., Comparative Fit Index and Tucker Lewis Index). The criteria for acceptable values for an acceptable goodness of fit were based on the work of Bollen and Long (1993), Dimitrov (2006), and Hu and Bentler (1999). The ratio of chi-square to degrees of freedom was set at a value less than 2 as an indication of acceptable fit. For RMSEA, the criteria were set at .08 for the lower-bound indicator of goodness of fit, and .06 as an indicator of a well-fitting model. For the Comparative Fit Index (CFI) and the Tucker Lewis Index (TLI), the value was set at a value of less than .90 for the lower-bound indicator for an adequate model of fit and values above .95 as a well-fitting model. Furthermore, the goodness-of-fit of a model was also conducted using the Maximum-Likelihood (ML) estimator in order to obtain the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). Generally, models with the lowest AIC and BIC values are considered to fit the data better as compared to the aforementioned methods, because these indices compare models by accounting for the complexity of each (Brown, 2006).

To address the secondary objective of the study, simultaneous multiple regression analyses using PASW 13.0 were conducted to examine how subject characteristics predict factor scores based on results from the CFA, as well as the RBS-R sum score. Multiple regression analyses included the same independent variables: intelligence, age, hyperactivity, and adaptive functioning. The dependent variable included the RBS-R sum score as well as factor scores.

CHAPTER 3
RESULTS

The results of this study are divided into four sections. The first section includes data screening procedures that were conducted in advance to evaluate whether assumptions guiding the specific analyses were met. The second section includes descriptive statistics for relevant variables in the study and correlation analyses to examine whether there were significant relationships between the RBS-R and ADI-R. The third section includes the results of the CFA. The fourth section includes the results of multiple regression analyses examining whether intelligence, age, adaptive functioning, and hyperactivity predict RBS-R sum and factor scores.

Data Screening

When conducting statistical analyses to test hypotheses, appropriate conclusions can be drawn when assumptions that are particular to the analysis are satisfied. Therefore, prior to conducting the analyses all variables used in the study were screened. Descriptive statistics for the entire sample and subsample can be found in Tables 3-1 and 3-2. Means, standard deviations, skewness and kurtosis values can be found in Tables 3-3 and 3-4. According to an analysis using the Mahalanobis Distance statistic, there were no statistically significant multivariate outliers. Tolerance values suggested that there was no statistically significant multicollinearity in the data. Univariate normality was assessed by examining scatter plots along with skewness and kurtosis values for each variable. According to Finney and DiStefano (2006), absolute values of skewness and kurtosis beyond 2 and 7, respectively, may indicate a lack of univariate normality. For all variables included in the study skewness and kurtosis

values were within normal limits. Skewness values ranged from .936 to 1.961 and kurtosis values ranged from .040 to 4.146.

Descriptive Statistics

Outcome Variables

Table 3-3 displays the mean ratings and standard deviations for outcome variables measured in the study, including stereotyped behavior, self-injurious behavior, ritualistic/sameness behavior, compulsive behavior, restricted behavior, and the RBS-R Sum Score. Item endorsements on the RBS-R were similar to endorsements from other ASD samples (Flores et al., 2011). Internal consistency for this measure was calculated using Cronbach's alpha. Coefficients for each subtest ranged between .74 and .91 for all five factors, indicating adequate or better internal consistency. These results support Lam and Aman's (2007) study using the RBS-R, which found Cronbach's alpha values between .78 and .91 (see Table 3-5).

Predictor Variables

Table 3-4 displays predictor variables measured in the study. Approximately half of the sample was between the ages of 60 and 108 months, with a mean age of 120.4 months (SD = 45.3). The mean score for hyperactivity was (M = 19.8; SD = 11.7). This finding is similar to Capone et al. (2005), who reported a mean hyperactivity score of 20.8 (SD = 10) for 61 individuals diagnosed with an ASD. The mean score for Intelligence was 90.1 (SD = 25.6) and lower than the scores in the standardization sample (M=100). These findings are consistent with a report of 129 individuals diagnosed with an ASD and administered the Leiter-R who had a mean IQ score of 89.6 (SD = 23; Grondhuis, Mulick, & Aman, 2010). Adaptive Functioning (M = 77.2) were also lower than the scores in the standardization sample (M = 100). These results were

expected given deficits in socialization and communication. These findings are in accord with Sparrow et al. (2005).

Correlational Analysis

Table 3-6 displays a correlation matrix between the RBS-R subscales and ADI-R items related to repetitive behavior. The correlation matrix included the six subscales that comprise the RBS-R as well as the thirteen items that comprise the Interests and Behaviors composite on the ADI-R. In addition, an item measuring self-injurious behavior and an item measuring verbal rituals from the ADI-R were included in the analysis based on their relevance to repetitive behavior among those with an ASD.

Although repetitive communication is not included in the RBS-R, the Verbal Rituals item was significantly and positively correlated only with stereotyped behavior ($r = .21$, $p < .01$). Repetitive Use of Objects was significantly and positively correlated with Stereotyped Behavior ($r = .32$, $p < .05$), Restricted Behavior ($r = .34$, $p < .01$) and the Sum score ($r = .29$, $p < .05$). Unusual Sensory Interests was significantly and positively correlated with Stereotyped Behavior ($r = .34$, $p < .01$), Self-Injurious Behavior ($r = .27$, $p < .05$), Restricted Behavior ($r = .25$, $p < .05$), and the Sum score ($r = .27$, $p < .05$). Sensitivity to Noise was significantly and positively correlated with Compulsive Behavior ($r = .32$, $p < .01$), Ritualistic Behavior ($r = .29$, $p < .05$), and the Sum score ($r = .28$, $p < .05$). Negative Responses to Sensory Stimuli was significantly and positively correlated with Self-Injurious Behavior ($r = .34$, $p < .01$). Difficulty with Minor Changes in Routine was significantly and positively correlated with Insistence on Sameness ($r = .48$, $p < .01$) and the Sum score ($r = .34$, $p < .01$). Resistance to Trivial Changes in routine was significantly and positively correlated with Stereotyped Behavior ($r = .27$, $p < .05$), Self-Injurious Behavior ($r = .31$, $p < .05$), Compulsive Behavior ($r = .35$, $p < .01$), Insistence

on Sameness ($r = .28$, $p < .05$), and the Sum score ($r = .36$, $p < .01$). Hand and Finger Mannerisms was significantly and positively correlated with Stereotyped Behavior ($r = .34$, $p < .01$). Stereotyped Body Movements was significantly and positively correlated with Stereotyped Behavior ($r = .43$, $p < .01$) and the Sum score ($r = .30$, $p < .05$). Self-Injury was significantly and positively correlated with Stereotyped Behavior ($r = .35$, $p < .01$), Self-Injurious Behavior ($r = .68$, $p < .01$), Ritualistic Behavior ($r = .28$, $p < .05$), and the Sum score($r = .32$, $p < .05$).

Unusual preoccupations, Circumscribed Interests, Compulsions and Rituals, Unusual Attachments to Objects, and Midline Hand Movements were not significantly correlated with the RBS-R subscales or total score.

Confirmatory Factor Analysis

An examination of the RBS-R factor structure was conducted using CFA with the Mplus software program. Scores for each of the 43 items were entered into the analysis using the entire sample (N = 205). Five individual models were tested: (Model 1) a one-factor or general factor model consisting of all 43 items; (Model 2) a two-factor model consisting of (Factor 1) stereotyped behavior, restricted behavior, and self-injurious behavior; and (Factor 2) compulsive behavior, ritualistic behavior, and sameness behavior; (Model 3) a three-factor model consisting of (Factor 1) stereotyped behavior and self-injurious behavior; (Factor 2) compulsive behavior, ritualistic behavior, and sameness behavior; and (Factor 3) restricted behavior; (Model 4) a five-factor model consisting of (Factor 1) stereotyped behavior; (Factor 2) self-injurious behavior; (Factor 3) compulsive behavior; (Factor 4) ritualistic and sameness behavior; and (Factor 5) restricted behavior; and (Model 5) a six-factor model consisting of (Factor 1)

stereotyped behavior; (Factor 2) sameness behavior; (Factor 3) self-injurious behavior; (Factor 4) compulsive behavior; (Factor 5) ritualistic behavior; (Factor 6) behavior.

As can be seen in Table 3-7, the six-factor model had the best goodness-of-fit, based on multiple criteria as well as the lowest AIC and BIC values. A follow-up analysis of the standardized solutions for the six-factor model was conducted to evaluate the correlations of each factor within the six-factor model. There was a high correlation between the fourth and fifth factor, indicating that they are very similar and could be combined (see Table 3-10). As a result, the five-factor model was selected as the best fitting model based on the high correlation and parsimony.). Based on the inter-factor correlations in Table 3-9, moderate to high correlations were indicated across all factors, ranging from .46 (Ritualistic/Sameness and Self-Injurious Behavior) and .80 (Ritualistic/Sameness and Compulsive Behavior). The high correlations are not consistent with previous findings; however, a similar pattern was found in a study by Lam and Aman (2007), which reported inter-factor correlation coefficients between .14 (Ritualistic/Sameness and Self-Injurious Behavior) and .55 (Ritualistic/Sameness and Self-Injurious Behavior and Compulsive Behavior). These results are not consistent with Esbensen et al.'s study (2009), which reported inter-factor correlation coefficients between .31 (Compulsive Behavior and Self-Injurious Behavior) and .66 (Ritualistic/Sameness and Restricted Behavior).

When examining individual items, the only item with a low factor loading, or a value <.05, was for item 5, object usage (spins or twirls objects, twiddles or slaps or throws objects, lets objects fall out of hands). Item variance ranged from .25 (item 5) to .84 (item 35; see Table 3-11). Those with the lowest item variances were items 5, 36,

and 14, with variances of .25, .26, and .30, respectively. The residuals for covariances, correlations, and residual correlations are provided in Appendix B. The highest value was -.265, which was between items 20 (Hoarding/Saving) and 36 (Likes the same CD/tape/record or piece of music played continually; Likes the same movie/video or part of movie/video).

Multiple Regression

Several simultaneous multiple regression analyses were conducted with a subset of the main sample to test whether intelligence, age, hyperactivity, and adaptive functioning predicted overall RRBI and subtype scores. The RRBI subtypes were determined by the results from the CFA. The significance tests for these analyses show the effect of each variable after controlling for all of the other variables in the model. Simultaneous Multiple Regression analyses are presented in Tables 3-12 through Table 3-17.

Intelligence

Lower Intelligence was hypothesized to have a negative relationship with lower-order RRBIs, or, lower intelligence would be related to increased levels of lower-order RRBIs, including stereotyped behavior and self-injurious behavior. Higher intelligence was hypothesized to be positively related to higher-order RRBIs, with increased intelligence predicting increased levels of higher-order RRBIs, including IS and ritualistic behavior combined, restricted behavior, and compulsive behavior. Level of intelligence was found to be a significant predictor of higher IS and ritualistic behavior combined ($t = 2.3$, $p < .05$). There was not a statistically significant relationship between intelligence and stereotyped behavior, self-injurious behavior, restricted behavior, compulsive behavior, or overall RRBI.

Age

Lower age was hypothesized to be related to lower-order RRBIs whereas higher age was hypothesized to be related to higher-order RRBIs. Results indicated that age was not significantly related to RRBI subtypes or overall RRBIs.

Hyperactivity

Hyperactivity was predicted to be positively related to RRBI subtypes and overall RRBIs. Results indicated that higher levels of hyperactivity predicted higher levels of stereotyped behavior ($t= 3.9$, $p<.01$), self-injurious behavior ($t= 3.2$, $p<.01$), IS and ritualistic behavior ($t= 4.7$, $p<.01$), restricted behavior ($t= 3.5$, $p<.01$), and compulsive behavior ($t=2.6$, $p < .01$). In addition, high levels of hyperactivity predicted higher behaviors of overall RRBIs ($t=5.3$, $p < .01$).

Adaptive Functioning

Adaptive functioning was predicted to have a negative relationship with subtypes as well as overall RRBIs. Adaptive functioning was negatively and significantly related to restricted behavior ($t=-2.9$, $p < .01$). However, adaptive functioning was not significantly related to the other RRBI domains.

Table 3-1. Descriptive statistics for the entire sample

Characteristics	N	%	Mean	SD	Range
Sex	205				
Male	165	80.5			
Female	40	19.5			
Age at assessment (Months)	205	100	120.4	45.3	60-247
Ethnicity	193				
Non-Hispanic	161	83.4			
Hispanic	32	16.6			
Race	195				
White	155	82.4			
Black	20	6.8			
Other	20	10.8			

Table 3-2. Descriptive statistics for the subsample

Characteristics	N	%	Mean	SD	Range
Sex	78				
Male	68	87.2			
Female	10	12.8			
Age at assessment (Months)	78	100	119.9	41.38	60-247
Ethnicity	75				
Non-Hispanic	7	90.7			
Hispanic	68	9.3			
Race	73				
White	61	78.2			
Other	12	21.8			

Table 3-3. Descriptive statistics for outcome variables

Outcome and Predictor Variables	Mean	SD	Skewness	Kurtosis	Range
Repetitive Behavior Sum Score	31.5	19.7	1.1	1.4	2-95
Stereotyped Behavior	4.7	3.7	.94	.59	0-16
Self-Injurious Behavior	3.1	4.3	1.9	4.1	0-20
Compulsive Behavior	5.1	4.4	1.4	2.4	0-21
Insistence on Sameness/Ritualistic Beh.	14.1	9.5	.64	.04	0-42
Restricted Behavior	4.1	2.9	.79	.14	0-12

Table 3-4. Descriptive statistics for predictor variables

Outcome and Predictor Variables	Mean	SD	Skewness	Kurtosis	Range
Intelligence	90.1	25.6	-.61	.47	36-135
Hyperactivity	19.8	11.7	.29	-.66	0-46
Age (Months)	119.9	41.4	.71	.30	60-247
Adaptive Functioning	77.2	16.1	.19	-.28	42-119

Table 3-5. Internal consistency (Cronbach's α) for factors from the 5-factor model

Factors	RBS-R Items	α
Stereotyped Behavior	1-6	.74
Self-Injurious Behavior	7-14	.83
Compulsive Behavior	15-22	.84
Ritualistic/Sameness Behavior	23-39	.91
Restricted Behavior	40-43	.77

Table 3-6. Pearson product moment correlation for RBS-R and ADI-R Scores (N=64)

Variable	Stereo	SIB	Compul.	Ritual.	IS	Restricted	Sum
Verbal Rituals	.38**	.18	.18	-.16	-.05	.24	.14
Unusual Preoccupations	.21	.07	-.02	-.06	-.10	.15	.02
Circumscribed Interests	.04	.15	.06	.21	.07	.22	.15
Repetitive Use of Objects	.32*	.16	.24	.19	.19	.34**	.29*
Compulsions/Rituals	.12	.09	.21	.09	.22	.13	.19
Unusual Sensory Interests	.34**	.27*	.18	.19	.09	.25*	.27*
Sensitivity to Noise	.24	.09	.32*	.29*	.23	.06	.28*
Neg. Response to Sensory Stimuli	.17	.34**	.15	.16	.08	.08	.23
Difficulty With Minor Changes in Routine	.14	.24	.16	.23	.48**	.03	.34**
Resistance to Trivial Changes	.27*	.31*	.35**	.19	.28*	.21	.36**
Unusual Attachments to Objects	.07	.06	-.17	.66	.01	.02	.01
Hand and Finger Mannerisms	.34**	.22	.24	.10	.04	.13	.22
Stereotyped Body Movements	.43**	.22	.17	.13	.22	.18	.30*
Midline Hand Movements	-.13	-.06	.01	.21	.14	.13	.07
Self-Injury	.35**	.68**	.17	.05	.04	.28*	.32*

Note:* significant at p-value <.05; ** significant at p-value <.01

Table 3-7.Goodness-of-fit indices of the hypothesized latent-factor models of the RBS-R (N=205)

Model	χ^2	*df*	RMSEA	CFI	TLI	AIC	BIC
Model 1 (one factor)	1683.3**	860	.07	.86	.85	17513.7	18085.3
Model 2 (two factors)	1367.7**	859	.05	.91	.91	17276.9	17851.8
Model 3 (three factors)	1287.2**	857	.05	.93	.92	17196.7	17778.2
Model 4 (five factors)	1141.2**	850	.04	.95	.95	17033.6	17638.4
Model 5 (six factors)	1111.1**	845	.04	.95	.95	17007.6	17629.0

Note:* significant at p-value <.05; ** significant at p-value <.01

Table 3-8. Standardized factor loadings

Items	Stereo. Behavior	Self-Injurious Behavior	Compuls. Behavior	Rit/Sameness Behavior	Restricted Behavior
1. Whole Body	.66				
2. Head	.70				
3. Hand/Finger	.60				
4. Locomotion	.62				
5. Object Usage	.50				
6. Sensory	.79				
7. Hits Self with Body Part		.82			
8. Hits Self Against Surface or Object		.79			
9. Hits Self with Object		.88			
10. Bites Self		.75			
11. Pulls		.65			
12. Rubs or Scratches Self		.68			
13. Inserts Finger or Object		.75			
14. Skin Picking		.55			
15. Arranging/Ordering			.74		
16. Completeness			.78		
17. Washing/Cleaning			.68		
18. Checking			.75		
19. Counting			.79		
20. Hoarding/Saving			.68		
21. Repeating			.73		
22. Touch/Tap			.61		
23. Eating/Mealtime				.64	
24. Sleeping/Bedtime				.68	
25. Self-Care-Bathroom and Dressing				.75	
26. Travel/Transportation				.83	
27. Play/Leisure				.68	
28. Communication/Social Interactions				.56	
29. Insists that Things Remain in the Same Places				.75	
30. Objects to Visiting New Places				.59	
31. Becomes Upset if Interrupted in what he/she is Doing				.78	
32. Insists on Walking in a Particular Pattern				.75	
33. Insists on Sitting at the Same Place				.71	
34. Dislikes Changes in Appearance of Behavior of the People Around him/her				.74	

Table 3-8. Continued

Items	Stereo. Behavior	Self-Injurious Behavior	Compuls. Behavior	Rit/Sameness Behavior	Restricted Behavior
35. Insists on Using a Particular Door				.91	
36. Likes the same CD, tape, record or piece of music played continually; Likes same movie/video or part of movie/video				.51	
37. Resists changing activities; Difficulty with transitions				.70	
38. Insists on same routine, household, school, or work schedule everyday				.78	
39. Insists that specific things take place at specific times				.78	
40. Fascination, preoccupation with one subject or activity					.80
41. Strongly attached to one specific object					.80
42. Preoccupation with part(s) of object rather than the whole object					.80
43. Fascination, preoccupation with movement/things that move					.68

Table 3-9. Correlations among the five factors

Factors	1	2	3	4	5
1. Stereotyped Behavior	1.0				
2. Self-Injurious Behavior	.63	1.0			
3. Compulsive Behavior	.70	.50	1.0		
4. Ritualistic/Sameness Behavior	.58	.46	.80	1.0	
5. Restricted Behavior	.65	.50	.68	.67	1.0

Table 3-10. Correlations among the six factors

Factors	1	2	3	4	5
1. Stereotyped Behavior	1.0				
2. Self-Injurious Behavior	.52	1.0			
3. Compulsive Behavior	.69	.45	1.0		
4. Ritualistic	.33	.32	.73	1.0	
5. Sameness Behavior	.38	.47	.68	.83	
6. Restricted Behavior	.52	.47	.64	.66	1.0

Table 3-11. RBS-R item variance

Items	R-Squared Estimate	S.E. Est./S.E.	P-Value	Residual Variance
1. Whole Body	.44	.09	<.05	.56
2. Head	.49	.11	<.05	.51
3. Hand/Finger	.37	.08	<.05	.64
4. Locomotion	.38	.08	<.05	.62
5. Object Usage	.25	.08	<.05	.75
6. Sensory	.62	.08	<.05	.38
7. Hits Self with Body Part	.67	.08	<.05	.33
8. Hits Self Against Surface or Object	.62	.08	<.05	.38
9. Hits Self with Object	.77	.09	<.05	.23
10. Bites Self	.57	.10	<.05	.44
11. Pulls	.43	.09	<.05	.56
12. Rubs or Scratches Self	.46	.10	<.05	.54
13. Inserts Finger or Object	.56	.13	<.05	.44
14. Skin Picking	.30	.09	<.05	.70
15. Arranging/Ordering	.55	.07	<.05	.45
16. Completeness	.61	.06	<.05	.39
17. Washing/Cleaning	.47	.07	<.05	.53
18. Checking	.56	.10	<.05	.44
19. Counting	.64	.08	<.05	.36
20. Hoarding/Saving	.46	.07	<.05	.54
21. Repeating	.54	.08	<.05	.46
22. Touch/Tap	.38	.07	<.05	.62
23. Eating/Mealtime	.40	.07	<.05	.60
24. Sleeping/Bedtime	.46	.07	<.05	.55
25. Self-Care-Bathroom and Dressing	.56	.06	<.05	.44
26. Travel/Transportation	.68	.06	<.05	.32
27. Play/Leisure	.46	.06	<.05	.54
28. Communication/Social Interactions	.32	.06	<.05	.68
29. Insists that Things Remain in the Same Places	.56	.05	<.05	.44
30. Objects to Visiting New Places	.35	.07	<.05	.65
31. Becomes Upset if Interrupted in what he/she is Doing	.62	.06	<.05	.34
32. Insists on Walking in a Particular Pattern	.56	.08	<.05	.44
33. Insists on Sitting at the Same Place	.51	.07	<.05	.50
34. Dislikes Changes in Appearance of Behavior of the People Around him/her	.55	.06	<.05	.45

Table 3-11. Continued

Items	R-Squared Estimate	S.E. Est./S.E.	P-Value	Residual Variance
35. Insists on Using a Particular Door	.84	.08	<.05	.16
36. Likes the same CD, tape, record or piece of music played continually; Likes same movie/video or part of movie/video	.26	.06	<.05	.74
37. Resists changing activities; Difficulty with transitions	.48	.06	<.05	.52
38. Insists on same routine, household, school, or work schedule everyday	.61	.05	<.05	.39
39. Insists that specific things take place at specific times	.64	.06	<.05	.39
40. Fascination, preoccupation with one subject or activity	.64	.07	<.05	.36
41. Strongly attached to one specific object	.64	.08	<.05	.36
42. Preoccupation with part(s) of object rather than the whole object	.63	.07	<.05	.37
43. Fascination, preoccupation with movement/things that move	.46	.08	<.05	.54

Table 3-12. Adaptive functioning, age, hyperactivity, and intelligence for predicting stereotyped behavior

Predictor Variables	β	SE β	t
Age (Months)	-.20	.01	-1.9
Hyperactivity	.42	.03	3.9**
Adaptive functioning	-.15	.03	-1.3
Intelligence	-.05	.02	-.49
F	8.2**		
Adj. R^2	.28		
R^2	.32		

Note:* significant at p-value <.05; ** significant at p-value <.01

Table 3-13. Adaptive functioning, age, hyperactivity, intelligence for predicting self-injurious behavior

Predictor Variables	β	SE β	t
Age (Months)	-.06	.01	-.50
Hyperactivity	.37	.04	3.1**
Adaptive functioning	-.08	.04	-.65
Intelligence	-.00	.02	-.02
F	3.6*		
Adj. R^2	.12		
R^2	.17		

Note:* significant at p-value <.05; ** significant at p-value <.01

Table 3-14. Adaptive functioning, age, hyperactivity, intelligence for predicting compulsive behavior

Predictor Variables	β	SE β	t
Age (Months)	-.19	.01	-1.7
Hyperactivity	.34	.04	2.6**
Adaptive functioning	.08	.04	.59
Intelligence	-.10	.02	-.84
F	4.1**		
Adj. R^2	.14		
R^2	.19		

Note:* significant at p-value <.05; ** significant at p-value <.01

Table 3-15. Adaptive functioning, age, hyperactivity, intelligence for predicting IS/Ritualistic behavior

Predictor Variables	β	SE β	t
Age (Months)	-.14	.01	-1.4
Hyperactivity	.50	.04	4.7**
Adaptive functioning	.02	.03	.14
Intelligence	.26	.02	2.3*
F	14.2**		
Adj. R^2	.28		
R^2	.32		

Note:* significant at p-value <.05; ** significant at p-value <.01

Table 3-16. Adaptive functioning, age, hyperactivity, and intelligence for predicting restricted behavior

Predictor Variables	β	SE β	t
Age (Months)	-.11	.01	-1.1
Hyperactivity	.36	.03	3.5**
Adaptive functioning	-.34	.02	-2.9**
Intelligence	-.07	.01	-.61
F	10.2**		
Adj. R^2	.33		
R^2	.36		

Note:* significant at p-value <.05; ** significant at p-value <.01

Table 3-17. Adaptive functioning, age, hyperactivity, and intelligence for predicting the sum RBS-R Score

Predictor Variables	β	SE β	t
Age (Months)	-.18	.05	-1.8
Hyperactivity	.54	.17	5.3**
Adaptive functioning	-.06	.14	-.53
Intelligence	.03	.08	.27
F	10.5**		
Adj. R^2	.34		
R^2	.37		

Note:* significant at p-value <.05; ** significant at p-value <.01

CHAPTER 4
DISCUSSION

The primary aim of this study was to examine the best fitting factor structure of a variety of RRBIs in a sample of individuals diagnosed with an ASD. The secondary aim was to evaluate whether intelligence, age, adaptive functioning, and hyperactivity significantly predicted the severity of RRBIs, as defined by the best fitting factor structure. A discussion regarding the most salient findings from each research question, implications for future research, limitations regarding the study will be discussed in the following sections.

Research Question 1: Factor Structure of the RBS-R

The primary goal of the study was to examine the factor structure of the RBS-R. Factor analysis allows researchers to examine patterns of relationships among a wide variety of different behaviors that have been measured empirically. Those behaviors that are correlated are combined to form a group, or factor. To date, most of the research evaluating the factor structure of RRBIs has utilized the ADI-R. Research examining the factor structure of RRBIs using the ADI-R has found two (i.e., RSMBs and IS; Cuccaro et al., 2003; Mooney et al., 2009; Richler et al., 2010; Szatmari et al., 2006) and three factors (i.e., RSMBS, IS, and CI; Lam et al., 2008). A limitation to using the ADI-R as a measure of RRBIs is that this particular measure was not developed with the intentions to serve as a comprehensive measure of RRBIs.

Recent research has begun to examine the RBS-R, which is a comprehensive measure of RRBIs for those diagnosed with an ASD. Research using the RBS-R has found two (Georgiades et al., 2010), three (Mirenda et al., 2010), and five factors (Lam & Aman, 2007; Mirenda et al., 2010). These inconsistencies have been associated

varying statistical procedures and instruments used to measure of the structure of RRBIs as well as the use of a wide age ranges.

The factor structure of the RBS-R has been previously subject to empirical evaluation; therefore, the CFA method was employed to evaluate five competing models, which included one-, two-, three-, five-, and six-factor solutions, rather than using exploratory methods. The three-factor model was selected based on Lam et al.'s (2008) study rather than Mirenda et al.'s (2010) study on the grounds of theoretical support. Although Mirenda et al. (2010) utilized the RBS-R in their study, information regarding how the three-factor model was derived was not provided.

The findings of this study support the notion that RRBIs in those diagnosed with an ASD are multifaceted. Based on multiple fit indices, the CFA results found support for a six-factor model and five-factor model. An analysis of standardized solutions indicated that factors 4 and 5 were highly correlated and, therefore, could be combined. In addition, the descriptive categories of the Ritualistic subscale and Sameness Behavior subscale are quite similar. The RBS-R qualifies Ritualistic behavior as "performing activities of daily living in a similar manner" and Sameness Behavior as "resistance to change, insisting that things stay the same." As a result, a five-factor solution was selected as the best fitting model, which included Stereotyped Behavior, Self-Injurious Behavior, Compulsive Behavior, Ritualistic Behavior/Sameness Behavior, and Restricted Behavior. These results are in accord with the findings by Lam and Aman (2007) and Mirenda et al. (2010), who also reported a five-factor structure consisting of the same subscales. The three-factor solution also had acceptable fit, which may be useful in some instances, including genetic qualitative trait locus studies.

Research Question 2: Intelligence, Age, Hyperactivity, Adaptive Skills

Intelligence

Results examining the role of intelligence on RRBIs found that higher intelligence significantly predicted higher levels of Insistence on Sameness and Ritualistic Behavior combined. Intelligence was not a significant predictor for Stereotyped Behavior, Self-Injurious Behavior, Compulsive Behavior, Restricted Behavior, and the Sum Repetitive Behavior Score. This study is the first to examine the role of intellectual functioning as a continuous variable using a single intelligence test with a moderately large sample. These findings show partial support for Turner's theory, which postulates the existence of two primary classes of repetitive behavior including "lower order" behaviors characterized by repetitive motor behavior and "higher order" behaviors characterized by insistence on sameness, compulsive behavior, restricted behavior, and repetitive language. Turner hypothesized that lower order behaviors were related to lower cognitive ability whereas higher order behaviors were related to higher cognitive ability. These results did not support the results from Gabriels et al. (2005) study, which found significantly higher levels of Sameness Behavior in those with low levels of cognitive ability, as measured by the Leiter-R, which was defined as an IQ score $\leq$56.

Although this study did not find support in accord with previous theory and research, it is important to consider the limitations in the cognitive assessment of those with neurodevelopmental disorders. It is quite possible that the intelligence scores may be impacted by ASD symptomology.

Age

Results from a series of multiple regression analyses indicated that age was not found to be a significant predictor for Stereotyped Behavior, Compulsive Behavior, Self-Injurious Behavior, Ritualistic/Sameness Behavior, and Restricted Behavior. Previous studies regarding other classes of repetitive behaviors have been inconsistent. For example, Esbensen et al. (2009) found that age was negatively and significantly correlated with the five subscales of the RBS-R used in this study. Other studies have reported that older age is related to insistence on sameness behavior (Bishop et al., 2006; Richler et al., 2010). More research is needed to evaluate the relationship between age and repetitive behavior subtypes.

A limitation to evaluating the role of age on RRBIs for this study was an issue of restricted range with over half of the sample being younger than 120.4 months (10.0 years); therefore, this result should be interpreted with caution. It is possible that having a restricted age range limited to ability to examine patterns that may have emerged for older participants.

Hyperactivity

Results indicated that hyperactivity was a significant predictor for all RRBIs. Higher levels of hyperactivity significantly predicted higher levels of Stereotyped Behavior, Self-Injurious Behavior, Compulsive Behavior, Ritualistic/Sameness Behavior, Restricted Behavior, and the Sum Repetitive Behavior score. This finding supports a previous research study of 14 participants, which found hyperactivity was significantly correlated with the Sum Repetitive Behavior score on the RBS-R, even after controlling for NVIQ. This is the first study to date to examine the role of hyperactivity on subscale scores. Future research should examine the role of hyperactivity on RRBIs using rating scales

that were designed to comprehensively measure hyperactive behavior. In addition, future studies should evaluate whether interventions such as behavioral interventions and/or medication used for the treatment of hyperactive behavior improve or reduce RRBIs in frequency and/or severity.

Adaptive Functioning

Results indicated that adaptive functioning was a significant predictor for Restricted Behavior. Specifically, a decrease in adaptive functioning significantly predicted higher levels of Restricted Behavior. Adaptive functioning was not a significant predictor of other RRBI domains.

Convergent Validity

In the area of RRBIs, the RBS-R and ADI-R have demonstrated strong psychometric characteristics and have allowed researchers and practitioners to measure repetitive behavior particular to those diagnosed with an ASD. The convergent validity of the RBS-R was assessed by comparing subscale scores with items on the ADI-R. The ADI-R has 15 items measuring repetitive behavior. The verbal rituals item was included to explore whether verbal rituals was related to RRBIs, as the RBS-R does not include verbal rituals as a repetitive behavior. The majority of the significant correlations ranged from having a weak to strong positive relationship, ranging from a low of .25 to a high of .68. Furthermore, five items from the ADI-R were not significantly correlated with any of the RBS-R subscales. The weak correlations among the RBS-R and ADI-R may be related to many factors, including the way each rating scale is completed. The RBS-R is completed independently by a parent or caregiver whereas the ADI-R is administered in an interview format. In addition, the RBS-R subscales include multiple items measuring each domain, whereas the ADI-R includes individual

items targeting each domain. These factors may also explain discrepancies regarding factor studies that have used the RBS-R versus ADI-R. Further research is needed to refine the measurement of RRBIs.

Limitations

This study is subject to several limitations. This sample may not be truly representative of all individuals with an Autism Spectrum Disorder. Parents who participated in the research study were more likely to be from a rural locale in the southeast. They may also be more concerned, involved, and have access to participation in research projects as compared to other parents with a child diagnosed with an ASD. In addition, the sample consisted of a wide age range, with over half of the sample being restricted between the ages of 5 and 9. As a result, interpretations of the findings may have limited generalizability.

The questionnaires and rating scale information collected from participants was based largely on their parent's report about their behavior, which may be subject to response-bias. The assessment methods used to measure restricted and repetitive behaviors or interests, adaptive functioning, age, and hyperactivity were selected due to the ability to collect a variety of information in a brief time period, research evidence supporting their psychometric properties and the ability to quantify subtle differences in the degree of the impairment. Although direct observations could validate the presence of RRBIs, these behaviors do not always occur frequently and are not always present in all settings. Therefore, observational data may not be sufficient in capturing a comprehensive RRBI profile of an individual but could be useful in validating parent-reports.

Moreover, Intellectual functioning was measured using the Leiter-R, which is administered in a nonverbal format. It is possible that different results may have emerged if participants were administered a different intelligence test presented in a nonverbal and/or verbal format. Furthermore, the ASD diagnosis was based on parent report and was not verified. However, over 80% of the sample had a Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003) score equal to or greater than 15. Research has shown that a total score equal to or greater than 15 is suggestive of a high probability of having an ASD (Rutter et al., 2003).

Furthermore, the analyses methods were selected based on the research questions and the size of the sample. More complex multivariate analyses would provide more accurate and informative representations of the relationships between predictor and dependent variables; however, a larger sample size would have been required.

Despite these limitations, this study adds to the body of knowledge suggesting that RRBIs represent a heterogeneous category with five different subtypes. In addition, hyperactivity was found to have a significant role on all repetitive behaviors. This study found partial support for Turner's (1999) theoretical categorization of RRBIs. Replication studies with larger sample sizes and confirmed ASD diagnoses are needed to validate these findings. Furthermore, continued research is needed to add more detailed information regarding the development and treatment of RRBIs as well as associated characteristics.

Summary and Implications for Future Research

The results of the current study indicate that RRBIs when measured using the RBS-R are comprised of five domains, including Stereotyped Behavior, Self-Injurious

Behavior, Compulsive Behavior, Ritualistic/Sameness Behavior, and Restricted Behavior. Internal consistency values were adequate with values between .74 and .91. These results are consistent with previous studies evaluating the internal consistency of the RBS-R. Age was not found to be a significant predictor for any of the RRBI subtypes. This result may have occurred because this sample was restricted in age. Research results regarding the relationship between age and RRBI subtypes have not been entirely consistent. Future research is needed to clarify the role age has on repetitive behavior.

Higher levels of hyperactivity significantly predicted higher RRBIs overall as well as within each subtype. This result has implications for future research regarding possible impact of interventions targeting hyperactivity as a treatment of RRBIs. Future research should evaluate the effect of behavioral and pharmacological interventions targeting hyperactivity on overall RRBIs as well as RBI subtypes. Furthermore, treatment studies should evaluate whether the acquisition of positive behavior occurs simultaneously as RRBIs decrease.

Lower adaptive functioning predicted higher levels Restricted Behavior. Adaptive functioning was not a significant predictor for Stereotyped Behavior, Self-Injurious Behavior, Compulsive Behavior, Ritualistic/Sameness Behavior, and the Sum RRBI score.

Future studies should evaluate how RRBIs develop over time using a longitudinal design. This type of research could provide information regarding the nature of RRBIs as well as provide insight into other factors that may impact RRBIs (e.g., age, experiences, and interventions). In addition, specificity in how the sample is stratified

may provide precise information regarding the manifestation of RRBIs. Stratifying samples by verbal versus nonverbal ability, age, language ability, and RRBI profiles may help improve our knowledge and better inform interventions.

Furthermore, treatment studies are needed to better understand how to reduce problem behavior. McDougle, Kresch, and Posey (2000) cite research supporting the efficacy of Clomipramine© and Fluvoxamine© as a treatment method for the reduction of repetitive behaviors within an ASD sample. Both medications are often used for the treatment of repetitive thoughts and repetitive behavior. Behavioral interventions are also needed to better understand their impact on overall functioning. Future studies should examine treatment effects on RRBI subtypes as well.

Finally, the RBS-R demonstrated adequate psychometric properties and may be a useful method for determining ASD diagnosis as well as measuring treatment effects. Future ratings scales measuring RRBIs within the ASD population should also consider whether verbal rituals should be included within the RRBI classification system. Differences in RRBI subtypes suggest that we should examine RRBI subtypes within those diagnosed with ASD and other disorders that have RRBIs present. Given the high inter-factor correlations, future research should examine whether a hierarchical model better represent RRBIs. Perhaps there is a general RRBI factor which explains the correlations among factors. Furthermore, understanding the structure of RRBIs may guide diagnostic classifications.

APPENDIX A
HEALTH HISTORY FORM

Please answer the following questions. If you are uncomfortable with any question, do not answer it. Best estimates are fine if you cannot remember specific details. Thank you!

Today's Date: _____

Your name: *Last:* *First:*	Your Relationship to Child:
Child's name: *Last:* *First:*	☐Mother
Child's gender: ☐Male ☐Female	☐Father
	☐Other (please specify):
Child's birth date:	
Mailing Address: Street: _____	
City: State: Zip code:	
Phone number: Primary: Secondary:	
Child's ethnicity: ☐Hispanic or Latino ☐Not Hispanic or Latino	
Child's race: ☐ White ☐Black or African-American ☐Asia ☐American Indian/Alaska Native ☐Native Hawaiian/Other Pacific Islander ☐Other (please specify):	
Name of School:	
Classroom Type: ☐Regular ☐ESE ☐Other (please specify):	
Services receiving: ☐Speech Therapy ☐ Occupational Therapy ☐Physical Therapy ☐Social Skills ☐Other (please specify):	
Past Medical History Has your child been diagnosed with any of the following medical disorders? If so, please check box. ☐Seizure disorder ☐Tics or Tourette syndrome ☐Fragile X syndrome ☐Fetal Alcohol syndrome ☐Other medical or genetic condition (please specify): *Sensory:* ☐Blind (If yes, in both eyes? ☐Yes ☐No) ☐Deaf (If yes, in both ears? ☐Yes ☐No) *Physical:* ☐Walking independently ☐Walking with assistance ☐Wheelchair bound	
Past Psychiatric History Diagnosis, if any: ☐Autism ☐Asperger ☐PDD NOS ☐Autism Spectrum Disorder Other (please specify):	
Name of clinician who diagnosed your child with an autism spectrum disorder: Profession: ☐Psychiatrist ☐Pediatrician ☐Psychologist ☐Other (please specify):	
Medication History Is your child currently on, or has been on within the last 3 months, any of the following medications? ☐Yes ☐No If yes, please complete the following:	

Antipsychotic medication (check box, if any): ☐Risperdal ☐Abilify ☐Seroquel ☐Geodon ☐Clozaril ☐Haldol ☐Navane ☐Prolixin ☐Thorazine ☐Stelazine ☐Other (please specify):
Stimulant (check box, if any): ☐Adderrall ☐Vyvanse ☐Dexedrine ☐Ritalin ☐Focalin ☐Concerta ☐MetadateCD ☐Daytrana ☐Strattera ☐Other (please specify):
Antidepressant (check box, if any): ☐Prozac or Fluoxetine ☐Zoloft ☐Celexa ☐Paxil ☐Lexapro ☐Luvox ☐Effexor ☐Elavil ☐Remeron ☐Wellbutrin ☐Tofranil ☐Desipramine ☐Other (please specify):
Mood stabilizer (check box, if any): ☐Lithium ☐Depakote ☐Tegretol ☐Lamictal ☐Trileptal ☐Topamax ☐Other (please specify):
☐Other (OTC, supplement or diet) If any, please specify:
Family History Has anyone related to the child (biological parents, grandparents, brothers/sisters) been diagnosed with any of the following illnesses? Please check the box and specify the relationship.

Check box, if any:	If yes, specify who:
☐ Autism	
☐ Asperger	
☐ Other Pervasive Developmental Disorder (PDD NOS)	
☐ Attention Deficit Hyperactivity Disorder	
☐ Bipolar Disorder	
☐ Depression	
☐ Anxiety	
☐ Obsessive Compulsive Disorder	
☐ Tics or Tourette syndrome	
☐ Schizophrenia	
☐ Other (please specify):	

APPENDIX B

RESIDUALS FOR COVARIANCES/CORRELATIONS/RESIDUAL CORRELATIONS

	RBSR1	RBSR2	RBSR3	RBSR4	RBSR5
RBSR1					
RBSR2	0.113				
RBSR3	0.023	0.042			
RBSR4	0.119	-0.145	0.063		
RBSR5	-0.095	0.046	0.008	0.029	
RBSR6	-0.074	-0.127	0.019	-0.043	-0.006
RBSR7	0.025	0.054	0.004	0.077	0.023
RBSR8	0.090	0.130	-0.078	0.033	0.011
RBSR9	0.073	0.120	-0.102	0.049	0.063
RBSR10	0.126	0.094	-0.007	-0.036	0.033
RBSR11	-0.021	0.194	-0.116	-0.084	0.034
RBSR12	0.074	0.073	-0.107	-0.191	0.058
RBSR13	0.000	0.040	0.042	0.130	0.015
RBSR14	0.034	0.060	-0.064	-0.145	-0.037
RBSR15	-0.092	-0.089	-0.060	-0.062	-0.055
RBSR16	0.062	-0.078	0.062	-0.075	0.076
RBSR17	-0.044	-0.136	0.026	-0.076	-0.106
RBSR18	-0.070	-0.035	0.041	-0.201	-0.060
RBSR19	-0.064	-0.004	-0.085	-0.101	-0.069
RBSR20	-0.020	0.017	-0.105	-0.097	-0.090

RBSR21	0.114	-0.043	-0.036	-0.045	-0.074
RBSR22	0.124	0.070	0.162	0.077	0.088
RBSR23	-0.104	-0.183	-0.015	0.041	-0.132
RBSR24	-0.031	-0.090	0.037	0.139	-0.082
RBSR25	-0.116	-0.115	-0.093	0.041	-0.097
RBSR26	-0.071	-0.040	0.049	0.113	-0.023
RBSR27	-0.061	-0.148	-0.106	-0.014	-0.047
RBSR28	-0.112	-0.084	0.085	0.124	-0.065
RBSR29	0.018	-0.042	0.072	0.069	-0.109
RBSR30	0.119	0.083	0.074	0.021	0.050
RBSR31	0.026	0.014	-0.013	0.072	0.009
RBSR32	0.087	-0.058	-0.010	-0.029	-0.120
RBSR33	-0.095	0.033	-0.133	-0.013	0.008
RBSR34	-0.089	-0.089	-0.033	-0.097	-0.102
RBSR35	-0.075	-0.061	-0.004	0.222	0.063
RBSR36	0.081	-0.010	0.105	0.039	0.067
RBSR37	0.012	-0.099	-0.096	-0.068	-0.036
RBSR38	-0.090	-0.126	-0.027	-0.065	-0.053
RBSR39	-0.045	-0.054	-0.034	-0.004	-0.097
RBSR40	-0.068	0.017	-0.036	-0.080	-0.037
RBSR41	0.012	0.153	0.007	-0.012	0.079
RBSR42	-0.033	0.085	0.060	-0.143	0.181
RBSR43	-0.213	-0.079	0.019	0.026	0.229

	RBSR6	RBSR7	RBSR8	RBSR9	RBSR10
RBSR7	-0.038				
RBSR8	-0.132	0.075			
RBSR9	-0.186	0.062	0.085		
RBSR10	-0.091	-0.003	-0.039	-0.147	
RBSR11	-0.119	-0.038	-0.048	-0.045	0.042
RBSR12	-0.167	-0.119	-0.137	-0.133	0.053
RBSR13	-0.005	-0.061	-0.151	-0.162	-0.126
RBSR14	-0.134	-0.160	-0.131	-0.123	-0.004
RBSR15	0.133	-0.041	-0.176	-0.176	-0.125
RBSR16	0.094	0.046	-0.024	-0.032	0.059
RBSR17	0.004	-0.018	-0.016	0.006	0.004
RBSR18	-0.005	-0.026	-0.098	-0.073	-0.044
RBSR19	0.038	0.002	-0.178	-0.099	-0.098
RBSR20	-0.107	0.011	0.016	0.054	0.065
RBSR21	-0.013	-0.061	0.016	-0.035	0.026
RBSR22	0.181	0.096	0.027	-0.163	0.041
RBSR23	0.028	-0.073	-0.072	-0.079	-0.008
RBSR24	0.098	0.015	-0.125	-0.101	-0.078
RBSR25	0.073	-0.017	0.021	-0.040	0.012
RBSR26	0.084	-0.055	0.085	0.050	0.028
RBSR27	-0.062	-0.112	-0.170	-0.129	-0.016

RBSR28	-0.002	-0.031	0.028	-0.106	-0.035
RBSR29	0.097	-0.170	-0.007	-0.042	-0.169
RBSR30	0.047	0.011	0.135	0.167	0.126
RBSR31	-0.027	0.014	0.092	0.153	0.104
RBSR32	-0.082	0.059	0.009	0.109	0.139
RBSR33	0.113	-0.041	-0.005	0.104	0.186
RBSR34	0.026	0.032	0.046	-0.075	-0.016
RBSR35	0.041	-0.050	-0.144	-0.041	-0.024
RBSR36	0.036	-0.064	-0.087	-0.150	-0.042
RBSR37	0.043	-0.030	0.094	-0.009	0.062
RBSR38	0.030	-0.065	-0.074	-0.003	0.018
RBSR39	0.107	-0.022	0.040	-0.029	0.009
RBSR40	-0.074	-0.046	-0.063	-0.110	-0.140
RBSR41	-0.175	-0.015	-0.019	0.099	-0.058
RBSR42	-0.020	0.104	0.059	0.219	0.111
RBSR43	-0.022	0.010	-0.020	0.071	-0.102

	RBSR11	RBSR12	RBSR13	RBSR14	RBSR15
RBSR12	0.073				
RBSR13	-0.019	0.041			
RBSR14	0.147	0.240	0.029		
RBSR15	-0.060	-0.011	-0.018	0.003	

RBSR16	-0.137	0.019	0.069	-0.045	0.088
RBSR17	-0.018	0.093	0.123	0.005	-0.014
RBSR18	-0.064	0.077	0.115	-0.032	-0.138
RBSR19	-0.080	-0.035	-0.026	-0.046	0.066
RBSR20	0.197	0.043	0.106	0.107	-0.070
RBSR21	-0.042	0.064	0.018	0.130	-0.088
RBSR22	-0.056	0.078	0.195	0.073	-0.027
RBSR23	-0.100	-0.031	0.027	0.029	0.023
RBSR24	-0.066	-0.038	0.095	0.018	0.149
RBSR25	-0.221	-0.079	0.046	-0.103	0.064
RBSR26	0.005	-0.023	0.078	-0.007	-0.029
RBSR27	0.010	0.021	-0.028	0.043	0.012
RBSR28	0.097	-0.051	0.095	0.064	-0.051
RBSR29	-0.229	-0.089	-0.211	-0.073	0.144
RBSR30	0.103	0.063	-0.011	-0.075	-0.123
RBSR31	0.166	-0.040	0.141	0.013	-0.089
RBSR32	0.071	0.115	-0.009	0.059	0.036
RBSR33	0.117	0.077	0.091	-0.048	-0.021
RBSR34	-0.113	0.066	0.109	0.024	0.017
RBSR35	-0.164	-0.108	-0.051	-0.129	0.065
RBSR36	0.007	0.105	-0.012	0.066	0.004
RBSR37	0.197	0.092	0.086	0.104	-0.047
RBSR38	-0.048	-0.014	-0.044	0.056	-0.035

RBSR39	-0.126	-0.059	-0.050	-0.048	-0.076
RBSR40	0.056	-0.109	-0.078	-0.081	-0.023
RBSR41	0.022	-0.152	-0.045	-0.048	-0.075
RBSR42	0.099	0.082	0.046	-0.016	0.009
RBSR43	-0.008	-0.120	-0.045	-0.156	0.032

	RBSR16	RBSR17	RBSR18	RBSR19	RBSR20
RBSR17	0.053				
RBSR18	0.025	0.176			
RBSR19	-0.094	-0.034	0.029		
RBSR20	-0.184	-0.093	-0.074	0.102	
RBSR21	-0.081	-0.047	-0.012	-0.119	0.063
RBSR22	-0.118	-0.032	-0.060	0.054	0.032
RBSR23	0.014	0.018	-0.053	-0.111	-0.084
RBSR24	0.013	0.039	-0.062	0.025	0.029
RBSR25	-0.055	0.016	0.087	0.051	-0.025
RBSR26	0.050	-0.002	0.054	-0.052	-0.027
RBSR27	0.054	-0.007	0.032	0.076	0.091
RBSR28	0.041	0.095	0.007	0.027	0.037
RBSR29	0.048	0.014	0.094	-0.019	0.014
RBSR30	0.033	-0.027	0.034	0.064	-0.128
RBSR31	-0.128	-0.034	-0.030	-0.019	-0.053

RBSR32	0.103	0.006	0.077	0.038	-0.071
RBSR33	-0.076	-0.081	0.001	0.099	0.097
RBSR34	-0.071	0.015	0.022	0.056	-0.041
RBSR35	0.083	0.156	-0.010	-0.004	0.017
RBSR36	0.126	-0.158	0.087	0.074	-0.001
RBSR37	-0.123	-0.088	-0.130	-0.116	0.012
RBSR38	-0.084	-0.009	0.006	0.027	-0.047
RBSR39	-0.027	-0.025	-0.102	-0.115	-0.056
RBSR40	-0.004	-0.127	0.010	-0.027	0.169
RBSR41	-0.069	-0.178	-0.070	0.066	0.145
RBSR42	0.043	-0.005	-0.106	0.017	0.019
RBSR43	0.019	0.028	-0.059	0.020	-0.108

	RBSR21	RBSR22	RBSR23	RBSR24	RBSR25
RBSR22	0.108				
RBSR23	-0.083	-0.056			
RBSR24	-0.037	-0.043	0.159		
RBSR25	-0.037	-0.070	0.136	0.070	
RBSR26	0.048	0.026	0.096	0.031	0.077
RBSR27	0.045	-0.064	0.165	0.084	0.002
RBSR28	0.014	0.010	0.041	0.075	-0.093
RBSR29	0.026	-0.103	0.055	-0.043	0.163

RBSR30	-0.014	-0.104	-0.050	-0.139	-0.161
RBSR31	-0.048	-0.078	-0.055	-0.096	-0.045
RBSR32	0.067	0.010	-0.066	-0.192	-0.129
RBSR33	-0.070	0.001	-0.049	-0.097	0.017
RBSR34	-0.021	0.028	0.046	0.012	0.030
RBSR35	0.045	-0.060	-0.037	0.056	-0.078
RBSR36	0.135	-0.038	-0.123	-0.087	-0.265
RBSR37	-0.046	-0.140	-0.021	-0.066	-0.076
RBSR38	0.038	-0.090	-0.121	-0.074	-0.031
RBSR39	0.052	-0.060	-0.170	-0.087	-0.052
RBSR40	0.073	0.019	0.002	0.011	-0.057
RBSR41	0.065	-0.029	0.036	0.055	-0.045
RBSR42	-0.106	-0.015	-0.073	-0.123	-0.069
RBSR43	-0.060	-0.004	0.005	-0.137	-0.057

	RBSR26	RBSR27	RBSR28	RBSR29	RBSR30
RBSR27	0.029				
RBSR28	0.052	0.141			
RBSR29	0.013	-0.025	-0.088		
RBSR30	-0.078	-0.003	-0.110	-0.082	
RBSR31	-0.093	-0.014	-0.055	-0.085	0.080
RBSR32	-0.097	-0.010	-0.161	-0.052	0.061

RBSR33	-0.028	0.019	-0.123	0.024	0.017
RBSR34	-0.033	-0.055	-0.027	0.027	0.059
RBSR35	-0.065	-0.105	-0.050	-0.089	-0.024
RBSR36	-0.039	-0.080	0.159	-0.034	0.013
RBSR37	-0.093	-0.071	-0.118	-0.105	0.025
RBSR38	-0.088	-0.108	-0.055	-0.058	0.000
RBSR39	-0.104	-0.030	0.021	-0.005	-0.004
RBSR40	0.076	0.094	0.179	0.014	-0.031
RBSR41	0.073	0.035	0.026	-0.013	-0.004
RBSR42	-0.013	-0.072	-0.157	-0.099	0.046
RBSR43	0.076	-0.039	-0.039	-0.044	0.038

	RBSR31	RBSR32	RBSR33	RBSR34	RBSR35
RBSR32	-0.037				
RBSR33	-0.014	0.114			
RBSR34	0.016	-0.029	-0.025		
RBSR35	-0.101	0.057	-0.033	0.002	
RBSR36	-0.103	0.057	0.002	-0.016	0.067
RBSR37	0.171	-0.112	-0.001	0.011	-0.088
RBSR38	-0.010	-0.008	-0.033	0.003	-0.010
RBSR39	0.024	-0.019	0.021	0.034	-0.050
RBSR40	0.026	-0.011	-0.117	0.008	0.095

RBSR41	0.099	-0.011	-0.054	-0.100	0.080
RBSR42	-0.004	0.100	-0.005	0.038	-0.007
RBSR43	0.008	0.058	0.038	0.006	0.115

	RBSR36	RBSR37	RBSR38	RBSR39	RBSR40
RBSR37	-0.086				
RBSR38	-0.090	0.138			
RBSR39	-0.101	0.089	0.187		
RBSR40	0.210	-0.028	-0.016	-0.046	
RBSR41	0.122	-0.049	-0.038	-0.077	0.072
RBSR42	0.000	-0.021	-0.097	-0.201	-0.113
RBSR43	0.051	-0.002	-0.110	-0.126	-0.118

	RBSR41	RBSR42	RBSR43
RBSR42	-0.118		
RBSR43	-0.144	0.158	

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BIOGRAPHICAL SKETCH

Cindi Guadalupe Flores was born and raised in San Bernardino, CA. She earned her B.A. in psychology and child development from California State University, San Bernardino. Subsequently, she moved to Florida to enroll in the school psychology doctoral program at the University of Florida. Since then, Cindi has been a part of various research and practica experiences to cultivate her professional career, including undergraduate teaching, research, and working in school, legal, and clinical settings in the greater Gainesville area. She has had the opportunity to work with unique populations, including migrant children and families, English language learners, foster-care children and youth, and those diagnosed with an ASD or Prader-Willi Syndrome. Cindi completed her pre-doctoral internship with Hillsborough County Public Schools in Florida. Cindi will begin working as a postdoc for the Department of Psychiatry at Shands Hospital in July 2012.