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The emergence of challenging behaviors in at-risk toddlers with and without Autism Spectrum Disorder: a cross-sectional and risk factor study

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THE EMERGENCE OF CHALLENGING BEHAVIORS IN AT-RISK TODDLERS WITH
AND WITHOUT AUTISM SPECTRUM DISORDER: A CROSS-SECTIONAL
AND RISK FACTOR STUDY

A Dissertation
Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
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requirements for the degree of
Doctor of Philosophy

In

The Department of Psychology

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ABSTRACT

Challenging behaviors including aggression, property destruction, stereotypy, and self injury occur at a high prevalence in individuals with Autism Spectrum Disorders (ASD). These behaviors are pervasive and chronic. Despite an increased probability and negative consequences, one area which has received little attention is the presence of challenging behaviors in infants and toddlers with ASD. Furthermore, there is a dearth of information identifying early age trends in the emergence of challenging behaviors and associated risk factors. The purpose of this investigation was to utilize a validated measure, the *Baby and Infant Screen for Children with Autism Traits - Part 3*, to investigate the relationship of challenging behaviors to ASD in the very young child. In Study 1, it was demonstrated that infants and toddlers with ASD do evince more severe behavior symptoms than atypically developing non-ASD toddlers. A general increasing trend of severity of challenging behavior in infants and toddlers with ASD was noted to occur across age cohorts. Study 2 further investigated this relation in detail for the ASD group, where it was determined that there was a cluster of personal characteristics which appear to increase the risk of the young child with ASD engaging in higher rates of problem behavior. Risk factors which were found to be the most salient predictors of severe challenging behaviors included symptoms of comorbid mental illness (e.g., tantrums, conduct problems, anxiety, avoidance, inattention, and impulsivity), more severe autistic symptoms, and areas of developmental functioning. Implications of the results and directions for future research are discussed.

INTRODUCTION

Autism Spectrum Disorders (ASD), defined by the *Diagnostic and Statistical Manual-Fourth Edition-Text Revision* (DSM-IV-TR; American Psychological Association [APA], 2000) to be a class of Pervasive Developmental Disorders, are a set of five neurodevelopmental conditions typified by early childhood onset, impairments in social interaction and communication, and restricted or repetitive interests or patterns of behavior. Included within this spectrum are Autistic Disorder (autism), Asperger's Disorder, Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS), Childhood Disintegrative Disorder, and Rett's Disorder. Though not a diagnostic criterion, challenging behaviors such as self-injury, aggression, and property destruction continue to be reported to occur at a high prevalence in individuals with ASD (Matson & Nebel-Schwalm, 2007; Mudford et al., 2008). Challenging behaviors hinder the individual's quality of life and are related to a multitude of adverse outcomes (Sturme, Seiverling, & Ward-Horner, 2008). Researchers have established that these behaviors are chronic across the lifespan of those with ASD, and that effective assessment measures and treatments do exist. Social, biological, and personal risk factors have been identified which may increase the probability of challenging behaviors occurring in individuals who have a developmental delay (Sturme et al., 2008; Mudford et al., 2008). Despite there being a bevy of literature on children and adults, research on challenging behaviors in infants and toddlers with ASD is lacking. There is some evidence that challenging behaviors do occur in the very young child with ASD (ref. Kozlowski & Matson, 2010); however, this data is preliminary. Furthermore, little has been done to investigate age trends in the emergence of these behaviors at this early stage of life and if risk factors identified in older age cohorts are still applicable.

The ability to effectively assess challenging behaviours in infants and toddlers with ASD has been noted to be limited by inadequate testing materials (Matson, 2007). A recent assessment battery, the *Baby and Infant Screen for Children with aUtism Traits* (BISCUIT; Matson, Boisjoli, & Wilkins, 2007), addresses this problem through the inclusion of a measure, the *Baby and Infant Screen for Children with aUtism Traits-Part 3* (BISCUIT-Part 3; Matson, Boisjoli, Rojahn, & Hess, 2009). The BISCUIT-Part 3 identifies and assesses the severity of challenging behaviors for infants and toddlers with ASD. The aim of the present study was to examine the emergence of challenging behavior through a cross sectional analysis of age in infants and toddlers with ASD versus atypically developing peers. Additionally, specific personal characteristics which may increase the odds of the individual engaging in these types of behaviors were examined. A summary of the history of ASD and its symptom characteristics are discussed along with a brief description of challenging behavior, assessment of these behaviours, and associated risk factors.

History of Autism Spectrum Disorders

Though our understanding of ASD has evolved over time, it is Leo Kanner's (1943) description of a unique childhood disorder termed *autistic disturbances of affective contact* or *infantile autism*, on which the current conceptualization is grounded. In his 1943 seminal paper, Kanner published a detailed account of 11 children who displayed atypical patterns of behavior. Among the most salient of the characteristics noted was a lack in typical motivation for social interaction, with disturbances in communication such as muteness, echolalia, and/or literal speech. Furthermore, these children were resistant and/or sensitive to environmental changes, engaged in repetitive or ritualistic patterns of behavior, and had circumscribed interests. Kanner used the term *autism* to describe the idiosyncratic, self-centered quality of disorder that he

observed (Volkmar & Klin, 2005). In addition to those behaviors he considered inherent to autism, Kanner proposed that these abnormalities were present at birth and were biological in nature. Subsequent revisions to this early conceptualization by Eisenberg and Kanner (1956) highlighted that children with autism exhibited extreme self-isolation from their social environment and insistence upon sameness. Furthermore, an onset of autism occurred prior to 2 years of age was indicated.

Kanner's initial description of impairments in social interaction, communication, and insistence on sameness or routine continues to be considered the hallmark symptoms of autism. However, there are some facets of the condition he initially proposed that have been refined. For example, Kanner believed that this disorder was not related to other medical conditions. Specifically, it was speculated that children with autism were "endowed with good cognitive potential" (Kanner, 1943; p. 242). Thus, any poor performance on tests of intelligence (i.e., typically verbal subtests) was due to a lack of motivation. These suggestions made by Kanner have been refuted by subsequent scientific evidence. Current data indicate that various medical conditions can be associated with autism and approximately 25% of individuals with autism also have a seizure disorder (APA, 2000; Rutter, 1970, 1978; Volkmar & Klin, 2005; Volkmar & Nelson, 1990). Furthermore, it is estimated that up to 75% of children with autism (i.e., excluding those from the broader spectrum of ASDs) have some level of intellectual disability (ID) that is stable over time (Rutter, 1978; Rutter, Bailey, Bolton, & LeCouter, 1994).

The severity of the disorder and the terminology (*infantile autism*) used to describe it led many clinicians in the 1950s to speculate that autism was an early form of schizophrenia (Bender, 1953). This confusion was partly due to the term *autism* having been previously coined by Eugene Bleuler in 1911 to describe the social withdrawal of individuals with schizophrenia

(Rutter, 1978). Autism, in its original derivation, means “self.” It was in this context that Bleuler used the term to refer to the self-centered thinking and withdrawal into fantasy characteristic of some schizophrenic individuals, particularly true of diagnostic criteria at that time (Stotz-Ingenlath, 2000). Kanner’s intention for using the term was to describe the absence in social reciprocity and imagination which was more representative of negative symptoms of schizophrenia that he observed among his clients (Rutter, 1978). Furthermore, Kanner went on to delineate that a defining difference between the two disorders was that autistic behaviors were more noticeable early in life whereas schizophrenia had a later onset (Eisenberg & Kanner, 1956). Autism was separate from schizophrenia due to initial observations that autistic children were unable to form biological connections with people (Kanner, 1971). Despite these efforts by Kanner to clarify his use of the term, autism continued to be synonymous with schizophrenia for some time.

In much of the early autism literature, clinicians and researchers referred to both autism and childhood schizophrenia, along with other childhood syndromes, as childhood schizophrenia or child psychosis (Rutter, 1978). Creak (1961) described what he referred to as *early childhood psychosis* which involved nine common characteristics: 1) impairments in emotional relationships, described as aloofness and difficulty with social play; 2) lack of awareness to personal identity, described as abnormal body posturing, self-injurious behavior, difficulty with the use of personal pronouns in expressive language; 3) abnormal preoccupation with characteristics or parts of objects, rather than an interest in the function of the object; 4) resistance to environmental change and an insistence on sameness; 5) abnormal response to perceptual experiences and environment stimuli, such as insensitivity to pain or hypersensitivity to sounds or smells; 6) acute or excessive anxiety typically associated with changes in the

environment; 7) loss of speech or failure to acquire language, and abnormal speech patterns including echolalia or pronoun reversal; 8) distorted pattern of motility described by abnormal gait, body posturing, and movements; and 9) intellectual impairment, although some children may have normal or exceptional intellectual functioning. Many of Creak's proposed characteristics overlapped with Kanner's description of autistic symptomatology and, thus, were affixed to conceptualizations of the disorder. Unfortunately, Creak failed to indicate how the behavior patterns he delineated were specific to childhood psychosis; therefore, many of the criteria he proposed have continued to be associated with autism and ASDs in general. Likewise, Creak's conceptualization of what symptoms defined early childhood psychosis have been incorporated into assessment measures for ASDs, many of which are still used today (Matson & Minshawi, 2006).

With regards to diagnostic conceptualizations, up until the *International Classification of Diseases, Ninth Edition* (ICD-9; World Health Organization [WHO], 1977) *childhood schizophrenia* was the only official term available to describe those children evincing symptoms consistent with ASD. In both the first (DSM-I; APA, 1952) and second (DSM-II; APA, 1968) editions of the *Diagnostic and Statistical Manual*, infantile autism was categorized as a type of childhood psychosis. Thus, even with evidence indicating that autism could be distinguished from childhood schizophrenia via patterns of onset, gender distribution, social background, cognitive/intellectual patterns, distinguishing disorder symptoms (i.e., presence of delusions and hallucinations), and family genetics (Eveloff, 1960; Kolvin, 1971; Rutter, 1978; Rutter & Bartak, 1971), Kanner's unfortunate choice of terminology continued to stymie the progression of the field (Romanczyk, Lockshin, & Harrison, 1993; Rutter, 1978).

In the 1960s, professionals and parents of children with autism began to organize themselves politically in order to advocate for education and treatment services (Wing & Potter, 2002). As autism has been described as a syndrome with diverse characteristics, there was much confusion in what symptoms constituted a diagnosis. During the late 1960s and early 1970s, the research of Michael Rutter and Edward Ritvo, chairman of The National Society for Autistic Children (NSAC), did much to clarify the core symptoms of autism (Schopler, 1978). Each proposed their own definition.

The literature at that time was filled with varying clinical accounts and suggested criteria. Rutter's review of the literature called for a return to Kanner's original observations and further scientific investigation to test the early hypotheses proposed by Kanner (Rutter, 1978). Rutter noted that autism is a distinct syndrome. Thus, he suggested that there are certain behaviors which occur with uniformity across all individuals diagnosed with the condition. These behaviors which are evident in all individuals with autism are specific to this disorder and differentiate it from other childhood and psychiatric conditions. Therefore, Rutter proposed that only those behaviors that were both universal and specific to autism should be considered essential diagnostic criteria.

Rutter (1978) further classified these universal autistic symptoms into three broad groupings of behaviors: 1) failure to develop social relationships relative to the child's intellectual ability; 2) delayed or impaired language development and comprehension relative to the child's intellectual ability; and 3) insistence on sameness or ritualistic behavior. He proposed a final criterion of symptom onset prior to 30 months. In addition to the diagnostic criteria of autism, Rutter suggested that the social and communication impairments in language were distinctive and, as a result, are not merely a function of concomitant ID. As a result, Rutter

believed that a clearer diagnostic picture of autism could be garnered through taking a more multi-axial approach-considering not only core deficit areas, but also the individual's medical status, intellectual level, and neurological status.

The definition of autism which was formulated by Ritvo (1977; 1978), along with the NSAC, was somewhat different than Rutter's. Ritvo's conceptualization of autism perceived the condition as a constellation of behavioral symptoms clustered in the following essential deficit areas: 1) delay or regression in the rate of development and/or sequences within one or more developmental pathways (i.e., motor, social-adaptive, cognitive); 2) abnormal reaction to sensory stimuli (i.e., visual, auditory, tactile, vestibular, olfactory or gustatory, and proprioceptive); 3) a delay in language, verbal communication, nonverbal communication, and cognitive abilities; and 4) incapacity to relate to people, objects, and events. Similar to Rutter's definition (1978), Ritvo (1977; 1978) suggested that these autistic symptoms are present and can be detected prior to 30 months of age. This definition also indicated that the most salient feature of autism included impairments in communication and social interaction. In addition to the aforementioned criteria, other associated features Ritvo noted to be useful for the diagnostic clarification of autism included mood lability (e.g., unexpected and inconsolable crying or laughing without an identifiable stimulus), lack of appreciation of danger and/or inappropriate fears, self-injurious and stereotypic behaviors, intellectual impairment, and seizures (Ritvo, 1977; 1978).

There is substantial overlap in the symptoms described by Rutter (1978) and Ritvo (1977; 1978); however, these definitions differed in terms of what was determined to be the essential or core characteristics of autism. Both indicated that social impairments, deficits in language and cognitive skills, and symptom onset prior to 30 months were critical features of autism. Rutter (1978) stated that the three deficit areas and the age of onset should be considered as the only

diagnostic criteria for autism. Conversely, Ritvo (1977; 1978) suggested that in addition to core symptoms and age of onset, the individual must also have a concomitant disturbance in the rate of development and an abnormal response to sensory stimuli to qualify for a diagnosis. In addition to differences in their diagnostic criteria, the two definitions diverged in terms of how certain autistic symptoms were conceptualized (e.g., insistence on sameness as an essential feature alone, or as part of a disturbance in relating to people, events, and objects; disturbance of developmental rates as a primary feature itself, or as a frame of reference for primary features). In addition to symptomatic differences, each definition was created from and for vastly different purposes. Rutter proposed his definition from historical and scientific perspective to offer a succinct conceptualization of autism for the purpose of stimulating research. On the other hand, Ritvo's definition was formed for the purpose of political and social action to fund treatments (Schopler, 1978). Regardless of the reasons which underpin their viewpoint or how the nosologies of autism they proposed differed, the definitions provided by both Rutter and Ritvo have contributed much to the current diagnostic/assessment technology employed.

A subclassification scheme of autistic symptoms proposed by Wing and Gould (1979) is also noteworthy to discuss in light of the clinical description it provided. Specifically, Wing and Gould provided empirical evidence that there was a broad spectrum of autistic-like syndromes, not just "Kanner's autism." Based on a large scale epidemiological survey of children, three subtypes of autistic sociability emerged: aloof, passive, and active-but-odd. Those categorized as being aloof were the most severely impaired. These children were described as indifferent to others and, except for those instances where personal needs had to be satisfied, rarely made spontaneous social approaches towards others. The passive subtype were children who rarely spontaneously approached others, but could be encouraged to participate in organized social

activities. Finally, those belonging to the active-but-odd group were noted to make spontaneous social approaches to others, albeit in a naïve and one-sided manner, usually to serve a restricted or repetitive preoccupation. In addition to social interaction, this sub-classification system also utilized communicative behavior, symbolic play, motor coordination and imitation, daily routines, and odd or stereotyped behavior to differentiate subtypes.

While their autistic subtypes have been extensively researched and subsequently validated (e.g., Borden & Ollendick, 1994; Castelloe & Dawson, 1993; O'Brien, 1996; Volkmar, Cohen, Bregman, Hooks, & Stevenson, 1989), the most important contribution to the literature stemming from Wing and Gould's (1979) conceptualization is that it engendered the belief that the condition was not a discrete, categorical disorder, but rather a broader definition exists (Volkmar & Klin, 2005). This broad continuum of impairments and competencies were believed to fully capture the complexity of autistic-like conditions. Based on their observations, Wing and Gould (1979) noted that there was a trio of impairment areas which clustered together and could reliably discriminate those with autism from those without autism: the absence or impairment in social interaction; the absence or impairment in the use of language and/or comprehension; and, the absence or impairment in flexible or imaginative activities (i.e., the presence of narrow, repetitive, and stereotyped interests). These symptom clusters were noted to occur at varying levels within the three subtypes (i.e., aloof, passive, and active-but-odd), thus reliably discriminating these groups from each other and from other behavioral, psychological, and medical conditions. In addition to viewing autistic symptomatology as varying along a spectrum, the "autistic triad" which was first proposed by Kanner (1943) and supported by the outcomes of Wing and Gould's (1979) investigation began to become an accepted central criteria of the spectrum of autistic symptomatology. Soon after 1979, the term "autism spectrum

disorder(s)" (ASD) took on vigor in the scientific literature, and is currently the most commonly used term to refer to the spectrum of conditions currently represented in the *DSM-IV-TR*.

It was not until 1980, with the publication of the *DSM-III* (APA, 1980), that autism was listed as a diagnostic category separate from childhood onset schizophrenia. Due to the increasing body of empirical literature supporting the notion that autism was a unique category, infantile autism along with other autistic-like conditions (i.e., residual infantile autism; childhood onset pervasive developmental disorder, COPDD; and, atypical pervasive developmental disorder) was listed under a class of disorders called Pervasive Developmental Disorders (PDDs; referred to as ASD throughout this review). This terminology was developed as an umbrella term for developmental disorders which onset in childhood and shared central features. Not only were the diagnostic criteria consistent with Rutter's (1978) description, but the *DSM-III* also employed a multi-axial approach to diagnose the ASDs and offered specific criteria for each disorder. The diagnosis of residual infantile autism was included for use in cases where the child once met the criteria for infantile autism, but no longer met criteria. COPDD was included to account for those rare cases where children developed autistic-like symptoms after 30 months of age. Finally, atypical pervasive developmental disorder was a sub-threshold category for use in cases where children exhibited symptoms most closely resembling an ASD, but did not meet the specific criteria for any one disorder. Overall, this class of conditions conveyed that individuals with these diagnostic labels suffered from impairments in development in multiple areas of functioning. To further differentiate it from other psychiatric conditions, individuals who presented with hallucinations and delusions were specifically excluded from an ASD diagnosis.

Soon after the *DSM-III* was published, revisions began (Volkmar & Klin, 2005). The definition of ASD in the *DSM-III-R* (APA, 1987) was strongly influenced by Wing and Gould's

(1979) broader view of autism. Changes in this revision included the disorder infantile autism being renamed Autistic Disorder to highlight the lifelong nature of the disorder (Matson & Minshawi, 2006; Volkmar & Klin, 2005). Additionally, the diagnostic categories of COPDD and residual autism were dropped, and atypical pervasive developmental disorder was renamed Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). Therefore, this specific terminology change implied that PDD-NOS was a diagnosis reserved for persons with qualitative impairments in reciprocal social interactions and verbal and non-verbal communication skills, but did not meet the full criteria for Autistic Disorder. The *DSM-III-R* also included the removal of the age of onset criteria, allowing the diagnosis to be given to individuals of any age, regardless of developmental history. As such, there was an overall broadening of symptom criteria to incorporate developmental changes that may occur (Factor, Freeman, & Kardash, 1989).

The *DSM-III-R* was conceptually more advanced than the *DSM-III*; however, with this revision also came problems (Volkmar & Klin, 2005). The most notable issue was that the new conceptualization of ASDs resulted in an increase in false-positive diagnosis rate of approximately 40% (Rutter & Schopler, 1992; Spitzer & Siegel, 1990). Additionally, the criteria for Autistic Disorder were more complex and detailed, which consequently limited clinician judgment (Volkmar & Klin, 2005). Even though there were valid reasons for eliminating the age of onset as a central diagnostic feature, this omission resulted in a discrepancy with Kanner's original description (1943) and with research establishing that autism symptoms did, in fact, emerge in early childhood. Taken as a whole, the main issue with the *DSM-III-R* is that it introduced major changes to the diagnostic concept of autism and the broader ASD spectrum (Matson & Minshawi, 2006; Volkmar & Klin, 2005). The revisions, as a result, increased the

difficulty with which researchers and clinicians could compare the outcomes from investigations using DSM-III-R and, at that time, the more conservative *International Classification of Diseases* (ICD-9; WHO, 1977; Volkmar & Klin, 2005) ASD criteria.

With the impending implementation of *ICD-10* (WHO, 1992), the development of *DSM-IV* (APA, 1994) began with the aim of increasing the clinical utility, reliability, and validity of the ASD diagnoses, as well as making these two classification systems more compatible. Extensive literature reviews, re-analysis of the data collected for the *DSM-III-R*, and a large multinational field trial were conducted in preparation for this revision (ref Volkmar et al., 1994). The field trial data provided an important empirical basis for constructing the definition of ASD for *DSM-IV*. Outcomes indicated that the sensitivity of the definition of Autistic Disorder could be improved substantially with the addition of an age of onset criterion of 36 months and also by raising the diagnostic threshold. The *DSM-IV* (APA, 1994) expanded the PDD category to include Autistic Disorder, Asperger's Disorder, Rett's Disorder, Childhood Disintegrative Disorder, and Pervasive Developmental Disorder - Not Otherwise Specified (PDD-NOS). Furthermore, the significant overlap between ID and ASD was noted and more emphasis was given to social deficits, as this was found to be important in avoiding over-diagnosing ASDs in those with ID (Constantino, Przybeck, Friesen, & Todd, 2000; Posserud, Lundervold, & Gillberg, 2006; Volkmar & Klin, 2005). This re-conceptualization of ASD as five disorders which were applicable over the life span comprises our current diagnostic classification per the *DSM-IV-TR* (APA, 2000).

Current Conceptualization of Autism Spectrum Disorders

There have been several descriptions of autism proposed, most notably those of Rutter (1978), Ritvo (1977, 1978), and Wing and Gould (1979). With respect to the *DSM-IV-TR* (APA,

2000), Rutter's definition of autism which was based on the historical accounts of Kanner has had profound influence over our current conceptualization of ASD (Volkmar & Klin, 2005). Therefore, much of what disorders are currently subsumed as an ASD in the DSM-IV-TR (APA, 2000) are grounded in much of what Kanner first observed in 1943-specifically the autistic triad which includes deficits in social interaction, communication, and restricted interests or behavior.

Core Symptoms

Social Interaction. A marked impairment in social skills is considered to be a central feature of ASD (APA, 2000). Early indicators of an abnormality in social skills characteristic of an autistic individual manifest through deficits in reciprocity, initiation of interactions, forming attachments, maintenance of eye contact, ability to share in enjoyment or sorrow, empathy, and ability to infer the interests of others (APA, 1994; Hauck, Fein, Waterhouse, & Feinstein, 1995; Rutter, 1978). Children diagnosed as having an ASD are rarely observed to enjoy engaging in activities with others, but prefer to play by themselves (Volkmar, Carter, Grossman, & Klin, 1997). Travis, Sigman, and Ruskin (2001) suggested that autistic children who were less competent in social norms and expectations were less likely to show empathy and joint attention skills. During adolescence and adulthood, these individuals continue to have difficulties engaging in conversations with others, likely due to a lack of insight into social norms and others' emotional states (Baron-Cohen, 1991; Cohen & Volkmar, 1997). These possible deficits translate into inability in the areas of initiating conversations, maintaining conversations, and generating spontaneous conversations (Volkmar et al., 1997). Additionally, deficits in social functioning can significantly interfere with the ability to establish lasting and meaningful friendships (Tantam, 2000).

These deficits in social skills have implications for an individual's opportunity for normalization, comfort and quality of his or her living environment, and success in the community. As a person ages, social skills become even more important in acclimation to the environment. An adult with ASD who has more skills in his repertoire and displays very few symptoms has a higher probability of being integrated into society and functioning successfully (Lagone, Clees, Oxford, Malone, & Ross, 1995). In contrast, those who are dually diagnosed as having profound or severe ID may require life-long treatment and may be unable to live independently in the community. Individuals with ID have been found to be less likely to hold jobs, become married, have children, own homes, and engage in adult education when compared to adults with normal intellectual functioning (Hall, Strydom, Richards, Hardy, Bernal, & Wadsworth, 2005). Thus, for the individual with ASD who also has concomitant ID, he/she may face incrementally more obstacles and have more difficulty achieving personal goals. Various techniques used to train social skills have been shown to have some utility; however, the majority of social impairments for individuals with ASD persist throughout their lifetime.

Communication. A qualitative impairment in communication comprises the second criterion for a diagnosis of ASD. Symptoms which are noted to be characteristic of this specific core feature include a lack of or delay in the development of speech, inability or impairment in initiating or sustaining conversation, stereotyped or repetitive use of language, and a lack of imaginative or imitative play (APA, 2000). Individuals with an ASD will always have some level of delay in their ability to communicate, yet the presence of communicative speech by the age of 5 years has been correlated with improved outcomes (Gillberg, 1991). However, longitudinal studies are mixed in their findings related to the level of social communication across the lifespan of those with ASD, with some studies reporting that a reduction in

communicative impairments occurs as the person ages (Piven, Harper, Palmer, & Arndt, 1996) and other studies yielding that no substantial change occurs (Sigman & McGovern, 2005).

An estimated 20-50% of the ASD population does not develop the ability to communicate effectively and may remain mute or acquire only a small amount of functional speech (Bishop, 2003; Frith, 1989; Mesibov, Adams, & Klinger, 1997; Rutter, 1978). An individual with ASD who is nonverbal may be suspected of being deaf; however, researchers have found that their inability to speak is not characteristic of an individual who is deaf or has a general learning disability. When language does develop, it is usually abnormal in quality due to features such as pronoun reversal and echolalia (Rutter, 1970, 1971; Schuler & Prizant, 1985). Other language idiosyncrasies that have been observed to occur in those with ASD include telegraphic speech (Wing, 1969), difficulty in making inferences (Minshew, Goldstein, Muenz, & Payton, 1992), failure to recognize connotations of words (Happè, 1991), infrequent use of mental state verbs (Tager-Flusberg, 1992), and inflexible and ritualistic language (Tager-Flusberg, 1981). Furthermore, it is often very difficult to hold a satisfactory two-way conversation with an individual diagnosed with an ASD. A typical conversation may turn stagnant due to the individual giving stereotyped answers, monologues about a special interest, an over-literal understanding of subject matter, and monotonous language (Hewitt, 1998; Rutter, 1978; Frith, 1989; Tantam, 1991).

Restricted interests or behavior. The final core feature of ASD is restricted, repetitive, and stereotyped patterns of behavior. To qualify for a diagnosis, the *DSM-IV-TR* requires one of the following behaviors to be present: an abnormal preoccupation of one or more stereotyped and restricted patterns of interest; an inflexible adherence to specific, nonfunctional routine or rituals; stereotyped and repetitive motor mannerisms; or, persistent preoccupation with parts of objects

(APA, 2000). This behavior, first described as an obsessive “insistence on sameness” by Kanner (1943), refers to a wide range of behaviors, interests, and activities. Stereotypies are specific to the individual and are often not stable over time, often changing in quantity, quality, and type (Militerni, Bravaccio, Falco, Fico, & Palermo, 2002).

Repetitive behaviors encompass a wide range of behavioral phenomena including stereotyped and repetitive body movements and manipulation of object parts; insistence on sameness of the environment and of routines; narrow and circumscribed interests; and self-injurious behaviors (Bodfish, Symons, Parker, & Lewis, 2000; Lewis & Bodfish, 1998; Rojahn, Matlock, & Tasse, 2000). Stereotyped behaviors (e.g., body rocking, pacing, posturing, vocalizing, sniffing, facial grimacing, nonsocial laughing, manipulating objects, and repetitively moving body parts with a lack of obvious purpose or function) occur in up to 50-100% of children and adults with an ASD (LaGrow & Repp, 1984; Lewis & Bodfish, 1998; Rojahn et al., 2000). Regardless of the particular type of repetitive behavior, engagement in stereotypy has been found to hinder both the acquisition of new skills and the performance of established behaviors (Epstein, Doke, Sajwaj, Sorrell, & Rimmer, 1974; Morrison & Rosales-Ruiz, 1997). For instance, autistic children have been observed to have limited and rigid play patterns due to their stereotypies, decreasing their imagination and creativity during play time (Rutter, 1978). Individuals also suffer from a rigid resistance to change. As a result of this insistence upon sameness, when the environment or their routine is changed, individuals with an ASD may experience increased levels of anxiety that can be stigmatizing and may potentially lead to self-injurious behavior (SIB) or aggressive/destructive behavior (Attwood, 2007; Jones, Wint, & Ellis, 1990). The presence of repetitive behavior has also been suggested as a risk factor for

significant caregiver stress (Konstantareas & Homatidis, 1989). Therefore for these and other reasons, reducing stereotypy is often a high priority for intervention.

Diagnostic Classifications

Autistic Disorder (Autism). The criteria to meet a diagnosis of Autistic Disorder is considered to be the most consistent with Kanner's earliest description of infantile autism, and as such is commonly referred to as "Kanner's autism" or "classic autism" (Volkmar & Klin, 2005). According to the *DSM-IV-TR* (APA, 2000), an individual must exhibit significant and pervasive impairments in social interaction and communication, and exhibit excessive restricted or repetitive interests, activities, or patterns of behaviors. These impairments are characterized by an endorsement of at least six symptom items among the three core deficit areas. To meet the criteria for a diagnosis of autism, at least two item endorsements must come from the socialization domain, and at least one item endorsement must come from the communication domain, and the restricted, repetitive and stereotyped domain. Items in the socialization domain include: 1) impairment in non-verbal behaviors (i.e., eye gaze, facial expression, body postures, social gestures), 2) impairments in the development of peer relationships, 3) deficits in spontaneously sharing achievements, interests, or feelings with others, and 4) impairments in emotional or social reciprocity. Items which fall in the communication domain include: 1) delay in the development of, or total lack in, verbal communication (i.e., commonly used benchmark is spoken words by age 2 years, and short phrases by 3 years), 2) deficits in initiating or sustaining conversation in individuals who have the ability to speak, 3) repetitive, stereotyped, or idiosyncratic language, and 4) deficits in developmentally appropriate spontaneous make-believe play or social imitative play. Items in the restricted, repetitive and stereotyped domain include: 1) preoccupation with a topic of interest which is abnormally high in either intensity or

frequency; 2) rigid inflexibility to specific non-functional rituals or routines, 3) repetitive and stereotyped motor movements such as hand or finger flapping, or rocking back and forth; and, 4) continual preoccupation with parts of objects rather than the whole object or function of the object. An additional prerequisite for a diagnosis of autism is that the delays or impairments must be present prior to 3 years of age in at least one of the following areas: 1) social interaction; 2) communication; and, 3) imaginative or symbolic play. It is noteworthy to mention that a diagnosis of Autistic Disorder can only be given if the individual's behavior and impairments are not better accounted for by a diagnosis of another ASD, specifically Rett's Disorder or Childhood Disintegrative Disorder.

Asperger's Disorder. The first clinical description of Asperger's Disorder was published by Hans Asperger in 1944 (Asperger, 1944). Through a series of case studies of four children, Asperger noted that these children shared common characteristics - namely typical cognitive development and verbal linguistic skills, social isolation, nonverbal communication impairment, idiosyncratic verbal communication, intellectualization of affect, clumsiness and poor body awareness, conduct problems, odd social behavior or excessive interests, and delays in social development and reasoning (Asperger, 1944; Attwood, 2007; Myles & Simpson, 2002). Asperger named the condition he initially observed *autistic personality disorders in childhood*. Often misinterpreted to be parallel to Kanner's description of infantile autism, and having a similar terminology, the disorder observed by Asperger did not gain popularity until the efforts of Wing (1981) and Frith (1991). As such, the pattern of symptoms that Asperger described did not become an official diagnostic entity until its inclusion in the *DSM-IV* (APA, 1994).

According to the *DSM-IV-TR* (APA, 2000) criteria for Asperger's Disorder, an individual must evince significant impairment in social interaction as well as have restricted, repetitive, and

stereotyped behavior patterns. These impairments must be characterized by an endorsement of at least two symptom items from the socialization domain and one from the restricted, repetitive, and stereotyped behavior domain. Items comprising the social interaction domain include: 1) deficits in non-verbal communication, 2) failure to develop developmentally appropriate relationships with peers 3) deficits in sharing achievements, interests or things that they enjoy, and 4) a lack of emotional or social reciprocity. Items included in the restricted interests and stereotypy domain are: 1) fixation with restricted and stereotyped patterns of interest that are abnormal in focus or intensity, 2) strict adherence to nonfunctional rituals or routines , 3) motor stereotypies, and 4) fixation with parts of objects. In addition to the aforementioned criteria, to qualify for Asperger's Disorder the individual must have no evidence of delays in language, cognitive, self-help skills, or adaptive behavior, and presenting symptoms must not be better accounted for by another specific ASD or schizophrenia (APA, 2000).

Childhood Disintegrative Disorder (CDD). Childhood Disintegrative Disorder (CDD), one of the least common of the ASDs, was first reported in 1908 by Theodore Heller. Heller (1908, as cited in Volkmar, Koenig, & State, 2005) reported on six children who, after a period of normal development, experienced severe regression in development between 3 to 4 years of age. In addition to a significant loss of skills, Heller noted that recovery to previously acquired developmental levels was quite limited and that peculiar behavior, most notably stereotypy and overactivity, developed. Originally termed *dementia infantalis*, CDD has also previously been referred to as "Heller's syndrome" and "disintegrative psychosis." In the literature, CDD has often been confused with childhood schizophrenia, COPDD, and autism. Most notably, children with CDD exhibit similar deficits as children with Autistic Disorder (i.e., deficits with social interaction, communication, and restricted interests or patterns of behavior, as well a loss of

interest in the environment). What distinguishes CDD from autism is that symptom onset generally occurs at a later age (i.e., between 3 and 5 years of age). Furthermore, the gradual or abrupt regression which occurs in those with CDD manifests not only with respect to the core autistic triad, but is pervasive across all areas of development (e.g., social, communication, adaptive behavior, play, toileting, and motor skills).

Although CDD has a long history, this disorder was not officially recognized as a distinct diagnostic concept until the *DSM-IV* (APA, 1994). To meet current diagnostic criteria for CDD, an individual must demonstrate normal development up until 2 years of age as demonstrated by age-appropriate verbal and nonverbal communication, play, adaptive behavior, and social relationships. This period of normal development must be followed by a marked loss in previously acquired skills before 10 years of age in at least two of the following areas: 1) expressive or receptive language, 2) social or adaptive behavior, 3) toileting (i.e., bladder or bowel control), 4) play, and 5) motor skills. Furthermore, deficits in functioning must be noted in two of the following areas: 1) social interaction, 2) communication, or 3) restricted, repetitive or stereotyped patterns of activities, behavior, or interests. Moreover, these symptoms must not be better accounted for by another ASD or schizophrenia (APA, 2000).

Rett's Syndrome. Rett's Syndrome is, based on prevalence estimates, the rarest disorder under the umbrella of ASDs. First identified by Andreas Rett in 1966, the most prominent feature of this disorder is the emergence of stereotypical hand movements, typically handwringing or handmouthing, following a characteristic pattern of cognitive and functional development and subsequent deterioration after a seemingly "normal" early infancy (i.e., first 5 months of life) period (Chabrouer & Zaghbi, 2007; Ghidoni, 2007; Hagberg, 2002; Hagberg, Aicardo, Dias, & Ramos, 1983; Matson, Fodstad, & Boisjoli, 2008). Rett's syndrome is the only

ASD which has a confirmed genetic component to its etiology, specifically an X-linked mutation on the MECP2 gene (Amir et al., 1999). Individuals with Rett's syndrome are noted to have a short life expectancy. This disorder is believed to exclusively occur in females; however, there have been a few case reports of males with the condition (Masuyama, et al., 2005).

According to the *DSM-IV-TR* (APA, 2000), in order to meet criteria for a diagnosis of Rett's Disorder, an individual must have developed normally in the prenatal and perinatal periods, demonstrate normal psychomotor development for at least the first 5 months of life, and be born with a normal head circumference. Following this period of normal development, the individual must manifest symptoms in all of the following areas: 1) decrease in head growth between 5 months and 48 months, 2) loss in hand skills between 5 and 30 months along with the development of stereotyped hand movements, 3) decrease in social interaction, 4) poor gait or trunk movement coordination, and 5) severe psychomotor impairments with impaired receptive and expressive language development.

PDD-NOS. Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) is the most prevalent of the ASDs (Buitelaar & Van der Gaag, 1998; Chakrabarti & Fombonne, 2005; Towbin, 2005). Unfortunately, due to the nebulous nature with which the condition is currently defined, PDD-NOS is perhaps the least researched and most misunderstood ASD. It is generally agreed that PDD-NOS represents a collection of conditions that share important features resembling the primary ASDs, but to a milder degree (Allen et al., 2001; Matson & Boisjoli, 2007). Although PDD-NOS was not recognized as an official diagnosis until the *DSM-III-R* (APA, 1987), the existence of an intermediate or mild ASD condition is not a new concept – individuals presenting with symptoms which are autistic-like has been identified and reported on for over 100 years (Bender, 1946; Itard, 1962). In clinical practice, PDD-NOS is often

viewed as a default or temporary strategy when the absence of reliable information prevents asserting a more specific ASD diagnosis (Tidmarsh & Volkmar, 2003; Towbin, 2005). This diagnostic uncertainty coupled with the myriad of atypical symptoms which often present, and the lack of scientific evidence providing definitive demarcations of this disorder, have been primary reasons why PDD-NOS is often defined by what it is not (i.e., autism) rather than specifying what symptoms this disorder actually encompasses (Mahoney et al., 1998; Matson & Boisjoli, 2007).

According to the *DSM-IV-TR* (APA, 2000), to meet criteria for a diagnosis of PDD-NOS, an individual must manifest severe and pervasive impairments in social interactions, and must have either of the following: 1) impairments in verbal or nonverbal communication; or 2) excessive repetitive, restricted or stereotyped interests, activities, or behaviors. Furthermore, these symptoms must not be better accounted for by a diagnosis of a specific ASD, Avoidance Personality Disorder, Schizotypal Personality Disorder, nor Schizophrenia.

Prevalence

Though once described as a rare condition (i.e., 3.9 per 10,000), more recent studies have reported much higher estimates of autism (Howlin, 2006; Rutter, 2005a). Average estimates of autism range from a minimum rate of 20.5 to 38.9 per 10,000 with estimates for the broader ASD spectrum ranging from 53.3 to 116.1 per 10,000 (Baird et al., 2006; Fombonne, 2005, 2009; Gillberg, Cederlund, Lamberg, & Zeijlon, 2006). Furthermore, annual epidemiological data suggests that both the incidence and prevalence estimates of autism, and ASD in general, are increasing (Chakrabarti & Fombonne, 2001, 2005; Matson & Kozlowski, 2010; Nicholas et al., 2008; Tidmarsh & Volkmar, 2003; Williams, Mellis, & Peat, 2005; Wing & Potter, 2002).

There have been several reasons proposed to account for these increased rates, most notably

shifting diagnostic criteria, variability across studies in diagnostic methodology, widening of the definition, increased awareness of ASD among professionals and parents, improved services for those with ASD, a better understanding of the disorder, and the development of more sensitive measures of ASD (Matson & Minshawi, 2006; Wing & Potter, 2002). Regardless of the rationale, ASDs are one of the most frequent serious developmental disability in the United States, aside from ID (Matson & Kozlowski, 2010; Nicholas et al., 2008). As such, ASD is considered to be a major public health concern (Newschaffer & Curran, 2003; Nicholas et al., 2008; Center for Disease Control [CDC], 2004).

Current estimates for ASD, in general, are approximately 60 in 10,000 or 1 in 150 children (CDC, 2004; Fombonne, 2005; 2009). Except for Rett's disorder, a gender disparity is noted to occur across the ASDs - with symptoms being more common in boys than girls with an average ratio of 4.3:1 (Fombonne, 2005). The most prevalent ASD is PDD-NOS, with a rate of 20.8 to 36.1 per 10,000 people (Chakrabarti & Fombonne, 2001, 2005; Fombonne, 2005, 2009; Howlin, 2006). Autistic Disorder is the second most prevalent out of the ASDs, occurring at a rate of approximately 13 to 19 per 10,000 people (Fombonne, 2005; Howlin, 2006). Following autism, Asperger's Disorder occurs at a rate of approximately 9.5 per 10,000 people (Howlin, 2006). Finally, the two least common of the ASDs are CDD and Rett's Disorder. CDD is noted to occur at rates ranging from .6 to 2 per 10,000, while Rett's is found in only 1 per 20,000 individuals (Chakrabarti & Fombonne, 2005; Fombonne, 200, 2009; Tidmark & Volkmar, 2003).

Etiological Theories

The etiology of ASD began as and remains one of the primary controversies in the field of mental health. In his original description of autism, Kanner (1943) reported the condition as being an "inborn error" of presumably congenital origins. Regardless of this early attempt to

characterize the condition as being largely influenced by genetic factors, over the next three decades the role of genes as an underlying etiological variant, was largely dismissed (Volkmar & Klin, 2005). This oversight was largely due the zeitgeist at the time being one which focused on determining environmental causes of pathogenesis. For example, this era of thought was exemplified by the belief that supposed “refrigerator” or “schizophrenogenic” mothers played a primary role in the cause of autism in children (Rutter, 1999; Bettelheim, 1967; Eveloff, 1960). In addition, geneticists at the time were equally dismissive (Hanson & Gottseman, 1976). The prevailing hypotheses placed emphasis on the lack of vertical transmission (i.e., the rarity with which children with autism had parents with autism), the very low rate of autism in siblings, and the lack of identified chromosomal anomalies associated with autism (Rutter, 1999, 2005b).

In addition to early psychogenic and psychodynamic theories, there have been numerous hypotheses in the literature stipulating the etiological underpinnings of ASD including the role of psychosocial, immunological, perinatal, neurobiological, and genetic factors (Matson & Minshawi, 2006). Many show promise in their contribution to determining the root cause(s) of ASD; however, the majority are quite controversial and have no empirical basis (e.g., Measles-Mumps-Rubella vaccine; Wakefield, 1998). At this time, explanations involving the influence of genetic factors have the most empirical support and, thus, appear to be an important determinant in the development of ASD (Rutter, 2005b).

Evidence from genetic theories for ASD was initially given little credibility; however, recent research examining the rate of ASD among twins suggests a much higher concordance than was initially noted. Research by Folstein and Rutter (1977) which examined 11 pairs of monozygotic and 10 pairs of dizygotic twins, found a 36% pair-wise concordance rate for ASD in the monozygotic twins and a 0% rate in the dizygotic twins. The concordance rate of

monozygotic twins increased to 82% when the data were reanalyzed to include higher functioning, yet socially impaired relatives (Folstein & Rutter 1988). Similarly, Ritvo, Freeman, Mason-Brothers, Mo, and Ritvo (1985), who studied 23 pairs of monozygotic and 17 pairs of dizygotic twins, found a 95.7% concordance rate of ASD among monozygotic twins and a 23.5% concordance rate among dizygotic twins. Given the current estimated prevalence rates of ASD, this data suggest that the concordance of ASD in monozygotic twins is greater than chance. Many of the early genetic studies of ASD have methodological problems (e.g., lack of random sampling); however, subsequent analyses have confirmed these early twin studies. Bailey et al. (1995), in a twin study in Britain with 45 twin pairs, found a 60% concordance rate among monozygotic twins and a 0% concordance rate among dizygotic twins. Furthermore, 92% of the monozygotic twins were found to share a mixture of social and cognitive deficits related to a broader phenotype of ASD.

Family studies, which investigate the rate of ASD among non-twin siblings and the offspring of individuals with ASD, have also lent support to the genetic basis of these disorders (Matson & Minshawi, 2006). While the outcomes of family studies may be influenced by a number of factors (i.e., environmental), they do provide additional data to consider. The reported rate of ASD among siblings is approximately 3%; however, some reported rates are as high as 5.9% (August, Stewart, & Tsai, 1981; Bolton et al., 1994; Baird & August, 1985). Again, when considering the prevalence rate of autism, these studies suggest a much higher rate in siblings. Ritvo, Jorde, and Mason-Brothers (1989), in their epidemiologic survey, reported an 8.6% risk of autism for siblings.

A third source of data supporting that there is genetic basis to ASD is the association with particular disorders of known genetic etiology (Browndyke, 2002). Fragile X is a cytogenetic

marker associated with Fragile X Syndrome. This syndrome is the second most common cause of ID and is associated with ASD, specifically autism (Gillberg & Coleman, 1996). Ritvo, Jorde, and Mason- Brothers (1989) reported that of 614 autistic males screened in 12 studies, 7.7% were identified as having the Fragile X marker. Other genetic disorders associated with ASD include tuberous sclerosis, untreated phenylketonuria, and neurofibromatosis (Gillberg & Coleman, 1996). While there does appear to be some association between ASD and genetic disorders, it should be noted that the great majority of autism cases have no known etiology (Browndyke, 2002).

In sum, the genetic basis of ASD has received increased attention over the recent years. While it does not appear that a single gene is responsible for the deficits found in ASD, researchers have suggested that there may be multiple genes involved, thus explaining the heterogeneity of symptoms found in individuals with ASD (Bailey et al., 1995). Though the nature of this genetic component is not yet fully understood, there is evidence to support such an etiology for ASD. More data is needed to clarify these issues. Current the literature indicates that in lieu of a clear etiological determinant, the best way to identify and diagnose ASDs is on behavioral presentation (Matson & Minshawi, 2006).

Early Diagnosis of Autism Spectrum Disorders

Major advances have been made in the diagnosis and treatment of children with ASDs. Among the most important are the development and wide implementation of reliable and valid early diagnostic instruments such as the *Autism Diagnostic Interview-Revised* (ADI-R; Lord, Rutter, & Le Couteur, 1994), the *CHecklist of Autistic Traits* (CHAT; Baron-Cohen et al., 2000), the *Modified Checklist of Autistic Traits* (M-CHAT; Robins, Fein, Barton, & Green, 2001), and the *Baby and Infant Screen for Children with aUtIsm Traits* (BISCUIT; Matson, Boisjoli, &

Wilkins, 2007), as well as early autism-specific intervention programs. Evidence that very young children with an ASD benefit, often times dramatically, from evidence-based early interventions (Ben-Itzhak, Lahat, Burgin, Zachor, 2008; Zachor, Ben-Itzhak, Rabinovich, & Lahan, 2009) has placed the earlier detection and treatment of ASD as a major public health priority over the past decade (Charman & Howlin, 2003; Filipek et al., 2000; Matson, 2007; Pinto-Martin, Dunkle, Earls, Fliedner, & Landes, 2005). Further, the economic impact of providing special education services and long-term care for those with autism and related disorders are considerable and are exponentially exacerbated when the identification and subsequent referral to appropriate services is delayed (Järbrink, Fombonne, & Knapp, 2003; Pinto-Martin et al., 2005; Mandall, Cao, Ittenbach, & Pinto-Martin, 2006). Therefore, the earlier diagnosis can be given, the more promise there is for the child, and also the family unit and society as a whole. In the absence of there being reliable biological markers for ASDs, efforts to identify and diagnose those children who evince autistic symptoms at a very young age is regrettably constrained by our limited knowledge of the earliest behavioral manifestations of ASD.

Existing evidence on the early signs of ASD comes largely from retrospective parent reports and early home videotapes. A number of researchers have suggested that the vast majority of parents of children with ASD report noticing abnormalities during the first 2 years of life (Baghdadli, Picot, Pascal, Pry, & Aussilloux, 2003; Chawarska et al., 2007; Di Giamoco & Fombonne, 1998; Rogers & DiLalla, 1990). Even within this time frame, there is great variability as approximately 50% of parents recall abnormalities being evident within the first year of life, and 80-93% indicate recognition of symptoms by age 3 (Baghdadli et al., 2003; Webb & Jones, 2009). This early parental recognition is reflected in that the mean age when

parents first report concerns to a medical professional is between 18 and 36 months of age, and clinical diagnoses of autism and other ASDs are most likely to occur between 3 to 4 years of age (Bagdadli et al., 2003). With respect to the link between the onset of parental concerns and the child's later diagnosis, Chawarska et al. (2007) found that children who presented with severe deficits very early in life (i.e., birth to 10 months of age) were more likely to receive a diagnosis of Autistic Disorder at age 4 years. Conversely, at 4 years old, those with deficits emerging between 11-18 months of age were equally likely to receive a diagnosis of autism or PDD-NOS while those with concerns arising at or after 18 months received a diagnosis of autism at age 4 years.

In general, problems in the development of speech and language are usually the first symptoms which cause a parent to consult a professional (Matson, 2007). Analyses of home videos from the first year of life indicate that 80% - 93% of children later diagnosed with an ASD evince atypical development and abnormal behaviors (e.g., Adrien et al., 1992; Baranek, 1999; Lösche, 1990; Osterling & Dawson, 1994). Symptoms reported as occurring within the first 12 months of a child's life include extremes of temperament and behavior (ranging from marked irritability to alarming passivity), poor eye contact, and lack of responsiveness to parents' voices or attempts to play and interact (Dahlgren & Gillberg, 1989; DeGiacomo & Fombonne, 1998; Ohta, Nagai, Hara, & Sasaki, 1987; Saint-Georges et al., 2009). Compared to typically developing peers, in the first 12 months of development children who are later diagnosed as having ASD appear to be less likely to respond when their names are called or to spontaneously look and smile at others, have greater negative affectivity and affective expressions, and exhibit repetitive behaviors (Volkmar & Klin, 2005). A few isolated case reports of children with ASD also implicate that early social-communicative impairments may be

accompanied by sensorimotor abnormalities (e.g., hyper-sensitivity to sound and touch) and/or atypical motor behaviors (e.g., specific finger or hand movements) (Dawson, Osterling, Meltzoff, & Kuhl, 2000; Osterling, Dawson, & Munson, 2002).

Recent research on the earliest behavioral manifestations of ASD is informative. However, the majority of these studies appear to be limited by several methodological problems, notably the recall biases of retrospective reports, the contextual constraints of videotapes, and the likelihood that isolated case reports represent the most severe or otherwise atypical cases (Zwaigenbaum et al., 2007). There is currently an ongoing debate on how early the diagnosis can be made and whether the diagnosis remains stable (Matson, Wilkins, & Gonzalez, 2008). It has been established that ASD can be detected with greater accuracy as children age (Landa & Garrett-Mayer, 2006). Likewise, the diagnosis of Autistic Disorder is noted to be more stable than PDD-NOS or Asperger's Disorder in the very young child (Cox et al., 1999; Turner, Stone, Pozdol, Coonrod, 2006). PDD-NOS is often diagnosed in the young child, while Asperger's Disorder is primarily not diagnosed until later in childhood (Matson, Wilkins, & Gonzalez, 2008). Ultimately, there needs to be a coherent picture of the early behavioral profiles and developmental trajectories that might potentially distinguish very young children with ASD. However, research to date is limited with respect to the emergence of symptoms in the very young child with ASD. Thus, more research is needed to clarify these issues.

Challenging Behaviors and Autism Spectrum Disorders

Over the past 50 years, an extensive body of research has amassed concerning the nature, extent, and impact of challenging behaviors evinced by individuals with developmental disabilities (DD; McClintock & Hall, & Oliver, 2003). Estimates indicate that approximately 13% to 30% of individuals with ID or general delays evince some type of challenging behavior

(Sturmev et al., 2008). It is apparent that challenging behaviors are a pervasive problem; however, there is no formally agreed upon operational definition. In addition to this variability in defining challenging behaviors, there is a vast array of terms commonly used including maladaptive behaviors, aberrant behaviors, problem behaviors, externalizing behaviors. Regardless of the term or definition employed, ‘challenging behavior(s)’ is a term generally used to describe behaviors which are not socially acceptable and occur of such frequency, intensity, or duration that the act places the individual or others in jeopardy and/or has the potential to significantly affect the individual’s education, living placement, or community involvement (Emerson et al., 2000; Mudford et al., 2008).

Literature indicates that there are a variety of behaviors evinced by individuals in the general population including those diagnosed as having an ASD, ID, psychopathology, language or communication disorder, and those without a diagnosis (Dominick, Ornstein, Davis, Lainhart, Tager-Flusberg, & Folstein, 2007; Emerson et al., 2001). However, for this discussion, the term “challenging behavior” will refer only to the broad class of unusual and aberrant behaviors which frequently occur in individuals with DD, specific to ASD. With this in mind, Sturmev, et al. (2008) proposed that challenging behaviors can be categorized into two classes: extra-personal and intra-personal. Extra-personal challenging behaviors refer to actions that interfere with the goal-directed behavior of others including physical aggression, verbal aggression/threats, tantrums, self-injurious behaviors (SIB), and property destruction. Challenging behaviors which are classified as being intra-personal include fearful, anxious, and withdrawn behaviors that hinder learning and social interactions such as stereotypies and other odd behaviors. In contrast to extra-personal, intra-personal behaviors cause less interference with others. As such, intra-personal behaviors are often viewed as the least problematic of challenging behaviors, thereby

often resulting in less intensive intervention or no treatment at all (Matson, Benavidez, Compton, Paclawskyj, & Baglio, 1996).

Individuals who engage in challenging behaviors often exhibit more than one topography with each being at a high frequency, severity, and/or intensity (Borthwick-Duffy, 2001; Maisto, Baumeister, & Maisto, 1978; Winchel & Stanley, 1991). That is, challenging behaviors frequently coexist. For example, individuals who display self-injurious behavior are likely to also evince aggressive behavior and/or property destruction. Outcomes from a large sample study conducted by Emerson et al. (2001) indicated that between one-and-a-half to two-thirds of individuals who engage in challenging behavior do so in at least two topographies. Likewise, Borthwick-Duffy (1994) found that approximately 25% of individuals with ID engage in multiple topographies of behavior, with those being aggression, SIB, and property destruction. While the co-occurrence of challenging behavior across multiple topographies is considerable, individuals with delays (e.g., ID and ASD) are also significantly more likely to show more than one form of the specific behavior topography. Harris (1993) observed that in a sample of 168 adults with ID, the most prevalent forms of aggression were punching, slapping, pushing or pulling (51%), kicking (24%), and pinching and scratching (21%). Similarly, common forms of SIB shown by individuals with ID include repeated self-biting, punching or slapping, hitting his/her head against objects, hitting other parts of the body, or self scratching (Emerson et al., 2001).

The relationship between symptoms of ASD and challenging behaviors has been discussed since the earliest descriptions of the disorder. Being that one of the core features of ASD is stereotypies, the vast majority of the early literature on challenging behavior is relegated to describing types of stereotypic behavior. Although some evidence of other forms of

challenging behaviors was noted, a thorough investigation into the nature of these behaviors was rare. Out of the 11 children Kanner (1943) described in his original account of autism, half evinced stereotypical behaviors with 5 of these children also engaging in tantrum behaviors, 2 also exhibited physical aggression, and 1 child was noted to also engage in property destruction. Similarly, Asperger (1944) noted in that the children he observed, problematic behaviors other than stereotypies occurred including property destruction, physical aggression, and verbal aggression.

Although challenging behaviors are not considered a core feature of ASD, numerous researchers report that many people with ASD engage in a variety of challenging behaviors (APA, 2000; Holden & Gitlesen, 2006; Lecavalier, 2006; Matson, Wilkins, & Macken, 2009; Murphy et al., 2005). Recent prevalence estimates range from 35.8% to 94.3%, with the majority of studies identifying at least half of individuals with ASD engaging in challenging behaviors (Baghdadli, Pascal, Grisi, & Aussilloux, 2003; Bodfish et al., 2000; Holden & Gitlesen, 2006; Matson et al., 2009; Murphy, Healy, & Leader, 2009). As such, the presence of challenging behaviors in individuals with an ASD is often the primary reason for treatment referral. A recent study of 6701 child and adolescent referrals to community mental health centers conducted by Mandell, Maytali, Novak, and Zabritsky (2005) found that the symptoms most likely to be cited as presenting problems by parents of children with ASD were hyperactivity, aggression, poor peer interaction, noncompliance social avoidance, and “strange” behaviors. Similarly, challenging behaviors reported in the literature as being commonly displayed by individuals with ASD include aggressive or destructive behaviors, SIB, and stereotypies (APA, 2000; Machalicek, O’Reilly, Beretvas, Sigafos & Luancioni, 2007; Matson & Nebel-Schwalm, 2007; Sturmey et al., 2008). These behaviors may be of such severity that

the individual may have a concomitant diagnosis to reflect the grave nature of their behavioral or conduct problems (Gurney et al., 2006).

Challenging behaviors have received considerable attention due to its association with a wide range of negative educational, vocational, and social consequences and their impact on quality of life. These behaviors are noted to significantly compromise the physical and mental health of the individual, immediate family, service providers, and society (Hastings, 2002). The act of engaging in these types of behaviors carries significant health risks, such as sutures, lacerations, poisoning, fractures, recurrent infections and, in extreme cases, death (Mukades & Topcu, 2006; Nissen & Haveman, 1997; Sturmey et al., 2008). However, the consequences of challenging behaviors extend far beyond their immediate impact. Individuals who exhibit challenging behaviors are more likely to be excluded from community-based services and are less likely to retain employment status (Borthwick-Duffy, Eyman, & White, 1987). The presence of these behaviors is also associated with placement in restricted settings such as segregated residential or institutionalized setting; exclusion from services provided within these settings; and, restrictive and potentially harmful treatment practices, including psychotropic medications, polypharmacy, emergency psychotropic medications, loss of personal property, physical and personal restraint, seclusion, and time-out (Sturmey et al., 2008). In the community, challenging behaviors may serve to limit the development of social relationships and activities in the individual's community (Anderson, Larkin, Hill, & Chen, 1992; Lusielli & Slocumb, 1983).

Topography of Challenging Behaviors

Aggressive Behavior. Aggressive behavior is commonly viewed as a set of distinct responses categorized as “inappropriate physical contact” initiated solely by the individual in an

attempt to physically harm another person (Dominick et al., 2007; Gerhardt, Weiss & Delmolino, 2004). Some representative topographies of aggression include hitting with an open or closed hand/fist, scratching, pinching, kicking, biting, pushing, and pulling hair (Alink et al., 2006; Crocker et al., 2006; Singh et al., 2006). While this definition of aggressive behavior posits that the act must be physical in nature, other researchers have extended the terminology to include acts beyond just physical aggression including verbal aggression (e.g., threatening to harm others, bullying, cursing at others, screaming and/or yelling at others), sexual aggression (e.g., behaviors of an inappropriate sexual nature including masturbating in public, fondling others, and exposing oneself in public), property destruction (i.e., behaviors that damage other objects such throwing objects, kicking objects, ripping/shredding objects, and urinating/defecating on objects), or a mixture of these in their definition of aggression (Ando & Yoshimura, 1979; Dominick et al., 2007; Sturmey et al., 2008). In addition to the aforementioned aggressive acts, researchers often include SIB as a form of aggression that is self-directed (e.g., hitting self, picking/pinching at self, biting self, banging head on objects (Crocker et al., 2006; Montes & Halterman, 2007); however, this specific topography will be discussed in a subsequent section.

Although aggressive behaviors are relatively common in childhood, for those with an ASD these behaviors are observed to occur at increased rates across the lifespan (Murphy et al., 2005; Nicholas et al., 2003). It has been estimated that the prevalence of physical aggression in children with ASD ranges from 26.2% to 50% (Dominick et al., 2007; Matson et al., 2009). Matson, Wilkins, and Macken (2009) reported that in 182 children with ASD 2 through 17 years of age, 44.3% engaged in verbal aggression, 42.6% displayed property destruction, 40.9% evinced banging on objects with hand, 36.9% engaged in throwing objects at others, 35.8% exhibited kicking objects, and 14.8% displayed pulling others' hair. It is noteworthy to mention

that across studies, estimates of aggression may be influenced by how the behavior is categorized. For example, Hartley, Sikora, and McCoy (2008) found that only 22.5% of children with an ASD 1.5 to 5.8 years engaged in clinically significant aggressive behavior, meaning these behaviors were greater than two standard deviations above normative data. However, the authors did note that it was possible their outcomes underestimated the actual prevalence of aggression in those with ASD, as they were only capturing behaviors deemed to be very severe and/or at a great intensity. Individuals with more severe symptoms of ASD are at an even greater risk for aggressive behaviors than those with mild ASD. Matson, Wilkins, and Macken (2009) found that children with differing severity levels of ASD (i.e., mild, moderate, and severe) engaged in different frequencies of challenging behaviors, with those with severe ASD being comparatively more at-risk for severe challenging behaviors. Throwing objects at others, banging on objects with hands, and pulling others' hair was more likely to be endorsed by children who met the cutoff score for severe ASD on a diagnostic measure. Likewise, aggression towards others and property destruction were significantly more likely to be endorsed by children with severe as compared to moderate ASD.

Research indicates that that individuals with ASD are more likely to engage in aggressive challenging behaviors than typically developing peers (Nicholas et al., 2003), those with ID alone (McClintock et al., 2003), and individuals with a history of language impairment (Dominick et al., 2007). Overall, it has been found that 17.6% to 60% of individuals with ID evince aggressive behavior, with most rates falling in the 20% to 40% range (Crocker et al., 2006; Lindsay et al., 2004; Tenneij & Koot, 2008). More specifically, physically aggressive behavior has been found to occur in 12.6% to 35.67% of adults with ID (Crocker et al., 2006; Hemmings, Gravestock, Pickard, & Bouras, 2006; Tenneij & Koot, 2008; Tyrer et al., 2006).

Verbal aggression has also been found to occur at high rates by those with ID with research demonstrating prevalence rates of 16.4% to 44.33% among adults (Crocker et al., 2006; Hemmings et al., 2006; Tenneij & Koot, 2008). Although other forms of aggression are less studied within the ID population, researchers have found that 15% of adults with ID evince destructive behaviors (Hemmings et al., 2006), and that 24% of adults with ID engage in property destruction and 9.8% in sexual aggression (Crocker et al., 2006).

Stereotypies. Per the *DSM-IV-TR* (APA, 2000), the third core behavioral symptom leading to a diagnosis of an ASD is the presence of restricted, repetitive, and stereotyped patterns of behaviors, activities, and interests. While the definition and application of the terminology is often debated in the literature, “stereotypy” and “stereotypic behavior” are umbrella terms which refer to a broad class of topographically similar behaviors. In general, a behavior is considered to be stereotypic in nature when it is rhythmic, chronic, rigid and invariant, appears to serve no adaptive purpose, and is socially and/or developmentally inappropriate (Berkson, 1967; Symons, Sperry, Dropik & Bodfish, 2005; Turner, 1999). Believed to be automatic or self stimulatory in nature, confirmation of the underlying function of the stereotypy is not a necessary requirement for classification.

Stereotypic behaviors are a highly heterogeneous class. A stereotypy may be verbal or nonverbal, gross or fine motor-oriented, and occur with or without objects. Overall, behaviors which are considered to be a stereotypy are primarily classified as being simple or complex in nature (Bodfish, 2007). Common examples of simple stereotypic behavior include hand flapping, body rocking, toe walking, spinning objects, sniffing, immediate and delayed echolalia, and facial posturing/grimacing (Schreibman, Heyser, & Stahmer, 1999; Bodfish et al., 2000). Behaviors which are considered to be complex stereotypies, are generally related to a restricted

and stereotyped pattern of interest or the demand for sameness. This may involve a persistent fixation on parts of objects or an inflexible adherence to specific, nonfunctional routines or rituals. For example, a child may attend only to specific parts of objects (e.g., car wheels, doll eyes) or insist on playing with his or her toys in a very specific fashion (e.g., lining blocks up in identical rows repetitively). Alternately, a child may experience significant distress when his/her typical schedule or routine is deviated from or interrupted.

Stereotypies are considered a form of challenging behavior. The act of engaging in these behaviors is not generally noted to cause physical harm, yet stereotypies are noted to limit the extent to which the individual successfully interacts with his/her environment. Specifically, stereotypical behaviors are negatively related to the acquisition of academic and social skills (Dunlap, Dyer, & Koegel, 1983; Morrison & Rosales-Ruiz, 1997; Sturmey et al., 2008). That is, when an individual engages in a stereotypy, they do so to an extent that the behavior competes with his/her ability to interact with other individuals, participate in learning activities, and contact reinforcement in their own environment, which results in a failure to develop new skills, social stigmatization, and a decline in community activities (Cunningham & Schreibman, 2008; Rapp & Vollmer, 2005). Despite being a considerable impairment to an individual's quality of life, stereotyped and repetitive behaviors are often viewed as the least problematic challenging behavior. Thus, this class of behaviors is noted to receive less intensive intervention than aggression or self-injury and, oftentimes, these behaviors may receive no intervention services at all (Matson et al., 1996).

Despite often being overlooked for treatment, stereotypy and ritualistic patterns of responding are considered a prevalent and significant diagnostic feature of children and adults with ASD. A number of researchers have suggested that individuals with ASD engage in

unusually and substantially high rates of stereotypy (Bodfish et al., 2000; Lancioni, Smeets, Ceccarani, & Goossens, 1983; Matson, Wilkins et al., 2008; Nicholas et al., 2008). Prevalence rates of stereotypy in those with ASD vary dramatically. A recent study by Murphy et al. (2009) examining challenging behavior in 157 children with ASD showed that overall, 139 participants (72%) emitted stereotyped patterns of behavior; however, depending on how stereotypical behavior was defined, estimates of the occurrence of stereotypy in children with ASD have been as high as 91-100% (Bodfish et al., 2000). With respect to the phenomenology of stereotypy, Matson, Wilkins, and Macken. (2009) found that 60.2% endorsed repeated and unusual vocalizations, 54% endorsed repeated and unusual body movements, and 48.9% endorsed unusual play with objects.

The presence of repetitive behaviors is not unique to ASD. They are common to individuals with other sensory, intellectual, or developmental disabilities, psychiatric conditions, and even among typically developing infants and toddlers (Bodfish et al., 2000; Cunningham & Schreibman, 2008). Persons diagnosed as having ID engage in a wide array of repetitive behaviors, with individuals with severe or profound ID being at an increased risk for stereotypies than persons with mild or moderate ID (McClintock et al., 2003). Although symptoms of ID and ASD overlap (i.e., communication and social deficits) and may make differential diagnosis difficult (especially for those with severe to profound ID), the stereotypical behaviors evinced by these two groups can be differentiated (Bodfish et al., 2000; Carcani-Rathwell et al., 2006; Matson & Dempsey, 2008). First, individuals with an ASD exhibit more motor stereotypy than atypically developing peers without an ASD diagnosis (Goldman et al., 2009). Second, individuals with ASD are noted to engage in more hand/finger stereotypies (e.g., tapping,

opening-closing, clapping, waving) and stereotypical gait patterns (e.g., skipping, spinning, jumping).

Stereotypies and rituals occur at a higher rate and intensity in children and adults with ASD than for any other developmental disorder; however, few have systematically investigated the presence of these behaviors in the very young child with ASD. In one of the largest studies to date, Matson, Dempsey, and Fodstad (2009) evaluated the type and extent of stereotyped and ritualistic behavior across 760 young children (age range 17–37 months) with autism, PDD-NOS, or non-ASD delays. Outcomes indicated that stereotypies and repetitive/ritualistic behaviors were most common in those with more severe symptoms of ASD. Consistent with other literature, individuals without ASD but presenting with other developmental delays were less likely to present with stereotypies or ritualistic patterns of responding. Matson, Dempsey et al. (2009) contend that their findings support the idea that stereotypies and ritualistic behaviors can be identified at very early stages of development (the mean age of infants in this study was 26.63 months).

SIB. More has been written about SIB in individuals with ID and ASD than any other challenging behavior. This is related, part and parcel, to the potentially dangerous and deleterious effects which occur more frequently with SIB than any other topography (Sturmeier et al., 2008). In general, SIB relates to a class of behaviors which the individual inflicts upon his/herself that has the potential to result in physical injury, more specifically tissue damage or, in extreme cases irreversible injury or death, if the behavior is not stopped (Rojahn, Schroeder, & Hoch, 2008; Schroeder, Mulick, & Rojahn, 1980). There are two broad subtypes of SIB with which persons most commonly present for treatment: stereotyped self-injury and impulsive self-injury (Barrett, 2009; Yates, 2004). Stereotyped self-injury is described as being repetitive in

nature and is most commonly exhibited by individuals with ASD, intellectual disability, and developmental disabilities (APA, 2000; Matson, Cooper, Malone, Moskow, 2008; Oliver, 1998). Conversely, impulsive self-injury is a habitual behavior (e.g., self mutilation) most commonly observed in individuals with a serious psychiatric illness (Linehan, Armstrong, Suarez, Allmon, & Heard, 1991; Suyemoto, 1998). Since the primary focus of this discussion is SIB in those diagnosed as having an ASD, only those behaviors classified under the stereotyped will be covered.

While the actual presentation varies from person to person, common forms of SIB in children and adults with DD include self-biting (e.g., biting one's hand or lip), self-scratching or skin picking, self-punching, self-pinching, and repetitive banging of the head and limbs against solid, unyielding surfaces such as walls, tables, and floors (Iwata et al., 1994). Less common forms of SIB include eye pressing or gouging; pulling one's own hair, teeth, or fingernails; repeatedly dislocating and relocating joints (especially the fingers and jaw); and, twisting or tearing of the ears or genitals (Iwata et al., 1994; Rojahn et al., 2008). Deliberate and forceful striking of the knee to one's face or head is a potentially lethal form of SIB that may result in detached retinas, serious damage to soft tissue, and fracture of the mandible and periorbital area (Rojahn et al., 2008). Although SIB is commonly described as a highly repetitive behavior occurring at frequencies up to "dozens of instances per minute" (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982; Iwata et al., 1994), the behavior can be episodic insofar as it either occurs under highly specific stimulus contexts or in bursts after long periods without problematic behavior (e.g., O'Reilly, 1997). Due to the high risk of injury or death, the presence of SIB is often associated with restrictive protective equipment such as helmets, padded mitts, arm and leg restraints, and other individually tailored protective clothing, as well as psychotropic medication

use (Borrero, Vollmer, Wright, Lerman, & Kelley, 2002; Rojahn et al., 2008; Sturmey et al., 2008). In general, treatment practices based on applied behavior analysis with or without medication use have been shown to be moderately effective at reducing SIB for the majority of individuals with ASD, ID, and other DDs; however, success is often short lived due to the chronic nature of SIB and the labor-intensiveness of treatment implementation (Kahng, Iwata, & Lewin, 2002; Rojahn et al., 2008).

It has been established that SIB is common in children and adults with ASD. Unfortunately, exact prevalence rates of SIB in those with ASD have yet to be determined. Epidemiological estimates differ widely, primarily due to the lack of standardized survey methodology, sampling methods, and inconsistent behavioral definitions of SIB (Rojahn & Esbensen, 2002; Baghdadli et al., 2003). Bodfish et al. (2000) reported that in a sample of 32 adults diagnosed with autism, 50% displayed some form of SIB. Similarly, approximately 53% of children and adolescents with an ASD are noted to engage in SIB (Baghdadli et al., 2003). Given these estimates, it seems that prevalence rates are relatively consistent across age groups of individuals with ASD, further supporting the belief that SIB is a chronic problem across the lifespan in this population (Rojahn et al., 2008). In children diagnosed with an ASD, self-hitting is noted to be the single most prevalent SIB with estimates ranging from 15.9% to 35.8% (Lecavalier, 2006; Matson, Wilkins, et al., 2009). Other common forms of SIB in children with ASD include mouthing or swallowing objects causing bodily harm (approximately 17% of cases), pica (approximately 12.2% of cases), self-hitting or head banging (approximately 11% of cases), eye poking (approximately 9.6% of cases), self-scratching or pulling one's own hair (8.5% of cases), and self-biting (5.9% of cases; Matson, Wilkins, et al., 2009; Lecavalier, 2006).

In addition being at a high risk for developing and engaging in SIB, individuals with an ASD are noted to engage in these behaviors at frequencies greater than typically developing peers, those who have language impairment, those with ID, and peers with visual impairments (Baghdadli et al., 2003; Berkson, 2002; Berkson & Tupa, 2000; Dominick et al., 2007; Nicholas et al., 2008). While approximately 3% to 25% of individuals with ID are noted to evince SIB, it appears that higher prevalence rates are associated with a decrease in intellectual functioning, with individuals with profound ID engaging in significant more SIB (McClintock et al., 2003; Oliver, 1988; Rojahn et al., 2008). However, despite this increased risk for individuals with ID engaging in SIB, those with ASD are reported to engage in significantly more of these behaviors. Bodfish et al (2000) noted that when matched on age, gender, and IQ, approximately 50% of adults with ASDs were found to engage in SIB compared to only approximately 25% of adults with ID alone. Even though prevalence rates for SIB were higher in those with ASD compared to those with ID only, it was also noted that the number of topographies evinced by those in each diagnostic group did not significantly vary (Bodfish et al., 2000).

Early Emergence of Challenging Behaviors in Autism Spectrum Disorders

There is a great deal of literature on challenging behavior in adults with ID and/or ASD; however, there is a dearth of data on these problems in very young children with ASD. Furthermore, information on the early emergence and course of challenging behavior topographies in this specific population is scarce. Out of the few investigations which have systematically studied this topic, there does appear to be developmental trends with respect to challenging behaviors evinced by children with DDs when compared to typically developing children (Cunningham & Schreibman, 2008; Dominick et al., 2007). Furthermore, it appears that individuals with ASD may have different symptom patterns in the development of aberrant

behavior than those with other types of delays (Kozlowski & Matson, 2010; Matson, Dempsey, et al., 2009). In a recent study by Kozlowski and Matson (2010), toddlers with ASD between the ages of 17 to 37 months were noted to engage in significantly more challenging behaviors than atypically developing, matched peers. Furthermore, significant differences were detected with respect to specific forms of aggressive, self-injurious, and stereotypical behaviors across diagnostic groups. These findings are of paramount importance given that this increased risk for challenging behaviors was able to be detected in very young children with ASD.

Early Development of Aggressive Behavior. With respect to the emergence of aggressive and/or destructive behaviors, the literature indicates that the age of onset varies in children with ASD with the vast majority of these behaviors emerging between early infancy to 11 years of age (Dominick et al., 2007). However, most children with ASD are noted to begin to engage in aggressive and/or destructive behaviors around 2 to 3 years of age (MacLean, Stone, & Brown, 1994). This is not to say that these behaviors are unable to be detected prior to 2 years (Dominick et al., 2007). Researchers have also indicated that specific developmental equivalents of aggressive behavior seem to be more likely to occur in the very young child with ASD. Kozlowski and Matson (2010) found that toddlers (i.e., 17 to 37 months of age) with ASD (i.e., Autistic Disorder or PDD-NOS) were more likely than atypically developing toddlers to engage in aggressive behaviors such as kicking objects, removal of clothing at inappropriate times, playing with own saliva, throwing objects at others, banging on objects with hands, leaving the supervision of caregiver without permission, aggression towards others, pulling others' hair, yelling or shouting at others, and property destruction. Upon further investigation, those with more severe autistic symptomatology (i.e., Autistic Disorder) engaged in significantly more

frequent and more severe SIB than those with milder autistic symptoms (i.e., PDD-NOS) and toddlers with general DD.

Early Development of Stereotypical Behavior. The presence of stereotypical behavior has long been established as being a normal occurrence in typically and atypically developing infants and toddlers. Researchers note that typically developing toddlers engage in stereotypical behaviors similar to those which occur in individuals with ASD, specifically head banging, finger and hand stereotypies, echolalia, and body rocking (Berkson & Tupa, 2000; Thelen, 1979, 1981, 1996). Although typically developing toddlers display motor and vocal stereotypies, it appears that these behaviors are less varied than toddlers with ASD. In a study by MacDonald et al. (2007), the frequency with which stereotyped patterns of behavior occurred were compared in children with ASD versus typically developing children matched at ages 2, 3, and 4 years of age. Results demonstrated that the 2-year-old children diagnosed with ASD showed a higher level of stereotypy than their typically developing 2-year-old counterparts during assessment conditions, and this gap incrementally increased at ages 3 and 4 years. Similarly, Singer (2009) investigated the age trends of repetitive arm and hand movements in a sample of 81 typically developing toddlers. Results indicated that 56 (69%) participants who evinced stereotypy had their behavior onset at younger than 24 months of age, 19 (23%) between 24-35 months, and 6 (8%) at the age of 36 months or older.

Although all children exhibit repetitive behaviors at very young ages, the course of these behaviors in typically developing children versus children with ASD differs dramatically. The progression through repetitive stereotyped movements involving the limbs, torso, head, and whole body are associated with the development of motor skills (Wolff, 1967), neuromuscular development (Thelen, 1979), and the central nervous system (Sprague & Newell, 1996). For the

typically developing toddler, repetitive behaviors, both motor and vocal, occur at peak frequencies at transition points in development, and decrease rapidly once the specific milestone has been maintained. This translates into an overall decrease in the rate of stereotypical behaviors as the child ages (MacDonald et al., 2007; Thelen, 1979, 1981; MacLean et al., 1994). For the severely delayed infant or toddler, stereotypical behaviors tend to emerge at much older chronological ages and persist for longer durations, well past the age of the behavior being considered developmentally appropriate (Berkson & Tupa., 2000; Cunningham & Schreibman, 2008; Field, Ting, & Shuman, 1979; MacDonald et al., 2007; Singer, 2009; Symons et al., 2005; Thelen, 1979). MacLean, Ellis, Galbreath, Halpearn, and Baumesiter, (1991) noted that typically developing children generally engaged in repetitive motor behaviors including as kicking, waving, sucking, banging, and rocking between 3 and 18 months of age whereas children identified as being developmental delayed engaged in the same behaviors between 6 and 36 months of age. With respect to the persistence of repetitive behaviors, motor stereotypies in toddlers with an ASD appear to increase from 7% at 2 years of age to 20% at 4 years of age (MacDonald et al., 2007). MacLean et al (1991) also noted that at 2 years of age the mean duration of vocal stereotypies for toddlers with ASD was 5% compared to 32% at 4 years of age. It has also been suggested that toddlers with ASD may be more likely to engage in certain forms of stereotypy than other child with non-ASD delays. Kozlowski and Matson (2010) noted that in children 17 to 37 months of age diagnosed as having ASD evinced significantly more frequent and more severe stereotypical behaviors than same-age peers with non-ASD delays. Behaviors which were reported to be attributed to those with ASD only included repeated and unusual body movements, repeated and unusual vocalizations, and unusual play with objects (Kozlowski & Matson, 2010).

Early Development of SIB. Certain forms of SIB are considered to be a typical feature of early motor and social development (Berkson & Tuipa, 2000; MacLean et al., 1994). Researchers have indicated that approximately 5% - 12% of typically developing infants and children engage in SIB primarily in the form of non-threatening head banging, self-scratching, or self-biting (Berkson, 2002; Berkson & Tupa, 2000; Baghdadli et al., 2003; Nicholas et al., 2008). In most typically developing toddlers, SIB is noted to emerge at about 8 months of age and then decline and eventually disappear by 5 years of age (Berkson & Tupa, 2000; Baghdadli et al., 2003). Some researchers have indicated that, in children with DD, behaviors such as head-banging and head-hitting occur and then decline by 3 years of age (Berkson, 2002; MacLean et al., 1991; Kroeker, Unis, & Sackett, 2001). During this “decline stage,” SIB in atypically developing toddlers continues to occur at levels above those seen in typically developing peers. However, since the trajectory of behavioral emergence and subsequent decline mirrors that of typical development, abnormalities are generally not noticed until the behaviors become problematic (Bodfish, 2007). Unfortunately, by the time the child is referred for treatment, the aberrant behavior is entrenched and thus become chronic (Bodfish et al., 2000).

Researchers have indicated that upwards of 70% of children with DD begin engaging in SIB during their first 5 years of life (Berkson & Tupa, 2000; Kroeker et al., 2001; Schneider, Bijam-Schulte, Janssen, & Stolk, 1996). Behaviors such as head-banging, head-hitting, eye-poking and eye-pressing are noted to be the most prevalent early forms of SIB in population (Sturme et al., 2008). For the very young child with ASD, emerging literature indicates that certain forms of SIB occur frequently and may be of a severe nature. This increased risk for SIB in toddlers with ASD can be differentiated not only from typically developing peers, but also when compared to toddlers with non-ASD developmental delays. Specifically, Kozlowski and

Matson (2010) noted that toddlers (i.e., 17 to 37 months of age) diagnosed with an ASD were more likely to engage in poking him/herself in the eye and harming self via hitting, pinching, scratching, etc than atypically developing peers.

Risk Factors for Challenging Behaviors

Current literature dictates that the etiological origin of aggression, stereotypy, and SIB in the ASD population is unlikely to involve a simple determinant (Sturmev et al., 2008; Mudford et al., 2008). That is, there appears to be multiple and often co-occurring processes involved in the emergence, presence, and maintenance of aberrant behavior - the most cited of which are biological or genetic and socially-mediated environmental factors. Operant theory posits that variables which underlie challenging behaviors can be inherent, learned, or an interaction of the two (Carr & Durand, 1985; Iwata et al., 1982). Furthermore, socially-mediated factors which have been implicated as maintaining functions include attention, escape, non-social reinforcement, tangible reinforcement, and physical discomfort/pain. The manipulation of operant factors appear to be crucial to the success of treating the incidence and severity of challenging behaviors, yet they do little to delineate specific reasons why challenging behaviors may or may not emerge beyond the individual's learning history.

In addition to socially-mediated environmental factors, researchers have implicated biological factors as contributing to the predisposition of a person to engage in challenging behaviors. Individuals with medical conditions such as congenital blindness, epilepsy, and deafness are noted to be at an increased risk for evincing challenging behaviors (Maisto et al., 1978; Emerson et al., 2001; Kiernan & Kiernan, 1994). Specific genetic syndromes have also been found to be associated with certain aberrant behaviors. Among these genetic syndromes there appears to be considerable variability with respect to the prevalence and form of stereotypic

behaviors and self injury. At one extreme is Lesch-Nyhan syndrome, where it appears that 100% of individuals primarily engage in chronic self-biting that is localized to the fingers, lips, and tongue (Anderson & Ernst, 1994; Nyhan & Wong, 1996). SIB is prevalent in other genetic disorders, but does not appear to be an invariant part of the phenotype. This includes Rett syndrome (30-40% of cases evince SIB primarily in the form of repetitive hand wringing or hand mouthing; Oliver et al., 1993), Smith-Magenis syndrome (50-70% of cases engage in SIB primarily characterized by removal of fingernails, body squeezing, and inserting objects into bodily orifices; Dykens & Smith, 1998), Prader-Willi syndrome (60-80% of individuals are noted to skin pick; Symons et al., 1999), Cornelia de Lang syndrome (Hyman, Oliver, & Hall, 2002), and Fragile X syndrome (Symons, Clark, Hatton, Skinner, & Bailey, 2003). It does appear that there are certain genetic or medical conditions correlated with specific forms of SIB; however, for the large portion of individuals with ASD, the etiological underpinnings of SIB is largely unknown and actual behaviors exhibited vary drastically (Rojahn et al., 2008).

Research is also beginning to emerge suggesting that neurobiological factors may be associated with the expression of challenging behaviors. These findings are byproducts mouse models and/or structural and functional neuroimaging studies. With respect to the expression of stereotypic behaviors and SIB, there is a confluence of data that implicates abnormalities within the basal ganglia, specifically the caudate nucleus region (Lewis & Bodfish, 1998; Lewis, Yanimur, Lee, & Bodfish, 1996; Sears, 1999). In addition to specific anatomical structures, numerous types of neurotransmitters are believed to mediate the expression of abnormal repetitive behaviors including dopamine, serotonin, opiate peptides, GABA, acetylcholine, and adenosine (Bodfish, 2007). There appears to be some merit to these findings; however, at this

time, the relationship between these structural abnormalities and neurotransmitter functioning in relation to challenging behaviors in those with an ASD is inconclusive.

There appears to be a burgeoning amount of information on the biological and operant underpinnings of challenging behaviors; however, there is an increasing body of evidence suggesting that individual characteristics play a significant role in the emergence, maintenance, and severity of these behaviors in persons with DD, specifically ASD. That is, there are a variety of maladaptive behavior correlates, or risk factors, that appear to be related to the inherent qualities of the person in question. Factors which have been associated with an increase in the risk, or odds, of engaging in challenging behaviors include the presence and severity of autistic symptoms, level of ID, gender, adaptive skills (i.e., socialization, communication, and daily living/motor ability), and psychological/emotional functioning (Sturmey et al., 2008). It is noteworthy to mention that the majority of this research is relegated to adults and children with ID with or without ASD. Therefore, there is limited data on the association between these factors and the presence of challenging behaviors in very young children with ASD. While this may limit the applicability of past research to this very young population, it also highlights the necessity for additional research to investigate if personal correlates of challenging behaviors are stable across the lifespan.

Severity of ASD. The diagnosis of an ASD is considered to be a risk factor for evincing challenging behaviors. McClintock and colleagues (2003) conducted a meta-analysis focusing on aggression, SIB, property destruction and stereotyped behavior in adults with ID. Results indicated that not only was the presence of ASD (i.e., Autistic Disorder or PDD-NOS) indicative of the presence of challenging behaviors, but that as severity of autistic symptomatology increased, the risk for more frequent and more severe behaviors also increased. Furthermore,

those with a diagnosis of Autistic Disorder who were also diagnosed as having profound or severe ID and had a low level of expressive communication were noted to be the highest risk group. This increased proclivity for challenging behaviors in adults with ASD has also been noted by other researchers (Matson & Rivet, 2008a). Children with more severe ASD are also reported to be more likely to engage in some forms of challenging behaviors (Baghdadli et al., 2003), and are more likely to exhibit a greater number of challenging behaviors (Matson, Wilkins, and Macken, 2009). As such, these findings suggest that an ASD diagnosis may predispose people to engage in challenging behaviors, especially for those with more severe symptomatology. More research is needed to clarify these issues in the very young child with ASD. While emerging literature indicates that there may be a link between autistic symptoms and challenging behaviors (Kozlowski & Matson, 2010) in the very young infant or toddler with ASD, these data are preliminary.

Intellectual Functioning. In general, the prevalence of challenging behaviors is positively correlated with intellectual impairment. It has been found that 17.6% to 60% of individuals with ID evince aggressive behavior, with most rates falling in the 20% to 40% range (Crocker et al., 2006; Tenneij & Koot, 2008). Furthermore, evidence indicates that for those with ID, higher prevalence rates are associated with a decrease in intellectual functioning. Borthwick-Duffy (1994), found that 7% of people with mild; 14% of people with moderate, 22% of people with severe, and 33% of people with profound levels of ID engaged in one or more forms of challenging behavior. Similarly, Holden and Gitlesen (2006) reported that challenging behavior in adults increased with the severity of ID, and that specific behavioral topographies were more common among persons with differing levels of cognitive impairment. Specifically, aggression was more common among individuals with mild and moderate ID and SIB was more

common among people with profound and severe ID (Holden & Gitlesen, 2006). Likewise, Rojahn, Wilkins, Matson, & Boisjoli (2009) found that in a sample of adults with ID, individuals with more severe ID were more likely to evince SIB with estimates indicating that 25% of those with profound ID engaged in at least one severe form of self-injury compared to 15.5% of those with severe ID, 7% of those with moderate ID, and 4% of those with mild ID.

Adaptive Functioning. Impairments in communication, socialization, and the physical ability to independently complete self-care tasks have been implicated as being associated with challenging behavior, especially in individual diagnosed with ID and/or ASD (Baghdadli et al., 2003; McClintock et al., 2003; Sturmey et al., 2008). Personal factors related to adaptive functioning which appear to increase the risk of adults with ID engaging in challenging behavior include being nonverbal or having deficits in receptive or expressive communication (Borthwick-Duffy, 1994; Emerson et al., 2001), poorer social skills (Matson, Fodstad, & Rivet, 2009), motor impairments (Emerson et al., 2001), and sleep disturbances (Kiernan & Kiernan, 1994). Researchers have also found a link between deficits in adaptive functioning and specific topographies of challenging behavior. For example, Emerson et al (2001) found that in a large sample of adults with ID, those who engaged in severe aggression or destructive behaviors were more likely to have a more self-care skills, greater expressive communication, and less severe epilepsy. Their findings also implied that there was a moderate association between SIB and individuals who had more restricted mobility, fewer self-care skills, and/or poorer general communication. In one of the few studies investigating the potential link between communication and challenging behavior in children with ASD, Chiang (2008) noted that speech impairment resulted in participants using challenging behaviors to express their needs, and thus concluded that those with lower verbal skills were more likely to engage in challenging behavior.

Similarly, Murphy et al (2005) found that in adults and adolescents with ID and/or ASD, poorer expressive language and social interaction skills were associated with the development of challenging behavior.

Psychopathology. There is no debate that the association between ASD and challenging behavior has been established. However, researchers suggest that challenging behaviors may also underpin psychiatric disorders for a proportion of individuals with ID. That is, within the ID population there appears to be a significant association between the presence of challenging behaviors and symptoms of psychopathology (Bodfish et al., 1995; Borthwick-Duffy, 1994; Emerson, 2001; Sturmey, Laud, Cooper, Matson, & Fodstad, 2010). Moss et al (2000) found that adults (i.e., 18 to 60 years old) with more severe challenging behavior were more likely to have a comorbid psychiatric diagnosis than those who did not engage in severe behavior. Their outcomes further indicated that individuals with certain psychiatric disorders appear to have an increased risk for engaging not only in challenging behaviors, but also certain behavioral topographies. Specifically, participants who presented with severe challenging behavior were four times as likely to have depression, three times as likely to have hypomania, and one-and-half times as likely to have significant symptoms of anxiety or psychosis. For those who engaged in SIB, anxiety disorders were identified as being the most prevalent comorbid diagnosis. Similarly, Matson and Mayville (2001) found that in adults with ID who engaged in physical aggression, approximately 50% of the group met criteria for a “probable” psychiatric disorder. Rojahn, Matson, Naglieri, Mayville, and Bodfish (2004) found that the presence of behavior problems increased the probability of almost all psychiatric conditions, and Laud and Matson (2006) found that individuals who exhibited manic symptoms were more likely than controls to show aggression and other problem behaviors during mealtime. Despite findings

which suggest a strong association between psychopathology and challenging behavior in those with ID, there are other researchers who have found there to be no association between the two (ref Rojahn, Borthwick-Duffy, & Jacobson, 1993; Tsouris, Mann, Patti, & Sturme, 2003).

Therefore, it appears that the nature of the relationship between challenging behavior and mental illness is unclear. Furthermore, the applicability of the aforementioned investigations to younger populations of children with ASD is inconclusive since, at this time, there is no such research.

Gender. The final personal characteristic which has been implicated as a potential risk factor for challenging behaviors in individuals with ID is gender. Researchers have found that males (both boys and men) with ID are more likely to be identified as showing challenging behavior than same-age females (Emerson, 2001). Outcomes from a study conducted by Tyrer et al. (2006) indicated that within the ID population there is a higher prevalence of aggression in men than in women. These findings mirror those by Oliver et al. (1987) who found that men with ID were more likely to engage in aggression and property destruction than SIB. Despite the aforementioned studies, research on the link between gender and challenging behavior has yielded mixed results. For example, Hartley et al. (2008) found that females diagnosed as having autism are more "emotionally reactive" than males with autism. Conversely, it has even been suggested that gender may not even be a risk factor for challenging behavior. Baghdadli et al. (2003) reported that there were no gender effects in a sample of children with ASD who evinced SIB. Similarly, Chadwick et al. (2000) found that there were no significant differences on any measure of challenging behavior (SIB or aggression) between boys and girls with ID. In one of the only studies to investigate the role of gender on challenging behaviors in toddlers with ASD or non-ASD delays, Kozlowski and Matson (2010) found that there were no gender effects noted across a variety of aggressive, self-injurious, and stereotypical behaviors nor was an interaction

between gender and diagnosis (i.e., Autistic Disorder, PDD-NOS, or atypically developing controls) noted to emerge.

Assessment of Challenging Behaviors and ASD

Given its high prevalence and the associated negative consequences, most referrals for treatment in those with ASD are initially made based on the presence of challenging behaviors (Gurney et al., 2006; Mudford et al., 2008). Therefore, the need for empirically validated measures to assess for challenging behaviors in individuals with ASD is imperative. Several parent or caregiver administered instruments currently exist which assess for challenging behaviors in the general population and those with ID or other DDs. Examples of these types of assessments include the *Aberrant Behavior Checklist* (Aman, Singh, Stewart, & Field, 1985), *Behavior Problems Inventory-01* (Rojahn, Matson, Lott, Esbensen, & Smalls, 2001), *Children's Scale of Hostility and Aggression: Reactive/Proactive* (Farmer & Aman, 2009), *Developmental Behavior Checklist* (Einfeld & Tonge, 1995), and *Nisonger Child Behavior Rating Form* (Aman, Tassé, Rojahn, & Hammer, 1996). Although these scales are frequently employed in the assessment of challenging behaviors for those with ASD, there are relatively few measures which specifically address behavioral concerns in those with ASD. At this time, the only measures which have been developed to assess challenging behaviors for ASD exclusively include the *PDD Behavior Inventory* (Cohen, Schmidt-Lackner, Romanczyk, & Sudhalter, 2003), *Autism Spectrum Disorder-Behavior Problems for Adults* (Matson & Rivet, 2007, 2008c), *Autism Spectrum Disorders-Behavior Problems for Children* (Matson, Gonzalez, & Rivet, 2008), and the *Baby and Infant Screen for Children with Autism Traits-Part 3* (Matson, Wilkins, Sevin et al., 2009).

The *PDD Behavior Inventory* (PDDBI; Cohen et al., 2003) is a measure designed specifically for use in the ASD population to assess adaptive and maladaptive behaviors (Cohen et al., 2003). There is a parent and teacher version of this instrument. The parent version is comprised of 10 *a priori* defined subscales with a total of 176 items. The teacher version consists of 8 *a priori* defined subscales with a total of 144 items. Subscales on the parent version that correspond to maladaptive behaviors include Sensory/Perceptual Approach Behaviors, Specific Fears, Arousal Problems, Aggressiveness, Social Pragmatic Problems, and Semantic/Pragmatic Problems. The teacher version is identical to the parent version, with the exception of the Specific Fears and Arousal Problems subscales being excluded and the Aggressiveness subscale being replaced with the Behavior Problems subscale. In addition to maladaptive subscales, both versions also contain 4 subscales which assess adaptive behavior: Social Approach Behaviors; Learning, Memory, and Receptive Language; Phonological Skills; and Semantic/Pragmatic Ability. The PDDBI has been found to have good construct validity through factor analysis (Cohen et al., 2003). Investigations into the psychometric properties of the both versions of the PDDBI have indicated that internal reliability for all subscales range from .73 to .97, with interrater reliability estimates ranging from .28 to .85 (Cohen et al., 2003). Interrater reliability is lower for the maladaptive behavior section (.28 to .67) than the adaptive behavior section (.45 to .85; Cohen et al., 2003).

The *Autism Spectrum Disorders – Behavior Problems for Adults* (ASD-BPA) is the only challenging behavior assessment instrument developed specifically for adults with ASDs (Matson & Rivet, 2007, 2008c). This measure is part of a comprehensive assessment battery for that includes the *Autism Spectrum Disorders-Diagnosis for Adults* (ASD-DA; Matson, Wilkins, Boisjoli, & Smith, 2008) and *Autism Spectrum Disorders-Comorbidity for Adults* (ASD-CA;

Matson & Wilkins, 2008). The ASD-BPA consists of three empirically-derived subscales: Aggressive/Destruction; Disruptive Behavior; and, Self-Injurious Behavior. The measure is comprised of 19 items rated on a Likert-type scale. Initial psychometrics for the scale estimated that the ASD-BPA has internal reliability ranges from .43 to .83 for all subscales, average test retest reliability approaches .60, and average interrater reliability is .43 (Matson & Rivet, 2008c). The ASD-BPA has also been found to have good convergent validity with the BPI-01, which is a psychometrically validated measure of challenging behavior in individuals with ID (Matson & Rivet, 2007).

The *Autism Spectrum Disorders – Behavior Problems for Children* (ASD-BPC) assesses challenging behaviors in children with ASDs (Matson, Gonzalez, & Rivet, 2008). This scale is part of a comprehensive battery of assessments which includes the *Autism Spectrum Disorders-Diagnosis for Children* (ASD-DC; Matson, Gonzalez, Wilkins, & Rivet, 2008) and *Autism Spectrum Disorders-Comorbidity for Children* (ASD-CC; Matson & Wilkins, 2008). The ASD-BPC contains a total of 18 items rated on a Likert-type scale by informants. The scale consists of two empirically-derived factors-Externalizing and Internalizing. Initial psychometrics of the ASD-BPC estimated that the measure has an internal consistency (α) of .90, a test-retest reliability (kappa) of .64, and mean inter-rater reliability of .49 (Matson, Gonzales, & Rivet, 2008).

At this time, the *Baby and Infant Screen for Children with aUtism Traits – Part 3* (BISCUIT – Part 3) is the only measure designed to assess the presence and severity of challenging behaviors in infants and toddlers (i.e., between 17 and 37 months of age) diagnosed with an ASD (Matson, Wilkins, Sevin et al., 2009). The BISCUIT-Part 3 contains 15 items which load onto one of 3 empirically derived factors: Aggressive/Disruptive Behaviors;

Stereotypic Behaviors; and Self-injurious Behaviors. Initial psychometric investigations into the utility of the BISCUIT-Part 3 have yielded excellent internal reliability estimates (Matson, Wilkins, Sevin et al., 2008). This measure will be covered more extensively in the materials section of Study 1.

PURPOSE

Research indicates that there is something unique about individuals with ASD that leads to an increased likelihood of engaging in challenging behaviors. Unfortunately, the majority of the literature on challenging behaviors in the ASD population focuses almost exclusively on children or adults with ASD with or without a concomitant ID diagnosis (Baghdadli et al., 2003; Holden & Gitlesen, 2006; MacDonald et al., 2007; Matson, Wilkins, & Macken, 2009). As such, limited attention has been given to the prevalence of these behaviors in the very young child with ASD. Preliminary data dictates that not only do challenging behaviors exist in the infant or toddler diagnosed with ASD, but that these behaviors occur at levels beyond that of infants and toddlers who are typically developing or have non-ASD delays (Kozlowski & Matson, 2010). Furthermore, researchers have indicated that infants and toddlers with ASD have differing patterns in the emergence of behavioral challenges from typically developing infants (Cunningham & Schreibman, 2008; Dominick et al., 2007), yet differences in the emergence of these behaviors in infants and toddlers with ASD compared to infants and toddlers with general delays are under-researched. More data is needed to deduce the relationship between challenging behaviors and autistic symptomatology in very young children. Evidence from early intervention studies has yielded promising outcomes (Zachor et al., 2007). However, the applicability of early intervention techniques for decreasing challenging behaviors is largely unknown as early intervention research generally reports on increases in the social and language repertoire of the child with ASD (Matson, 2007). If a clearer picture of the pattern with which challenging behaviors emerge could be ascertained, this would enable practitioners to be better able to identify and assess the severity of these acts at an earlier age, resulting in earlier intervention.

The purpose of this study was to investigate the emergence of challenging behaviors in infants and toddlers with ASD. To accomplish this goal, a two-experiment investigation was employed. Study 1 attempted to establish if there are specific trends for in the emergence of aggression/destruction, stereotypy, and SIB using the *BISCUIT-Part 3*. Data was analyzed based on a cross sectional analysis of age cohorts (12-18 months of age, 19-25 months, 26-32 months, and 33-39 months) compared across diagnoses (ASD versus atypically developing controls). Study 2 attempted to build upon findings from Study 1 through investigating if personal characteristics exist which influence the early emergence and presentation of challenging behaviors in infants and toddlers with ASD, and the magnitude with which these factors increase the odds of the individual having a pervasive and severe challenging behavior(s).

STUDY 1

Method

Participants

Participants for the current study included infants and toddlers ages 12 to 39 months of age who, at the time of data collection, were enrolled in and receiving services through the EarlySteps program. EarlySteps is Louisiana's Early Intervention System under the Individuals with Disabilities Education Act, Part C, which provides services to infants and toddlers and their families from birth to 37 months of age. To qualify for EarlySteps, the child must have a physical or medical condition that is likely to result in a developmental delay or have developmental delays. Prior to the initiation of a comprehensive developmental assessment to determine program eligibility, children referred to EarlySteps must have been identified by his/her family pediatrician as atypically developing either due to a slowed progression through developmental milestones, having an identified genetic or medical disorder, physical disability, or birth defect. Children in this early intervention program have a wide variety of diagnoses including, but not limited to, cerebral palsy, epilepsy, infant diabetes, microcephaly, blindness, hypoplastic left heart syndrome, tubular sclerosis, Klinefelter's syndrome, asthma, and Down syndrome. The individuals included in this study were already part of a broad investigation on early childhood development and the emergence of autistic traits and comorbid conditions. All demographic data was obtained through a thorough records review. A total of 2214 infants and toddlers were enrolled in this investigation at the time of this study.

Participants were assigned to one of two diagnostic groups: ASD or atypically developing without a history of ASD. Diagnoses of ASD (i.e., Autistic Disorder or PDD-NOS) were made for all children by a licensed doctoral level psychologist with over 30 years of experience in the field of developmental disabilities. Additionally, this individual was blind to

BISCUIT scores. Diagnoses were based on clinical judgment using the *DSM-IV-TR* algorithm for Autistic Disorder (APA, 2000), *DSM-IV-TR* descriptors for Pervasive Developmental Disorder-Not Otherwise Specified (APA, 2000), *Modified Checklist for Autism in Toddlers* scores (M-CHAT; Robins, Fein, Barton, & Green, 2001), and developmental profile scores from the *Battelle Developmental Inventory, Second Edition* (BDI-2; Newborg, 2005). Similar methodology to this diagnostic method has been described in the literature (e.g., Fombonne et al., 2004). Participants who are given a diagnosis of Autistic Disorder or PDD-NOS from the expert psychologist comprised the ASD group. In addition to toddlers with ASD, a control group of infants and toddlers who also received services through EarlySteps but who did not meet criteria for an ASD were included. Thus, these children comprised the atypically developing control group. The reason for including these infants and toddlers was to demonstrate that differences in the emergence of challenging behavior expression were attributable to the presence of a diagnosable ASD and not other developmental delays or atypical developmental variations.

Interrater reliability was determined for a subset of the sample ($n = 215$). A second Ph.D. level clinical psychologist with experience treating and assessing children with developmental disabilities was used to calculate inter-rater reliability. This second clinical psychologist assigned diagnoses based on the same information as the first clinical psychologist (i.e., BDI-2 scores, M-CHAT scores, *DSM-IV-TR* criteria) and was blind to the diagnoses made by the first psychologist as well as BISCUIT scores. Inter-rater reliability was excellent with a kappa value of 0.95 $p < .001$, and the percent agreement between the two raters was calculated to be 95.20%.

After individuals with missing data from the BISCUIT-Part 3 were deleted, there were 394 participants diagnosed with ASD (i.e., AD or PDD-NOS) and 1237 in the atypically

developing control group. It is noteworthy to mention that replacing these data points with the mean score would have resulted in a higher number of participants for this study; however, doing so may have resulted in decreasing the variance and, thus this procedure was avoided by the investigator (Tabachnick & Fidell, 2007). Given that the control group was significantly larger than the ASD group, measures were taken to ensure that the results from statistical analyses were robust. That is, the assumptions for multivariate analysis of variance (MANOVA) were controlled for and equal group sizes were utilized to control for normality and homogeneity of variance (Tabachnick & Fidell, 2007). To limit bias in selecting participants for the control group, participants were randomly excluded using a random numbers table. Furthermore, participants noted to score more than three standard deviations above or below the group mean for each subscale were deleted due to multivariate analyses being sensitive to outliers (Tabachnick & Fidell, 2007). Using these guidelines, 97 infants and toddlers with ASD and 50 atypically developing controls were excluded due to being more than 3 standard deviations above the mean for any of the three BISCUIT-Part 3 subscales. There were no participants who scored less than 3 standard deviations below the mean.

Using the above guidelines, a total of 624 infants and toddlers were retained for analysis. Out of these 624 participants, 297 individuals comprised the ASD group and 327 comprised the atypically developing control group. As 327 is within 1.5 times the number of participants in the ASD group, this is an appropriate number to protect against the violation of assumptions (Leech, Barrett, & Morgan, 2008). Participants ranged in age from 12 to 39 months ($M = 25.42$, $SD = 6.49$). Both males ($n = 444$) and females ($n = 180$) were included in this investigation. The majority of toddlers were Caucasian (54.0%); however, those of African American (41.1%), Hispanic (1.6%), and other ethnic origins (3.2%) were represented. The majority of the

participants were not noted to have an additional diagnosis (87.5%). Out of the infants and toddlers who did have a medical or physical condition, the most common were asthma (16.4%), epilepsy (7.5%), cerebral palsy (5.5%), allergies (4.9%), Down's syndrome (3.6%), acid reflux/GERD (2.0%), and microcephaly (2.0%). Fourteen toddlers (2.4%) were noted to be taking psychotropic medication at the time of this study, most commonly AED/mood stabilizers ($n = 14$). Preliminary analyses revealed there were no significant group differences in regards ethnicity, $\chi^2(3) = .85$, presence of additional medical conditions, $\chi^2(1) = 1.21$, or age, $t(622) = .35$, all *ns*.

The aim of this investigation was to examine the emergence and trend of challenging behaviors in very young children with an ASD compared to other general delays. To accomplish this goal, each diagnostic group was further separated into four different age cohorts. Age groups were established based on a span of 6 months and were as follows: 12-18 months of age, 19-25 months, 26-32 months, and 33-39 months. This range of ages was selected for research purposes, thus these groups were based on convenience only. As the acquisition of different skill sets varies drastically, there are no specific age “cutoff” points which are universal across all developmental domains. As such, it was assumed that for the developmentally delayed infants and toddlers representing this investigations' sample, a six month time frame would be an adequate window for differences in autistic symptoms to emerge and to, in essence, control for any developmental variation within each experimental group. Additional demographic information is displayed in Table 1. Again, it is noteworthy to mention that although the sample sizes vary across and within diagnosis and age groups, no one group was more than 1.5 times the size of another group (Leech et al., 2008), therefore ensuring robustness. Approval for this study was obtained by the Louisiana State University Institutional Review Board and by the state

Table 1
Demographic information per experimental group

	Diagnosis		Age (months)			
	ASD	12-18 <i>n</i> = 60	19-25 <i>n</i> = 87	26-32 <i>n</i> = 85	33-39 <i>n</i> = 65	
Mean age (<i>SD</i>) [*]		16.62 (1.89)	22.40 (2.17)	28.98 (2.07)	34.11 (1.13)	
Gender						
Male		85.0%	79.8%	76.5%	69.2%	
Female		15.0%	20.2%	23.5%	30.8%	
Ethnicity						
Caucasian		55.0%	55.2%	49.4%	52.3%	
African American		40.0%	39.1%	44.7%	43.1%	
Hispanic		1.7%	2.3%	2.4%	1.5%	
Other		3.3%	3.4%	3.5%	3.1%	
	Atypical Controls	<i>n</i> = 79	<i>n</i> = 89	<i>n</i> = 89	<i>n</i> = 70	
Mean age (<i>SD</i>) [*]		16.95 (1.73)	22.15 (2.16)	28.60 (2.09)	34.0 (0.95)	
Gender						
Male		69.6%	62.9%	65.2%	65.2%	
Female		30.4%	37.1%	34.8%	34.8%	
Ethnicity						
Caucasian		57.0%	56.8%	54.0%	50.0%	
African American		38.0%	37.5%	40.2%	45.7%	
Hispanic		1.3%	1.1%	2.3%	1.4%	
Other		3.8%	4.5%	3.4%	2.9%	

of Louisiana's Office for Citizens with Developmental Disabilities. Consent for participation was obtained from each child's parent or legal guardian.

Measures

Baby and Infant Screen for Children with aUtism Traits-Part 3 (BISCUIT-Part 3).

The BISCUIT-Part 3 is part of a comprehensive assessment battery, the *Baby and Infant Screen for Children with aUtism Traits* (BISCUIT; Matson, Boisjoli, & Wilkins, 2007). The BISCUIT was developed to assist in the identification and measurement of symptoms of ASD and associated difficulties in very young children 17-37 months of age. The BISCUIT battery is

comprised of three informant-based measures: 1) BISCUIT-Part 1 which assesses for core symptoms of ASD; 2) BISCUIT-Part 2 which assesses for symptoms of comorbid emotional/mental health problems commonly seen in ASD including Conduct Disorder, Tic Disorder, Specific Phobia, Attention Deficit/Hyperactivity Disorder, Obsessive Compulsive Disorder, and eating and sleeping difficulties (Matson, Boisjoli, Hess, & Wilkins, 2009); and, 3) BISCUIT-Part 3 which assesses for problem behaviors which are aggressive, disruptive, self-injurious, or stereotypic in nature (Matson, Boisjoli, Rojahn, & Hess, 2009). All three BISCUIT measures were derived following steps outlined in the scale construction literature (Crocker & Algina, 1986; DeVellis, 1991). This process began with a review of the relevant literature, *DSM-IV-TR* and *ICD-10* diagnostic criteria, and critical incidents and observations noted by clinical psychologists familiar with this population. An item pool was generated and then reviewed by experts, who suggested revisions and additional items. These items were then pilot-tested with persons unfamiliar with mental health terminology to ensure that the scales were easy to understand. Finally, the item reliability was examined for each component of the battery, and items were removed with very low endorsement rates and/or insufficient reliability (Matson, Wilkins, Sevin, et al., 2009). Specifically, items were retained according to the guidelines of Guilford and Fruchter (1973): corrected item-scale correlations fell in the range of .30 to .80 and mean inter-item correlations fell in the range of .10 to .60.

For the purposes of this investigation, only Part 3 of the BISCUIT battery was investigated. The BISCUIT-Part 3 was designed to assist in the assessment and identification of challenging behaviors in infants and toddlers with ASD (i.e., Autistic Disorder and PDD-NOS) or general developmental delays. The BISCUIT-Part 3 contains 15 items that are rated on a 3-point Likert-type scale. Using this format, informants (i.e., parents or legal guardians) are asked

to rate the extent to which each item symptom was ever a problem, and is rated as “0 = not different; no problem,” “1 = somewhat different; mild impairment,” or “2 = very different; severe impairment.” Furthermore, informants are instructed to base each item rating on their child’s behavior when compared to typically developing same-aged peers. Test administration time of the BISCUIT-Part 3 is approximately 20-30 minutes; however, this may vary as a function of the individual characteristics of the child. Factor analysis of the BISCUIT-Part 3 yielded a three factor solution: 1) Aggressive/Destructive Behavior; 2) Stereotypies; and, 3) Self-Injurious Behavior (Matson, Boisjoli, et al., 2009). Initial psychometric analyses indicate that the measure has excellent internal reliability ($\alpha = .91$). In addition, severity cutoff scores have been established for the BISCUIT-Part 3 factors for infants and toddlers with an ASD (Rojahn et al., 2009) and for those with non-ASD delays (Matson, Fodstad, Mahan, & Rojahn, 2010).

To better compare endorsements of the three BISCUIT-Part 3 subscales, participants’ total severity score were transformed into a total percentage score for each subscale. Specifically, new totals were computed which reflected the percentage out of the total possible endorsement score. The calculation used to compute total subscale percentage scores was the participant’s total severity score for a specific subscale divided by the highest possible score for that specific subscale, with this dividend then being multiplied by 100%. This calculation was perceived to be a more appropriate way to compare subscale scores due to total possible subscale scores not being equivalent. For the item analysis, mean scores were calculated based upon participant ratings for each specific item (i.e., 0, 1, or 2).

Procedure

All measures were completed in a one-to-one interview with parents and/or legal guardians of the infant and toddler participants. Interviews were conducted by personnel

certified to conduct assessments and provide services for the state of Louisiana's EarlySteps program. Assessors held degrees ranging from bachelors to doctoral level and are licensed or certified in disciplines such as occupational therapy, physical therapy, social work, education, speech-language pathology, or psychology. All interviewers previously attended a full-day training on ASD, scale development, and test administration issues specific to the measures used for this study. The BISCUIT-Part 3 was given as part of a large battery of assessments, which included measures of physical and social development and a child observation. Test administration for each child took place in his/her home or daycare setting with assessors interviewing the child's parent and/or legal guardian according to the instructions of each test.

Research Design

To assess the emergence of challenging behaviors in this sample of children, a 2 (diagnosis) x 4 (age) factorial MANOVA was conducted. Dependent variables were the percent endorsement scores from the subscales of BISCUIT-Part 3: Aggressive/Destructive Behavior, Stereotypies, and Self-Injurious Behavior. Significance was set at an alpha estimate of .05 and results were interpreted both for the main effects of diagnosis and age, as well as the interaction of the two. A MANOVA was employed because this test allows for the examination of possible existing relationships between the dependent variables (DV) without inflating alpha error associated with conducting multiple one-way analyses of variance (ANOVAs; Field, 2005; Tabachnick & Fidell, 2001).

Based on the outcomes from the MANOVA, univariate procedures and post hoc comparisons were utilized to further look at challenging behaviors and the relationship between ASD and age. To determine which subscales contributed to significant omnibus effects, a series of ANOVAs were conducted only for the independent variables found to have a significant effect

on the presence of challenging behaviors. Bonferroni correctional procedures for multiple tests was implemented for the total number of ANOVAs conducted for either age or diagnostic groups and the new alpha level was adjusted. For any significant omnibus effect yielded for the interaction between age and diagnosis, 2 (diagnosis) X 4 (age) ANOVAs were conducted with the BISCUIT-Part 3 subscales entered as the dependent variables, individually.

To investigate how challenging behaviors emerge, tests of simple effects were conducted for diagnosis and age to identify the differences within the levels of the other variable, and vice versa. The purpose of these analyses was to detect contrast within levels of the two variables. The first set of simple main effects test contrasted age groups within each diagnosis, whereas the second set of simple main effects tests examined diagnosis within each age group (Maxwell & Delaney, 1990). All simple effect tests p values were adjusted using a Bonferroni correctional procedure. Simple effect contrasts tests were first conducted to examine the effect of diagnosis within each age group across each BISCUIT-Part 3 subscale, followed by analyses examining the effect of age within each diagnosis.

Finally, an item analysis of the BISCUIT-Part 3 was conducted to offer a more fine grained investigation to determine if there are discrete behaviors which have different patterns of emergence in toddlers with ASD versus those with non-ASD delays. As such, the item analysis was restricted only to investigating the effects of age group (12-18 months of age, 19-25 months, 26-32 months, and 33-39 months) within diagnosis (ASD versus atypical controls). A MANOVA was conducted with age and diagnosis as the independent variables and items from significant BISCUIT-Part 3 subscales. All item analysis test p values were adjusted using a Bonferroni correctional procedure. The reader is referred to Appendix A for a list of all BISCUIT-Part 3 items per their respective subscale.

Hypotheses

Based on the literature, a few hypotheses were formulated. First and foremost, it was hypothesized that infants and toddlers with ASD would evince more challenging behaviors than infants and toddlers who have non-ASD delays. If this heightened occurrence of challenging behaviors was found in the young child with ASD, it would support researchers who have noted that individuals with ASD are at an increased risk for engaging in challenging behaviors at a high rate (Holden & Gitlesen, 2006; Lecavalier, 2006; Matson, Wilkins, & Macken, 2009; Murphy et al., 2005; Sturme et al., 2008). Furthermore, it would add support to the emerging literature which indicates that these behavioral problems are distinct from those with other delays and can be detected very early in life (Kozlowski & Matson, 2010; Matson, Dempsey, et al., 2009). This outcome would, thus, point to the importance of early detection of challenging behaviors in those with ASD and subsequent early, intensive intervention. Second, it was hypothesized that specific trends in the emergence and expression of challenging behavior occur with regards to age for both diagnostic groups. Based on literature from the general non-DD population, it was expected that some degree of aberrant symptoms occur at a very young age (i.e., 12 - 18 months), but that this would increase across ages for both experimental groups (ASD, atypically developing non-ASD controls; Baghdadli, Picot, Pascal, Pry, & Aussilloux, 2003; Chawarska et al., 2007; Di Giamoco & Fombonne, 1998; Rogers & DiLalla, 1990). Furthermore, even if a "decline stage" was observed to occur, this would be minimal as challenging behaviors are noted to continue to persist. Finally, the effect of age on the emergence of challenging behaviors in those with ASD was investigated. Specifically, it was hypothesized that individuals with ASD who are older would be more likely to engage in challenging behaviors than those who are younger and have ASD, and also more than those with non-ASD delays at all ages. If this

outcome is found, it would suggest that a diagnosis of ASD and the age of individual are both predisposing factors for the emergence of challenging behaviors in the very young child.

Results

A post-hoc power analysis was conducted to calculate the observed power of the analyses described below. In a post-hoc procedure, statistical power ($1 - \beta$) is computed as a function of significance level α , sample size, and population effect size (Cohen, 1988). G*Power 3, a power analysis computer program (Faul, Erdfelder, Lang, & Buchner, 2007), was used to estimate the ability of the analyses to find an effect assuming that one exists in the sample utilized for this investigation. Using a medium effect size $f^2(V) = 0.25$, an adjusted Type I error probability of .017, and a sample size of 624, MANOVA global effects analyses were assessed to have a power of 1.00 (age groups; 4 groups and 3 response variables) and 1.00 (diagnosis; 2 groups and 3 response variables). For the MANOVA special effects and interaction analyses, when a medium effect size $f^2(V) = 0.25$, adjusted Type I error probability of .017, 8 groups, 3 response variables, and 2 predictors were utilized, the power of this analysis was calculated to be 1.00.

Results of the 2 x 4 factorial MANOVA yielded a significant omnibus effect for diagnostic groups [$F(1, 623) = 74.54, p < .001$, Wilks' $\Lambda = .733$, partial $\eta^2 = .267$], age groups [$F(3, 620) = 3.67, p < .001$, Wilks' $\Lambda = .948$, partial $\eta^2 = .018$], and the interaction between diagnosis and age groups [$F(7, 616) = 2.44, p < .001$, Wilks' $\Lambda = .965$, partial $\eta^2 = .012$]. Levene's test was significant across all BISCUIT-Part 3 subscales; however, the homogeneity of variance was protected by equal sample sizes (Field, 2005; Leech et al., 2008).

Since both the independent variables of diagnostic group and age group were found to have significant omnibus effects, two separate series of ANOVAs were conducted. For each of these series, three separate ANOVAs were conducted - one ANOVA for each BISCUIT-Part 3

subscale. A correction for multiple tests was implemented for each series of ANOVAs based upon the total number of ANOVAs conducted (i.e., Bonferroni) resulting in the new alpha levels being set at 0.017 (i.e., .05/3). Results for diagnostic groups and age groups will be discussed separately.

The means and standard deviations for each dependent variable with respect to each diagnostic group are shown in Table 2. Results of these univariate analyses indicated that all

Table 2

Mean scores and standard deviations for BISCUIT-Part 3 subscale percent total endorsement for diagnostic groups

	Diagnosis				<i>F</i> (<i>df</i> = 1, 623)	Effect size (partial η^2)
	ASD (<i>n</i> = 297)		Atypical Controls (<i>n</i> = 327)			
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
BISCUIT-Part 2 subscales						
Aggressive/Destructive Behavior	20.05	24.66	4.34	9.47	114.15*	.155
Stereotypic Behaviors	18.52	25.47	0.41	2.58	163.50*	.208
Self Injurious Behaviors	10.44	18.96	1.61	6.14	63.63*	.093

* $p < .01$ (Bonferroni corrected)

three subscales (Aggressive/Destructive Behaviors, Stereotypic Behaviors, Self Injurious Behaviors) contributed to the significant main effect for diagnosis, $F(1, 623) = 114.15, 163.50,$ and $63.63,$ respectively, all $p < .01$. On the basis of these findings, a general trend emerged where infants and toddlers with ASD were noted to evince a greater frequency of and more severe behavior problems.

The means and standard deviations for each dependent variable with respect to each age group are shown in Table 3. Results of these univariate analyses indicated that the BISCUIT-Part 3 subscale Aggressive/Destructive Behaviors contributed to the significant main effect, $F(3, 620) = 7.95, p, .001$. There were no significant differences in average percentage score on the Stereotypic Behaviors and Self Injurious Behaviors subscales for age groups, $F(3, 620) = 2.603$

Table 3

Mean scores and standard deviations for BISCUIT-Part 3 subscale percent total endorsement for age groups

BISCUIT-Part 2 subscales	Age (months)								F (df = 3, 265)	Effect size (partial η^2)
	12-18 (n = 139)		19-25 (n = 176)		26-32 (n = 174)		33-39 (n = 135)			
	M	SD	M	SD	M	SD	M	SD		
Aggressive/ Destructive Behavior	6.30 ^{c,d}	10.82	9.74 ^d	15.56	15.23 ^a	24.25	15.81 ^{a,b}	24.16	7.95*	.037
Stereotypic Behaviors	6.00	15.15	7.86	16.90	10.25	21.84	12.10	24.13	2.99	.012
Self-Injurious Behaviors	4.86	13.75	4.83	11.87	6.90	16.87	6.67	15.02	0.96	.005

* $p < .01$ (Bonferroni)

^a Based on post-hoc analyses, significantly different from 12-18 months group ($p < .05$)

^b Based on post-hoc analyses, significantly different from 19-25 months group ($p < .05$)

^c Based on post-hoc analyses, significantly different from 26-32 months group ($p < .05$)

^d Based on post-hoc analyses, significantly different from 33-39 months group ($p < .05$)

and 0.953, *ns*, respectively. On the basis of these findings, a general trend emerged where younger children tended to have less severe challenging behaviors with severity levels increasing across age groups, with this trend being most salient with regard to behaviors which are aggressive and destructive in nature.

Test of simple effects were then conducted to offer a more basic investigation of the relationship between diagnosis and age (see Table 4). Please refer to Figure 1 for a pictorial representation of this data. Results are discussed first with respect to contrasts of age groups within each diagnosis, and then for diagnosis within each age group.

Analyses examining the effect of diagnosis within age groups indicated that there were diagnosis simple main effects across many of the BISCUIT-Part 3 subscales. For children 12-18 months of age, there were significant diagnosis effects for the subscales of

Table 4

Mean scores and standard deviations for BISCUIT-Part 3 subscales for simple within contrasts for interactions of diagnosis and age

	Age (months)							
	12-18		19-25		26-32		33-39	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Aggressive/Destructive Behaviors								
ASD	11.00 _{c,d} ¹	13.52	15.63 _{c,d} ¹	18.66	25.71 _{a,b} ¹	29.49	26.92 _{a,b} ¹	29.00
Atypical Controls	2.72 ¹	6.24	3.99 ¹	8.57	5.22 ¹	10.89	5.50 ¹	11.36
Stereotypic Behaviors								
ASD	13.61 _{c,d} ²	20.70	15.52 _d ²	21.39	20.39 _a ²	27.74	24.61 _{a,b} ²	30.06
Atypical Controls	0.21 ²	1.88	0.37 ²	2.48	0.56 ²	3.02	0.47 ²	2.80
Self Injurious Behaviors								
ASD	9.58 ³	19.03	7.76 ³	14.92	12.94 ³	22.03	11.54 ³	19.30
Atypical Controls	1.27 ³	5.52	1.97 ³	6.77	1.12 ³	5.21	2.14 ³	7.05

Note. For each diagnostic group (ASD or atypical controls), means in the same row with like lettered subscripts differed significantly at $p < .05$ with Bonferroni correction for multiple contrasts. For each age group, means in the same column with like numbered superscripts differed significantly at $p < .05$ with Bonferroni correction for multiple contrasts.

Aggressive/Destructive Behaviors [$F(1, 623) = 7.33, p = .007, \text{partial } \eta^2 = .012$], Stereotypic Behaviors [$F(1, 623) = 19.93, p < .001, \text{partial } \eta^2 = .031$], and Self Injurious Behaviors [$F(1, 623) = 12.39, p < .001, \text{partial } \eta^2 = .020$]. Those belonging to the 19-25 months age group had significant diagnosis effects on the Aggressive/Destructive Behaviors [$F(1, 623) = 18.70, p < .001, \text{partial } \eta^2 = .029$], Stereotypic Behaviors [$F(1, 623) = 32.84, p < .001, \text{partial } \eta^2 = .051$], and Self Injurious Behaviors [$F(1, 623) = 7.75, p = .006, \text{partial } \eta^2 = .012$]. For participants 26-32 months of age, there were significant diagnosis effects for Aggressive/Destructive Behavior [$F(1, 623) = 57.18, p < .001, \text{partial } \eta^2 = .085$], Stereotypic Behaviors [$F(1, 623) = 55.65, p < .001, \text{partial } \eta^2 = .083$], and Self Injurious Behaviors [$F(1, 623) = 31.88, p < .001, \text{partial } \eta^2 = .049$]. Finally, infants and toddlers 33-39 months of age had significant diagnosis effects across the BISCUIT-Part 3 subscales of Aggressive/Destructive [$F(1, 623) = 48.50, p < .001, \text{partial } \eta^2 = .073$],

Stereotypic Behaviors [$F(1, 623) = 63.92, p < .001, \text{partial } \eta^2 = .094$], and Self Injurious Behaviors [$F(1, 623) = 15.62, p < .001, \text{partial } \eta^2 = .025$].

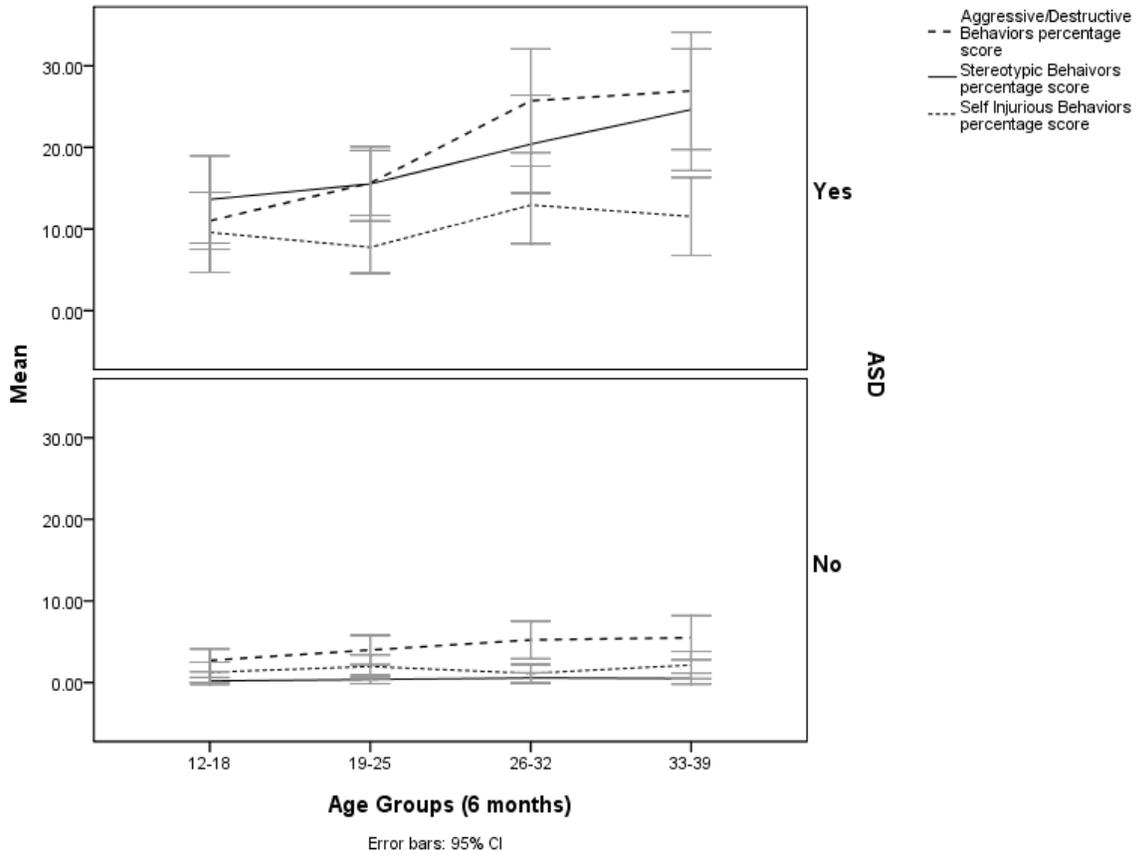


Figure 1: Estimated marginal means for the interaction of diagnosis and age groups using simple effects contrasts at each level of the independent variables across BISCUIT-Part 3 subscales.

Analyses examining the effect of age within diagnosis indicated that there were age effects for children with ASD for the BISCUIT-Part 3 subscales of Aggressive/Destructive Behavior [$F(3, 294) = 12.96, p < .0001, \text{partial } \eta^2 = .059$] and Stereotypic Behaviors [$F(3, 294) = 5.36, p = .0001, \text{partial } \eta^2 = .025$]. There were no age within ASD diagnosis effects for Self Injurious Behaviors nor was there age within diagnosis effects for children belonging to the atypically developing control group for any of the BISCUIT-Part 3 subscales.

Due to the influence which age had on the emergence of challenging behaviors in infants and toddlers with a diagnosis of ASD, an item analysis was conducted. This item analysis was restricted to only investigating the effects of age group within diagnosis. Since the purpose of this paper is to look at trends in comorbid symptoms in those with ASD, only significant results with respect to this diagnosis are reported (see Table 5). For the complete results of the item

Table 5
BISCUIT-Part 3 mean item endorsement as being a mild to severe problem for age within diagnosis contrasts for the ASD group

	Age (months)			
	12-18 (n = 60)	19-25 (n = 87)	26-32 (n = 85)	33-39 (n = 65)
<i>Aggressive/Destructive Behavior</i>				
Kicking objects	0.17 ^{c,d} (13.3%)	0.30 ^c (19.5%)	0.60 ^{a,b} (36.5%)	0.51 ^a (30.8%)
Removal of clothing at inappropriate times	0.17 ^d (16.7%)	0.12 ^{c,d} (9.2%)	0.31 ^b (17.6%)	0.46 ^{a,b} (32.3%)
Playing with own saliva	0.13 (6.7%)	0.10 (6.9%)	0.20 (12.9%)	0.17 (10.7%)
Throwing objects at others	0.27 ^{c,d} (20.0%)	0.51 (34.5%)	0.72 ^a (42.4%)	0.75 ^a (46.2%)
Banging on objects with hands.	0.33 ^d (30.0%)	0.51 (34.5%)	0.53 (34.1%)	0.60 ^a (36.9%)
Leaving the supervision of caregiver without permission	0.33 ^c (26.7%)	0.40 ^c (28.7%)	0.66 ^{a,c} (41.2%)	0.57 (32.3%)
Aggression toward others	0.32 ^{c,d} (25.0%)	0.38 ^d (27.6%)	0.60 ^a (35.3%)	0.65 ^{a,b} (41.5%)
Pulling others' hair	0.25 ^d (23.3%)	0.33 ^d (24.1%)	0.45 ^a (29.4%)	0.60 ^{a,b} (33.8%)
Yelling or shouting at others	0.10 ^{c,d} (8.3%)	0.18 ^{c,d} (13.8%)	0.53 ^{a,b} (31.8%)	0.57 ^{a,b} (33.8%)
Property destruction	0.13 ^{c,d} (10.0%)	0.30 ^{c,d} (19.5%)	0.55 ^{a,b} (34.1%)	0.51 ^{a,b} (33.8%)
<i>Stereotypic Behaviors</i>				
Unusual play with objects	0.22 ^d (18.3%)	0.30 (20.7%)	0.25 ^d (17.6%)	0.45 ^{a,c} (32.3%)
Repeated and unusual vocalizations	0.17 ^{c,d} (13.3%)	0.24 ^{c,d} (18.4%)	0.49 ^{a,b} (29.4%)	0.45 ^{a,b} (26.2%)
Repeated and unusual body movements	0.43 (33.3%)	0.39 (27.6%)	0.48 (31.8%)	0.58 (40.0%)

(table cont.)

Self Injurious Behaviors

Poking him/herself in the eye	0.07 (3.3%)	0.05 (4.6%)	0.16 (11.8%)	0.09 (7.7%)
Harming self by hitting, pinching, scratching, etc.	0.32 (18.3%)	0.26 (20.7%)	0.35 (24.7%)	0.37 (27.7%)

Note: Mean scores are presented along with the frequency of endorsement as a mild to severe problem in parentheses.

^a Based on Bonferroni-corrected item analyses, significantly different from 12-18 months group ($p < .05$)

^b Based on Bonferroni-corrected item analyses, significantly different from 19-25 months group ($p < .05$)

^c Based on Bonferroni-corrected item analyses, significantly different from 26-32 months group ($p < .05$)

^d Based on Bonferroni-corrected item analyses, significantly different from 33-39 months group ($p < .05$)

analysis (i.e., results from diagnosis, age, age within diagnosis, and diagnosis within age comparisons for both ASD and atypical controls), the reader may contact the author. All item analysis test p values were adjusted using a Bonferroni correctional procedure. Results of the items analysis indicated that there were 11 out of 15 BISCUIT-Part 3 items which had a significant age within ASD diagnosis interaction. Under the Aggressive/Destructive Behaviors subscale there was a significant age within ASD effect for the following items: a) kicking objects, $p < .001$, partial $\eta^2 = .043$; b) removal of clothing at inappropriate times, $p < .001$, partial $\eta^2 = .049$; c) throwing objects at others, $p < .001$, partial $\eta^2 = .038$; d) leaving the supervision of caregiver without permission, $p = .002$, partial $\eta^2 = .024$; e) aggression towards others, $p = .003$, partial $\eta^2 = .023$; f) pulling hair, $p = .002$, partial $\eta^2 = .023$; g) yelling/shouting, $p < .001$, partial $\eta^2 = .066$; and, h) property destruction, $p < .001$, partial $\eta^2 = .044$. The items on the Stereotypic Behaviors BISCUIT-Part 3 subscale which had a significant age within ASD diagnosis effect were a) unusual play with objects, $p = .009$, partial $\eta^2 = .019$ and b) repetitive vocalizations, $p < .001$, partial $\eta^2 = .038$. the only item on the Self Injurious Behaviors subscale which had a significant age within ASD diagnosis effect was "eye poking", $p = .018$, partial $\eta^2 = .016$.

Discussion

The purpose of this investigation was to examine the emergence and trend of challenging behaviors in very young children with an ASD compared to other general delays. An examination of the results revealed that there was a clear overall pattern of toddlers with ASD having more severe problem behaviors than toddlers with non-ASD delays. Additionally, there was a general trend where younger children (ASD and non-ASD delays) appeared to engage in less severe challenging behaviors. Furthermore, the severity of challenging behaviors tended to increase across age groups with the older groups evincing the most severe problems across all classes of behaviors. It is noteworthy to mention that the only statistically significant overall age trend was observed for aggressive and destructive behaviors. Summarizing the results from Table 4 and Figure 1, it can be deduced that those with ASD have a unique pattern of challenging behaviors which emerges early in life and continues to progress throughout the infant and toddler years. Statistically meaningful increases in the rates of Aggressive/Destructive Behaviors and Stereotypic Behaviors were noted to begin around 26-32 months of age. For the domain of Self Injurious Behavior, no clear age trend was observed for this sample of toddlers with ASD; however, a visual inspection of the data revealed a variable trend with an increase in challenging behaviors beginning to occur for those in the 26-32 age group. For infants and toddlers with non-ASD delays, no statistically significant age effects were detected; however, a visual inspection of the data did yield a general increasing trend of the severity of the three broad BISCUIT-Part 3 challenging behavior domains.

Inspecting the trends of those with ASD with regards to specific items (see Table 5), a very clear progression in the severity of symptoms was evident in the BISCUIT-Part 3 items “removal of clothing at inappropriate times,” “aggression towards others,” “yelling or shouting at

others,” “property destruction,” and “repetitive and unusual vocalizations.” The other items found to have a significant ASD diagnosis by age effect, in general, also showed a progression from low severity and endorsement rates at ages 12-18 months to high severity and endorsement rates at ages 26-32 and 33-39 months of age. It is important to note that although the majority of significant item specific age trends in infants and toddlers with ASD occurred with respect to the BISCUIT Part 3 domain of Aggressive/Destructive Behavior, no “zero” level item endorsement or decreasing age trends were noted to have occurred across all challenging behavior domains. Thus, there does appear to be general upward trends in behaviors which can be subsumed under the challenging behavior topographies of aggression, self injury, and stereotypy in infants and toddlers with ASD.

While other studies have examined phenomenological differences in problem behaviors in those with ASD, this is one of the first to investigate the severity of multiple these problems in very young children. This investigation is somewhat different from previous investigations with young children with ASD in that it included an atypically developing control group used a measure designed for detecting problem behaviors in those with ASD, looked at multiple behavior problem topographies at one time, and investigated the emergence of these behaviors in regards to age trends. Thus, these findings supported previous researchers who assert that individuals with ASD can and do exhibit symptoms that are not wholly accounted for by their diagnosis of ASD (Gadow et al., 2004; Matson, Hess, et al., 2009; Gillberg & Billstedt, 2000). Additionally, it appears that challenging behavior problems can begin to emerge as early as 12 months of age and increase to problematic levels beginning at 25-39 months of age, therefore necessitating the need for earlier intervention.

There are several limitations which should be considered when interpreting these results. First, the sample was derived from a population of atypically developing children who were enrolled in a statewide early intervention program. Thus, it is likely that there was a variable distribution of the type and intensity of support services rendered to the children in the sample. Also, it is likely that at the time of testing administration participants were at different stages in service provision. As such controlling for the effects of early intervention services would have been difficult given the presumed varied experiences of the participants.

Another potential limitation to the current study is the intellectual functioning (i.e., IQ) was not taken into consideration. Previous research has found that the severity of ID severely impacts the occurrence of challenging behaviors (Allen, 2000; McClintock et al., 2003; Oliver et al., 1987; Rojahn et al., 2008; Tyrer et al., 2006). Due to the common comorbidity of ASD and ID (Fombonne, 2005; La Malfa, Lassi, Bertelli, Salvini, & Placidi, 2004; Matson & Shoemaker, 2009), the presence of ID within this study could be worthy of note. However, given that a very young cohort of children were assessed, accurate assessment of intellectual functioning was not possible. It is noteworthy to mention that IQ was assessed as a potential risk factor for the emergence of challenging behavior in study 2.

Third, results are largely dependent upon parent report of the child's behavior per BISCUIT-Part 3 item endorsements. As such, no behavioral observation of the challenging behaviors in question by an independent observer was conducted. It is possible that parents may have over or underestimated their child's behavior problems. Thus, these findings are limited by both source and temporal biases. Gadow, DeVincent, and Schneider (2008) found a similar relationship between family history of psychopathology and problem behavior in children and adolescents with ASD. However, this relationship did not emerge when teacher-completed

behavior ratings were used. Investigators of future studies should consider incorporating the use of behavior ratings completed by sources other than the caregiver to eliminate source bias.

Fourth, the study was a cross sectional analysis. As such, it is probable that differences between age groups are a mere reflection of variations in the different age samples.

Furthermore, it is likely that results may not actually reflect a true progression of challenging behaviors in very young children with ASD or general delays given the nature of the sample. A logical extension of this investigation would be to conduct a longitudinal analysis of infants and toddlers with the first administration being within a specific age frame (e.g., 12-19 months of age) with periodic reassessments of aberrant symptom presentation at logical and predictable periods of time (e.g., every 6 months). The data for this study was derived from a preexisting database of only one initial test administration and minimal numbers of retests (typically at unpredictable lapses in time). Thus, a cross sectional analysis was the only logical solution at the time of data analysis.

Fifth, there is still debate about whether atypical symptoms which often present in those with ASD can be truly distinct entities or are just facets inherent this diagnosis. The purpose of this investigation was not to lend itself to either side of this debate. Rather, the purpose of this experiment was to add supporting evidence to the growing consensus that challenging behaviors are likely to occur in those with an ASD and can occur very early in life at rates higher than the general population and also compared to those with general developmental delays.

Even in light of these shortcomings, the findings of this study lend themselves to some important clinical implications. First, this study acknowledges that the diagnostic concept of ASD is a rather heterogeneous entity. Thus, not every individual who is diagnosed as having an ASD will exhibit challenging behaviors to the same degree. Being cognizant of the possibility of

the early emergence of challenging behaviors and the potential progression of specific behavior symptoms in those with ASD allows for more effective screening initiatives and treatment planning. Second, the earlier clinicians can identify aberrant behavioral presentations, the sooner appropriate intervention for these problems can commence. With literature suggesting that the implementation of early, intensive intervention renders the best possible outcomes for those with ASD, it is imperative to treat emerging challenging behaviors before more serious problem develop (Ben Itzhak, Lahat, Burgin, & Zachor, 2008; Evans et al., 2005; Matson, 2007). This study is a first step in establishing the emergence of concomitant behaviors in those with ASD. More is yet to be discovered about the relationship between ASD and conditions not currently subsumed under the ASD disorder. Future research should focus on the nature of ASD in relation to potential predisposing factors to the emergence of psychopathology and the implications for responsiveness to treatment, natural history, and overall prognosis.

STUDY 2

Method

The purpose of Study 2 was to investigate and identify potential risk factors for the emergence of challenging behaviors in toddlers with ASD. To fulfill the purpose of this study, only the participants from Study 1 who were classified as belonging to the ASD group who were administered and had at least a partially completed a standardized measure of developmental functioning (*Battelle Developmental Inventory-2nd Edition*), a valid measure of core autistic symptomatology for infants and toddlers (*BISCUIT-Part 1*), and a valid measure of comorbid symptoms in infants and toddlers with ASD (*BISCUIT-Part 2*) were retained. The same diagnostic procedures, administration technique, and data collection from Study 1 were also employed in Study 2 (ref. Methods, pg 63). It is noteworthy to mention that all of the ASD participants ($n = 297$) from Study 1 fulfilled the criteria for being retained for analysis for Study 2.

Measures

Baby and Infant Screen for Autism Traits- Part 1 (BISCUIT-Part 1). The BISCUIT-Part 1 component was designed to assist in the assessment of core symptoms and diagnosis of ASD (i.e., Autistic Disorder and PDD-NOS) in infants and toddlers. The BISCUIT-Part 1 contains 62 items that are rated on a 3-point Likert-type scale. Using this format, informants (i.e., parents or legal guardians) are asked to rate the extent to which each item symptom was ever a problem, and is rated as “0 = not different; no problem,” “1 = somewhat different; mild impairment,” or “2 = very different; severe impairment.” Furthermore, informants are instructed to base each item rating on their child’s behavior when compared to typically developing same-aged peers. Test administration time is approximately 20-30 minutes; however, this may vary as a function of the individual characteristics of the child. Initial psychometric analyses have found

that the BISCUIT-Part 1 has excellent reliability with an overall internal reliability coefficient of .97 (Matson, Wilkins, Sevin et al., 2009). In the preliminary investigation of the scale's validity, Matson, Wilkins, Sharp, and colleagues (2009) established cut-off scores for differentiating between both atypically developing at-risk children with no diagnosis and PDD-NOS (total score of 17 or greater; sensitivity = 84.7, specificity = 86.4) and atypically developing at-risk children with autism and PDD-NOS (total score of 39 or greater; sensitivity = 84.4, specificity = 83.3). Sensitivity and specificity estimates for ASD (PDD-NOS and autism) versus atypically-developing children without ASD have been found to be 93.4% and 86.6%, respectively (Matson, Wilkins, Sharp et al., 2009). Convergent validity of the BISCUIT-Part 1 has been established with the M-CHAT (Matson, Wilkins, & Fodstad, in press). For the purpose of this investigation, mean total BISCUIT-Part 1 scores were retained for statistical analysis.

Baby and Infant Screen for Children with aUtism Traits-Part 2 (BISCUIT-Part 2).

The BISCUIT-Part 2 is also part of the BISCUIT battery, with this portion being developed to specifically assess for symptoms of comorbid conditions in infants and toddlers with ASD (Matson, Boisjoli, & Wilkins, 2007). The BISCUIT-Part 2 contains 57 items that are rated on a 3-point Likert-type scale with severity ratings of "0 = not a problem or impairment; not at all", "1 = mild problem or impairment", and "2 = severe problem or impairment." Factor analyses have yielded a five factor solution for the BISCUIT-part 2 with those factors being Tantrum/Conduct Problems, Inattention/Impulsivity, Avoidance Behavior, Anxiety/Repetitive Behavior, and Eating Problems/Sleeping (Matson, Boisjoli, Hess, & Wilkins, 2009). Initial psychometric analyses have found that the BISCUIT-Part 2 has excellent reliability with an overall internal consistency coefficient of .96 (Matson, Wilkins, Sevin et al., 2009). Cutoff scores and normative data have also been established for each of the subscales of the BISCUIT-

Part 2 as well as the total score for children with ASD and, also, for atypically developing children (Matson, Fodstad, & Mahan, 2009; Matson, Fodstad, Mahan, & Sevin, 2009). For the purposes of this study, mean scores for all of the factors were utilized for statistical analyses.

BISCUIT-Part 3. Since this measure was also outlined in Study 1, the reader is referred to the Materials section of Study 1. It is noteworthy to mention, that for the purposes of this study, mean factor scores were used instead of factor percentage of endorsement scores.

Battelle Developmental Inventory- 2nd Edition (BDI-2). The BDI-2 is a criterion-referenced, standardized assessment designed to measure the developmental functioning of children from birth through 7 years, 11 months of age (Newborg, 2005). This assessment consists of 450 total items which are grouped into one of five domains: Adaptive, Personal/Social, Communication, Motor, and Cognitive. In addition, the BDI-2 contains a 100 item screening section; however, for the purposes of this study the full BDI-2 assessment was utilized. Item “skills” are scored as either “0 = no ability in this skills,” “1 = emerging ability,” or “2 = ability at this skill,” with item responses being elicited via a structured test format, directly observing the child or by interviewing the child’s parent or legal guardian. Scoring the BDI-2 produced a total battery score and standard scores for all five domains. In addition, an overall development quotient can be computed from a summation of all domain scores. The development quotient score has a mean of 100 and a standard deviation of 15, and represents a gross index of the child’s overall developmental functioning. Studies of the scale’s psychometric properties have revealed that the BDI-2 has excellent interrater and test-retest reliability with estimates ranging from .90 to .99 depending on the age of child. Internal consistency of the total scale was excellent at .98 to .99, as were the domain scores, except for the Adaptive domain which was slightly below the recommended cut-off for subscale internal consistency at .80.

Content validity was demonstrated through examination of the scale by experts, and criterion validity was demonstrated by correlating the BDI-2 with other well-known developmental scales (correlations ranged from .64 to .76 for domain scores and .78 for total score). For the purposes of this study, participants' developmental quotients on all of the BDI-2 subscales (i.e., Adaptive, Persona/Social, Communication, Motor, and Cognitive) were used for statistical analysis.

Demographic Information. The demographic form accompanying the BISCUIT battery consists of questions that inquire about the child's background information. Specifically, the form includes questions regarding the toddler's date of birth, ethnicity, medical history, toileting, and age of certain developmental milestone attainment (i.e., first word, first phrase, onset of crawling, and onset of walking). For the purposes of this study, the demographic variables of interest include chronological age, gender, and presence of medical/genetic condition (i.e., epilepsy, blindness, Smith-Magenis, Fragile X, Cornelia de Lange, or Prader Willi). Chronological age was entered into subsequent data analyses as a continuous variable (i.e., instead of the "age groups" ordinal variable from Study 1). Gender and the presence of a medical/genetic condition were dummy coded with "0" representing the absence of having a medical/genetic condition or being female, and "1" representing being male or having a previous diagnosis of a medical/genetic condition.

Statistical Procedures

Prior to conducting statistical analyses, steps were taken to ensure the robustness of the findings from data analysis in light of the assumptions of correlation and regression analyses. Four participants were excluded due to missing data (i.e., more than 5% of the BDI-2, BISCUIT-Part 1 or BISCUIT Part 2) and 8 participants were excluded due to missing questionnaires (the BDI-2, BISCUIT-Part 1, or BISCUIT Part 2) or missing demographic variables (gender,

presence/absence of medical or physical condition). All other missing data were imputed with the mean score for that particular variable (Tabachnick & Fidell, 2007). Furthermore, participants noted to score more than three standard deviations above or below the group mean for each subscale across both the dependent and independent variables were deleted due in an effort to control for variations or error in the data (Tabachnick & Fidell, 2007). Seven participants were classified as being outliers, and therefore were dropped from subsequent analyses. The following data reflect those who remained in the database after excluded cases were removed.

Data were also examined for normality prior to conducting any statistical analyses and skewness and kurtosis values were calculated as well as Kolmogorov-Smirnov test results. Skewness is a measure of distribution asymmetry and kurtosis is a measure of the peakedness of a distribution. Both measure deviation from normality. The Kolmogorov-Smirnov test checks for significant deviation from normality. It is important to note that findings from these analyses did

Table 6
Risk factor endorsement scores for infants and toddlers with ASD (N = 278)

Risk Factor	
Mean age (SD)	25.42 (6.48)
Gender (n; %)	
Male	219 (78.8%)
Female	59 (21.2%)
Medical/Physical Diagnosis	
Yes	37 (13.3%)
No	241 (86.7%)
Mean ASD severity (SD; BISCUIT-Part 1)	42.32 (19.29)
Mean Comorbid Difficulties (SD; BISCUIT-Part 2)	
Tantrum/Conduct Behaviors	6.48 (7.17)
Impulsiveness/Inattention	6.51 (6.40)
Avoidance	2.34 (3.42)
Anxiety/Repetitive Behaviors	2.06 (2.52)
Eating Problems/Sleeping	1.54 (2.16)
Mean Developmental Functioning (SD; BDI-2)	
Adaptive	76.59 (14.49)

(table cont.)

Personal-Social	79.26 (13.40)
Communication	65.18 (13.95)
Motor	88.28 (17.26)
Cognitive	73.29 (11.66)

not yield any notable deviations from normality. The following data reflect those 278 infants and toddlers with ASD who remained in the database after excluded cases were removed. The reader is referred to Table 6 for endorsement scores per each potential risk factor.

Identification of Significant Correlates of Challenging Behavior. In order to examine the strength of the relationship between potential putative risk factors and challenging behaviors, Pearson product correlations were computed between potential risk markers for challenging behaviors and between these variables and the BISCUIT-Part 3 subscale scores. The strength of these correlations was then measured against the criteria established by Cohen (1988): correlations in the range of .10 - .29 were considered small, .30 - .49 were considered moderate, and .50 or above were considered large.

Prediction of Challenging Behaviors Using Pre-established Diagnosis Specific Normed Cutoffs. Binary logistic regression analyses were conducted using the subject characteristic as predictor variables (bivariate correlations found to be significant at the $p < .10$ level) and the presence (yes/no) of "clinically significant" BISCUIT Part 3 subscale scores as the dependent variable. An interaction variable was also calculated to further assess the effects of the relationship between the severity of autism core symptoms (BISCUIT Part 1) and age (age group variable from Study 1) on challenging behaviors for the BISCUIT-Part 3 subscales found to have significant age within diagnosis effects from Study 1 (i.e., Aggressive/Destructive Behavior and Stereotypic Behavior). Although reducing a continuous variable to a binary variable may result in a loss of power compared to linear regression, this method was selected because it allows for the inclusion of multiple categorical predictor variables (e.g., gender,

presence of medical/physical diagnosis) and has fewer assumptions regarding the normality of the data (Field, 2005). Furthermore, this procedure would allow for the possible identification of predictors of "clinically significant" problem behavior versus predictors of the continuum of maladaptive behavior. Therefore, it will permit the identification of predictors that significantly affect the odds of having BISCUIT Part 3 scores which are considered to be of a significant nature (diagnosis-specific norm referenced scores in the moderate to severe impairment range).

BISCUIT Part 3 scores were dummy coded as a binary variable. Specifically, for each domain score (i.e., Aggressive/Destructive Behavior, Stereotypic Behaviors, and Self Injurious Behaviors), scores for "moderate impairment" and "severe impairment" were summed together. Thus, those who scored in the "no/minimal impairment" range were coded as 0 (the absence of significant problems), and those scoring in the "moderate/severe impairment" range were coded as 1 (presence of significant problem behavior per normative cutoff scores). The transformation of the BISCUIT Part 3 domain scores to "no impairment" versus "moderate/severe impairment" was conducted by utilizing the pre-established cutoffs for infants and toddlers with ASD as calculated by Rojahn and colleagues (2009). The specific cutoffs used can be found in Appendix B. The indicator method was selected for contrasting categorical variables as it contrasts presence versus absence of category membership. With regard to the four levels of the age group variable, the lowest level (12-18 months) was used as the reference category. Simultaneous entry of predictor variables was used. In simultaneous entry, all predictor variables are entered at the same time and the unique contribution of each predictor is calculated while holding all other predictor variables constant. Logistic regression coefficients were calculated for each predictor variable and the Wald statistic was used to test statistical significance of the individual coefficients. One drawback to using the Wald statistic is that for

large regression coefficients, it tends to be rather conservative (higher probability of type II error, failing to reject the null hypothesis). Logistic regression also produces odds ratios (OR) for each predictor variable entered into the regression model. An OR is a ratio of the odds of an event happening for one group over the odds of that same event happening for another group. Odds are calculated by dividing the probability of an event occurring by the probability of the event not occurring. An OR of 1.00 indicates equal odds of an event happening for two groups. As the purpose of the current study was to identify possible predictors of challenging behavior and not to verify predictive models, on the ORs will be discussed.

Prediction of Continuum of Challenging Behavior. To determine the unique and combined ability of potential risk markers to predict challenging behavior in infants and toddlers with ASD, multiple regression analyses were conducted using the relevant subject characteristics as predictor variables (correlations found to be significant at the $p < .01$ level) and BISCUIT-Part 3 domain scores as the dependent variables. Separate multiple regression analyses were conducted for each BISCUIT-Part 3 subscales. The goal of multiple regression is to minimize model error in prediction. Specifically, this statistical procedures seeks to minimize the sum of squared distances between observed and predicted responses (Tabachnick & Fidell, 2007). Unlike logistic regression, multiple regression has many more assumptions that must be met with regards to the data. First and foremost, the dependent variable must be continuous and either uses an interval or ratio scale. Second, the relationship between the independent and dependent variables must be linear. Third, several assumptions exist with respect to the error terms (e.g., homoscedasticity and normally distributed error terms for each set of values of the independent variables). Finally, none of the independent variables can be perfect linear combinations of the other independent variables (i.e., multicollinearity).

Similar to the procedures employed to conduct logistic regression, predictor for the multiple regression analysis were entered using the simultaneous entry method. Multiple regression uses an F test to determine overall model fit. Betas (b ; regression coefficients) and their respective T statistic probabilities are used to determine the statistical significance of the individual predictor variables to the regression model. R^2 represents the amount of variance explained by the regression model. To check for multicollinearity among the predictor variables, collinearity statistics were calculated for each regression model. Normal Probability-Probability (P-P) plots of regression standardized residuals were created for each regression analysis model to check for normality of the data and can be found in Appendix C.

Hypotheses

Although this investigation should be deemed exploratory, a few hypotheses were formulated based upon research utilizing older cohorts of individuals with ASD and/or ID. First, symptoms of autism severity (as measured by the BISCUIT-Part 1) were predicted to be positively correlated with challenging behaviors. This relationship autism severity and challenging behavior should be the strongest for the BISCUIT Part 3 subscale of Stereotypic Behavior due to the inherent nature of the diagnostic criteria of ASD. Second, age would be correlated with increased scores on BISCUIT-Part 3 subscales. This would suggest that although challenging behaviors may be detectable in the very young child with ASD, severity of challenging behaviors should increase as the child ages especially if no appropriate interventions have been initiated. Third, measures of psychopathology (as measured by the BISCUIT-Part 2) would be positively correlated with broad domains of challenging behaviors. Thus, this finding would corroborate with findings from the adult literature which suggests in the ID/DD population there appears to be a link between mental illness and challenging behavior (Borthwick-Duffy, 1994; Emerson, 2001; Sturmey et al., 2010). Fourth, measures of

developmental behavior were predicted to be negatively and positively correlated with measures of challenging behaviors. Similar to findings by Emerson (2001), a higher level of developmental skill development should be related to increased proclivity to engage in aggressive and destructive behaviors. Likewise, children who have skills deficits across adaptive domains should be less likely to engage in significant self-injurious and stereotypical behaviors. Fifth, presence of a medical or physical diagnosis (epilepsy, cortical blindness, Cornelia de Lange syndrome, etc) should be positively correlated with challenging behaviors as certain conditions have been found to have symptom profiles which include specific forms of aberrant behaviors (Hyman et al., 2002; Kiernan et al., 1994; Oliver et al, 1993; Dykens & Smith, 1998; Symons et al., 1999; Symons et al., 2003). Lastly, based upon mixed findings with respect to the relationship between gender and challenging behaviors in ASD it is highly probably that no statistically significant relationship will be found.

Results

A post-hoc power analysis was conducted to calculate the observed power of the analyses described below. Using G * Power 3 (Faul et al. 2007) and the instructions for Bivariate Correlation analyses, for a two tailed test with an effect size $|r| = .30$, alpha error of .05, and a sample size of 278, power was calculated to be 1.00. When the instructions for computing the observed power of Multiple Regression analyses was conducted, the specific combinations of predictor variables for each BISCUIT-Part 3 subscale were entered (see Table 7) along with an adjusted alpha value of .017 and a medium effect size (0.15). The power for a sample size of 278 infants and toddlers with ASD was calculated to be 0.99 (11 predictor variables; BISCUIT-Part 3 Aggressive/Destructive Behavior subscale), 1.00 (7 predictor variables; BISCUIT-Part 3

Stereotypies subscale), and 1.00 (8 predictor variables; BISCUIT-Part 3 Self Injurious Behavior subscale).

Identification of Significant Correlates of Challenging Behavior. Complete bivariate correlation matrices among the predictor variables can be found in Table 7. Correlation matrices between the putative predictor variables and the BISCUIT- Part 3

Table 7

Pearson product correlations amongst demographic variables, ASD symptom severity, psychopathology, and developmental functioning for participants with ASD

	Age	Part 1	Gen	M/P	Tan	Imp.	Av.	Anx	Eat	Adap	Soc	Com	Mot	Cogn
Age	1													
Part 1	.12*	1												
Gen	-.13*	-.06	1											
M/P	-.05	.04	-.06	1										
Tan	.26**	.22**	-.01	-.04	1									
Imp	.20**	.38**	-.03	-.08	.66**	1								
Av	.22**	.39**	-.07	-.08	.53**	.57**	1							
Anx	.32**	.42**	-.05	-.07	.34**	.45**	.45**	1						
Eat	.18**	.13*	-.10	-.00	.49**	.50**	.42**	.44**	1					
Adap	.11	-.24**	.07	-.20**	.13*	.07	.10	.12*	.13*	1				
Soc	-.21**	-.26**	-.01	-.03	.08	-.04	-.07	-.08	.02	.41**	1			
Com	.17**	-.14*	-.14*	-.10	.23**	.06	.12*	.12*	.14*	.40**	.45**	1		
Mot	.30**	-.17**	.04	-.18**	.26**	.11	.07	.20**	.16**	.55**	.37**	.45**	1	
Cogn	-.07	-.27**	-.01	-.02	.06	-.11	.00	-.02	.06	.42**	.53**	.49**	.49**	1

* $p < .05$ (two tailed)

** $p < .01$ (two tailed)

Note. Part 1 = total severity of core autism symptoms (BISCUIT-Part 1); A X D = age X diagnosis (Autism), Gen = gender, M/P = presence of a medical or physical condition, Tan = Tantrums/conduct problems (BISCUIT-Part 2), Imp = Impulsiveness/inattention (BISCUIT-Part 2), Av = Avoidance/withdrawal (BISCUIT-Part 2), Eat = Eating Problems/Sleeping (BISCUIT-Part 2), Adap = Adaptive (BDI-II), Soc = Personal/Social (BDI-II), Com = Communication (BDI-II), Mot = Motor (BDI-II), Cog = Cognitive (BDI-II)

subscale scores and composite (i.e., total) scores for infants and toddlers with ASD can be found in Table 8. It is noteworthy to mention that across all BISCUIT Part 3 subscales, no significant relationships were found to occur with the risk factors of gender or having a medical/physical preexisting condition. Subsequent regression analyses included only predictor variables which elicited correlations significant at the $p < .10$ level with BISCUIT-Part 3 domain scores.

Table 8
Bivariate correlation matrix among predictor variables and BISCUIT Part 3 subscale scores for participants with ASD

	Aggressive/Destructive Behavior	Stereotypy	Self Injurious Behavior
<i>Age</i>	.16*	.11*	.10
<i>Part 1</i>	.19**	.37**	.15**
<i>Gen</i>	.03	.02	-.05
<i>M/P</i>	.01	-.06	.06
<i>Tan</i>	.85**	.12	.29**
<i>Imp</i>	.45**	.34**	.25**
<i>Av</i>	.37**	.24**	.17**
<i>Anx</i>	.38**	.30**	.23**
<i>Eat</i>	.26**	.02	.06
<i>Adap</i>	.14*	.03	.02
<i>Soc</i>	.14*	-.09	-.16*
<i>Com</i>	.21**	-.04	-.15*
<i>Mot</i>	.23**	-.23**	-.20*
<i>Cogn</i>	.11*	-.15*	.10

* $p < .05$ (two tailed)

** $p < .01$ (two tailed)

Note. Part 1 = total severity of core autism symptoms (BISCUIT-Part 1); A X D = age X diagnosis (Autism), Gen = gender, M/P = presence of a medical or physical condition, Tan = Tantrums/conduct problems (BISCUIT-Part 2), Imp = Impulsiveness/inattention (BISCUIT-Part 2), Av = Avoidance/withdrawal (BISCUIT-Part 2), Eat = Eating Problems/Sleeping (BISCUIT-Part 2), Adap = Adaptive (BDI-II), Soc = Personal/Social (BDI-II), Com = Communication (BDI-II), Mot = Motor (BDI-II), Cog = Cognitive (BDI-II)

Small positive correlations were found between scores on the BISCUIT Part 3

Aggressive/Destructive Behaviors subscale and the putative risk factors of age ($r = .16$), severity of core autistic symptoms (i.e., as measured by the BISCUIT-Part 1; $r = .19$), and across all domains of developmental functioning (i.e., as measured by the BDI-2; r range .11 - .23). Small

to moderate positive correlations were found between Aggressive/Destructive Behavior and all of the comorbid problem areas (i.e., as measured by the BISCUIT-Part 2; r range .26 - .45) with the exception of the Tantrum/Conduct Behavior subscale which yielded a strong positive correlation ($r = .85$). Although this data asserts that there is a strong association between the BISCUIT Part 3 Aggressive/Destructive Behavior and BISCUIT-Part 2 Tantrum/Conduct Behavior subscale, it also lends to the conclusion that there may be an increased amount of overlap between the items content of these subscales which could influence subsequent analyses adversely. Therefore in an effort to control for multicollinearity and suppressor effects, the BISCUIT-Part 2 subscale Tantrums/Conduct Behavior was absent from all subsequent regression analyses for the BISCUIT - Part 3 Aggressive/Destructive Behavior subscale (Field, 2005). Thus, these data indicate that more severe Aggressive/Destructive Behavior in infants and toddlers with ASD was more likely to occur in older children, those with more severe core autistic symptomatology, those with higher developmental functioning, and more comorbid problems.

For the Stereotypic Behavior subscale small positive correlations was found for the risk factors of age ($r = .11$) and the BISCUIT - Part 2 Avoidant Behavior subscale ($r = .24$). A small negative correlation was found between the BDI-2 Motor domain and Stereotypic Behavior ($r = -.23$), as well as the BDI-2 Cognitive domain ($r = -.15$). Moderate positive correlations were found between Stereotypic Behavior and the BISCUIT-Part 2 subscales of Inattentiveness/Impulsivity ($r = .34$) and Anxiety/Repetitive Behavior ($r = .30$), and the BISCUIT-Part 1 total score ($r = .37$). Thus, these data indicate that infants and toddlers with ASD who engaged in more Stereotypic Behavior were also reported to be more likely to be older, to have more salient symptoms of autism, to have a lower level of motor skills, to have

severe comorbid difficulties in the areas of inattentiveness/impulsiveness and anxiety-related behaviors. Finally, small positive correlations were found for the BISCUIT Part – 3 Self Injurious Behavior subscale and the following putative risk factors: autistic symptomatology (as measured the BISCUIT-Part 1; $r = .15$), Tantrum/Conduct Behaviors (as measured by the BISCUIT-Part 2; $r = .29$), Inattentiveness/Impulsivity (as measured by the BISCUIT-Part 2; $r = .25$), Avoidant Behavior (as measured by the BISCUIT-Part 2; $r = .17$), and Anxiety/Repetitive Behavior (as measured by the BISCUIT-Part 2; $r = .23$). Small negative correlations were found between Self Injurious Behavior subscale and the BDI-2 subscales of Personal-Social skills ($r = -.16$), Motor skills ($r = -.20$) and Communication skills ($r = -.15$). Thus, these data suggest that children with ASD who present with more severe core autistic symptoms, engage in more comorbid problems, or are more delayed in social, motor, or communication skills may also engage in more severe self-injurious behavior.

Prediction of Challenging Behaviors Using Pre-established Diagnosis Specific Normed Cutoffs - Logistic Regression. Table 9 depicts the odds ratios associated with each predictor variable for the separate logistic regression analyses for "clinically significant" Aggressive/Destructive Behavior, Stereotypic Behavior, and Self Injurious Behavior. The following predictor variables were included in the logistic regression analysis for Aggressive/Destructive Behavior: age, BISCUIT Part 1 total score (e.g., severity of core autistic symptoms), the interaction variable of age group by BISCUIT Part 1 total score, BISCUIT - Part 2 Inattention/Impulsivity scores, BISCUIT - Part 2 Avoidant Behavior scores, BISCUIT -Part 2 Anxiety/Repetitive Behavior scores, BISCUIT - Part 2 Eating Problems/Sleeping scores, BDI-2 Adaptive domain scores, BDI-2 Personal-Social domain scores, BDI-2 Communication domain scores, BDI-2 Motor domain scores, and BDI-2 Cognition domain scores. The logistic

Table 9

Binary logistic odds ratios (95% confidence intervals) for BISCUIT Part 3 subscales for participants with ASD

	Aggressive/Destructive Behavior			Stereotypy			Self-Injurious Behavior		
	OR (CI)	Wald χ^2	β	OR (CI)	Wald χ^2	β	OR (CI)	Wald χ^2	β
Age (mos)	.923 (.773, 1.002)	3.98*	-.194						
Part 1	.912 (.829, 1.004)	3.53	-.092	1.036 (.993, 1.080)	1.50	.106	.989 (.964, 1.014)	.765	-.011
A X Part 1									
12-18		6.09			5.06				
19 - 25	1.056 (.977, 1.142)	1.87	.055	.930 (.931, 1.041)	2.86	-.028			
26-31	1.086 (.991, 1.189)	3.13	.082	.999 (.871, 1.145)	3.75	-.001			
32-39	1.120 (1.008, 1.243)	4.46*	.113	1.022 (.859, 1.217)	4.69*	.022			
Gen									
M/P									
Tan				1.294 (.586, 2.491)	.812	.258	1.463 (1.016, 2.105)	4.19*	.380
Imp	3.527 (1.854, 6.710)	14.76**	1.261	3.439 (1.332, 2.495)	6.51*	1.235	1.444 (.896, 2.326)	2.27	.367
Av	1.894 (1.118, 3.207)	5.64*	.639	.514 (.246, 1.072)	.70	-.666	1.345 (.882, 2.049)	1.90	.296
Anx	1.144 (.584, 2.239)	.15	.134	4.436 (1.466, 2.425)	8.10**	1.490	1.697 (.970, 2.697)	3.92*	.529
Eat	1.176 (.673, 2.057)	.32	.162						
Adap	.964 (.924, 1.007)	2.76	-.036						
Soc	1.002 (.963, 1.004)	.01	.002				1.016 (.978, 1.054)	.646	.015
Com	1.047 (1.004, 1.092)	4.66*	.046				1.010 (.976, 1.045)	.329	.010
Mot	1.054 (1.002, 1.108)	4.20*	.052	.940 (.884, .998)	4.06*	-.062	.957 (.926, .990)	6.50*	-.044
Cogn	.978 (.921, 1.038)	.56	-.023	1.062 (.979, 1.151)	2.11	.060			

* $p < .05$ (two tailed)** $p < .01$ (two tailed)

Note. OR = Odds ratio, CI = Confidence interval, Part 1 = total severity of core autism symptoms (BISCUIT-Part 1); A x Part 1 = age group (12-18, etc) by total severity of core autism symptoms (BISCUIT Part 1), Gen = gender, M/P = presence of a medical or physical condition, Tan = Tantrums/conduct problems (BISCUIT-Part 2), Imp = Impulsiveness/inattention (BISCUIT-Part 2), Av = Avoidance/withdrawal (BISCUIT-Part 2), Eat = Eating Problems/Sleeping (BISCUIT-Part 2), Adap = Adaptive (BDI-II), Soc = Personal/Social (BDI-II), Com = Communication (BDI-II), Mot = Motor (BDI-II), Cog = Cognitive (BDI-II)

regression model was found to be significant ($\chi^2 [14, 263] = 80.63; p < .001$) indicating that the model with the predictor variables was significantly different from the model with only the constant included.

In predicting the presence of significant Aggressive/Destructive Behaviors, five predictor variables and one level of the interaction variable had statistically significant odds ratios (OR). BISCUIT-Part 2 Inattentiveness/Impulsivity scores had an associated OR of 3.53 ($p < .001$). Thus, every three-unit increase in Inattentiveness/Impulsivity scores increased the odds of having "clinically" significant aggressive and destructive challenging behaviors (BISCUIT-Part 3 Aggressive/Destructive total scores in the moderate/severe cutoff range) by approximately 53%. BISCUIT-Part 2 Avoidant Behavior scores had an associated OR of 1.89 ($p = .02$). Thus, for every 1 unit increase in avoidant/withdrawal behavior the odds of having pervasive aggressive or destructive problem behavior by approximately 89%. The predictor, BDI-2 Motor domain scores, was assessed to have an associated OR of 1.05 ($p = .04$) which translates into approximately a 5.4% increase in the odds of having moderate/severe aggressive and destructive behavior for every 1 unit increase in motor skills. BDI-2 Communication domain scores was determined to have an OR of 1.047 ($p = .03$). As such, every 1 unit increase in the developmental functioning area of communication increased the odds of having significant BISCUIT-Part 3 Aggressive/Destructive scores by 4.7%. Finally, the interaction variable of age group by BISCUIT-Part 2 was found to have a significant OR for infants and toddlers 33 - 39 months of age of 1.12 ($p = .04$) for BISCUIT-Part 1 total scores. For infants and toddlers with ASD aged 33-39 months, for every 1 unit increase in core autism symptom severity the odds of significant aggressive or destructive problem behaviors increases by approximately 12%.

For the logistic regression analysis of the Stereotypic Behavior problems subscale, the following predictor variables were included: BISCUIT Part 1 total score (e.g., severity of core autistic symptoms), the interaction variable of age group by BISCUIT Part 1 total score, BISCUIT - Part 2 Tantrum/Conduct scores, BISCUIT - Part 2 Inattention/Impulsivity scores, BISCUIT - Part 2 Avoidant Behavior scores, BISCUIT -Part 2 Anxiety/Repetitive Behavior scores, BDI-2 Motor domain scores, and BDI-2 Cognition domain scores. The logistic regression model was found to be significant ($\chi^2 [11, 266] = 63.57; p < .001$) indicating that the model with the predictor variables was significantly different from the model with only the constant included. In predicting the presence of severe Stereotypic Behaviors, three predictors and one level of the interaction variable were found to have statistically significant OR. BISCUIT-Part 2 Inattentiveness/Impulsivity scores had an associated OR of 3.439 ($p = .03$). Thus, this result indicates that for every three units increase in inattentive and impulsive behavior, the odds of an infant and toddler with ASD having severe stereotypy increases by approximately 43.9%. BISCUIT-Part 2 Anxiety/Repetitive Behavior scores had an associated OR of 4.436 which is related to approximately a 43.6% increase in the odds of having severe stereotypic behaviors for every 4 units increase in anxious and repetitive behavior. BDI-2 Motor domain scores were analyzed to have an associated OR of .994 ($p = .04$). That is, having higher motor skills decreased the odds of being identified as having severe BISCUIT Part 3 Stereotypic Behaviors scores by approximately 6.0%. Finally, the interaction variable of age group by BISCUIT-Part 2 was found to have a significant OR for infants and toddlers 33-39 months of age of 1.022 ($p = .03$) for BDI-2 Communication domain scores. Therefore, for every 1 unit increase in core autism symptoms (as measured by the BISCUIT-Part 1) the odds of significant aggressive or destructive problem behaviors increases by approximately 2.2%.

For BISCUIT-Part 3 Self Injurious Behavior subscale scores, the predictors that were entered in the logistic regression analysis included BISCUIT Part 1 total score (e.g., severity of core autistic symptoms), BISCUIT-Part 2 Tantrum/Conduct scores, BISCUIT-Part 2 Inattention/Impulsivity scores, BISCUIT-Part 2 Avoidant Behavior scores, BISCUIT-Part 2 Anxiety/Repetitive Behavior scores, BDI-2 Personal-Social domain scores, BDI-2 Communication domain scores, and BDI-2 Motor domain scores. The logistic regression model was found to be significant ($\chi^2 [8, 269] = 42.13; p < .001$) indicating that the model with the predictor variables was significantly different from the model with only the constant included. In predicting the presence of severe Stereotypic Behaviors, three predictors were found to have statistically significant ORs. BISCUIT-Part 2 Tantrum/Conduct Behavior scores had an associated OR of 1.463 ($p = .01$). Thus, this result indicates that for every one unit increase in tantrums and conduct-related challenging behaviors, the odds of an infant and toddler with ASD having severe self-injurious behavior(s) increases by approximately 46.3%. BISCUIT-Part 2 Anxiety/Repetitive Behavior subscale scores yielded a significant OR of 1.697 ($p = .04$). This corresponds to a 69.7% increase in BISCUIT-Part 3 Self Injurious Behavior scores for every 1 unit increase in BISCUIT-Part 2 Anxiety/Repetitive Behavior subscale scores. Finally, the predictor BDI-2 Motor domain scores had an associated OR of .964 ($p = .02$). Thus, for every one unit increase in motor skills, an individual's odds of having clinically significant BISCUIT - Part 3 Self Injurious Behavior scores decrease by 36%.

In summary, various risk factors were found to increase the odds of having significant challenging behaviors as measured by the BISCUIT-Part 3. Measures of comorbid difficulties/psychopathology as measured by the BISCUIT Part 2 which were found to increase the odds of having significant and severe behavior problems included Inattentiveness/Impulsivity

(on Aggressive/Destructive Behavior and Stereotypical Behavior subscales of the BISCUIT-Part 3), Avoidance/Withdrawal Behavior (on Aggressive/Destructive Behavior subscale of the BISCUIT-Part 2), and Anxiety/Repetitive Behavior (on Stereotypical Behavior and Self Injurious Behavior subscales of the BISCUIT-Part 2). This likely reflects the presumed significant association between the presence of challenging behaviors and symptoms of psychopathology in those with developmental delays (Bodfish et al., 1995; Borthwick-Duffy, 1994; Emerson, 2001; Sturmey, Laud, Cooper, Matson, & Fodstad, 2010). Higher scores on domains of developmental functioning as measured by the BDI-2 were found to increase the odds of significant behavior problems included Motor domains on all three BISCUIT-Part 3 subscales, as well as the Communication domain on the Aggressive/Destructive subscale. Although this seems to be somewhat contrary to original hypotheses (i.e., lower functioning children would be more likely to engage in challenging behaviors), this may suggest that for the very young child with ASD to engage in severe challenging behaviors one must have at least a moderate ability to ambulate, interact with one's environment, and have be able to on some level communicate his/her needs. These findings with respect to the relationship between developmental functioning and challenging behaviors in this sample does mirror conclusions drawn by Emerson (2001) utilizing an adult sample with ID. The only instance where severity of autism (as measured by the BISCUIT-Part 1) was found to increase the odds of having problem behavior occurred for children with ASD 33-39 months of age.

Prediction of Continuum of Challenging Behavior - Multiple Regression. Results from the multiple regression analyses are depicted in Table 10. Again, only those predictor variables which elicited correlations significant at the $p < .10$ level with BISCUIT-Part 3 domain scores were retained for subsequent analyses. Regression models were found to be statistically

significant ($p < .001$) for each multiple regression analysis conducted. That is, knowledge of the predictor variables significantly improves our ability to predict challenging behaviors measured

Table 10
Significant standardized regression coefficients (β) for risk factors and BISCUIT Part 3 subscales for participants with ASD

	Aggressive/Destructive Behavior	Stereotypy	Self Injurious Behavior
df	(11, 266)	(7, 270)	(9, 268)
F value	19.648	15.131	8.791
p value	< .001	< .001	< .001
Adjusted R^2	.425	.263	.202
Age	.015		
Part 1	-.028	.177**	-.056
Gen			
M/P			
Tan		-.066	.382**
Imp	.350**	.253**	.111
Av	.208**	.015	.106
Anx	.127	.306**	.140*
Eat	.071	.	
Adap	-.078		
Soc	.072		.180**
Com	.107		-.038
Mot	.153*	-.139*	-.114
Cogn	-.043	.072	

⁺ $p < .01$

* $p < .05$ (two tailed)

** $p < .01$ (two tailed)

Note. Part 1 = total severity of core autism symptoms (BISCUIT-Part 1); Gen = gender, M/P = presence of a medical or physical condition, Tan = Tantrums/conduct problems (BISCUIT-Part 2), Imp = Impulsiveness/inattention (BISCUIT-Part 2), Av = Avoidance/withdrawal (BISCUIT-Part 2), Eat = Eating Problems/Sleeping (BISCUIT-Part 2), Adap = Adaptive (BDI-II), Soc = Personal/Social (BDI-II), Com = Communication (BDI-II), Mot = Motor (BDI-II), Cog = Cognitive (BDI-II)

by the BISCUIT-Part 3. The Adjusted R^2 associated with each regression model can be found at the top of the table under the corresponding BISCUIT-Part 3 subscale as well as the total score.

Regression coefficients for each predictor variable are displayed under the corresponding BISCUIT Part 3 composite or subscale columns.

For the Aggressive/Destructive Behaviors subscale, the regression model accounted for approximately 42.5% of the variance in BISCUIT-Part 3 scores. Likewise the regression models for the Stereotypic Behavior and Self Injurious Behavior subscales accounted for 26.3% and 20.2% of the variance of BISCUIT-Part 3 scores, respectively. Severity of core autism symptoms was found to have a significant *beta* value ($\beta = .177, p < .001$) only for the BISCUIT Part 3 Stereotypic Behaviors subscale. Comorbid problems were found to be significant predictors of a number of BISCUIT-Part 3 subscales. Specifically, the Tantrum/Conduct Behavior subscale was identified as a statistically significant predictor of the BISCUIT-Part 3 subscale of Self Injurious Behaviors ($\beta = .382, p < .001$). The Inattentive/Impulsive Behavior subscale of the BISCUIT-Part 2 was found to be a statistically significant predictor of the BISCUIT-Part 3 subscales of Aggressive/Destructive Behavior ($\beta = .350, p < .001$) and Stereotypic Behavior ($\beta = .253, p < .001$). The comorbid problem of Avoidant/Withdrawal Behavior was found to be a statistically significant predictor of Aggressive/Destructive Behavior ($\beta = .208, p = .001$). Finally, the BISCUIT-Part 2 subscale of Anxiety/Repetitive Behavior was found to be a statistically significant predictor of Self Injurious Behavior ($\beta = .306, p < .001$). Areas of developmental functioning, as measured by the BDI-2, which were found to be statistically significant predictors of BISCUIT-Part 3 subscales included Motor skills on Aggressive/Destructive Behavior ($\beta = .153, p = .033$) and Stereotypic Behavior ($\beta = .382, p < .001$) BISCUIT-Part 3 subscales., as well as Personal-Social skills on Self Injurious Behavior ($\beta = .180, p = .005$)

P-P and residual plots for each regression model (Appendix B) showed that the regression models appear to adhere to the assumptions of normality. Specifically, the residuals tended to be uniformly distributed (indicative of homoscedasticity) overall and the observed

versus expected residuals did not significantly depart from the regression line. Due to initial procedures to safeguard against error and overfitting of the data due to multicollinear data, multicollinearity was not a problem for these regression models as indicated by acceptable collinearity statistics.

Discussion

There is a burgeoning amount of literature which posits that those with ASD are at an increased risk for engaging in challenging behaviors, and that these behaviors appear to be detectable at earlier ages. Furthermore, it appears that this increased prevalence may be above that which is expected to occur in individuals who have general delays. Given that this appears to be the case, the purpose of this specific investigation was to determine if there are risk factors related to the specific individual (i.e., inherent characteristics) which may influence or predispose the very young child with ASD to engage in severe behavior problems. In an effort to examine potential putative factors which may increase the probability of evincing challenging behaviors, a thorough three part statistical analysis was undertaken. First, bivariate correlation analyses were conducted to look at the underlying strength of the relationship between risk factors and broad topographies of challenging behaviors. Second, logistic regression analyses were utilized to investigate factors which may increase the odds of engaging in severe challenging behaviors. Third, a series of multiple regression analyses were calculated to assess what combination of risk factors are most likely to engender a significant change in the probability of an infant or toddler engaging in various topographies of challenging behavior.

Across all of these various analyses, variables which were consistently identified as potential risk markers for the three major topographies of challenging behaviors measured by the BISCUIT-Part 3 (aggressive/destructive behaviors, self-injury, and stereotypy) included psychopathology/comorbid difficulties, developmental functioning, and severity of core autism

symptoms. As previously mentioned, research in the neurotypical and ID population provides evidence for the role of multiple factors (i.e., biological, developmental, and environmental) in the presentation of challenging behaviors (Sturmev et al., 2008; Mudford et al., 2008). In the ASD population, researchers have implicated the role of the severity of autistic symptoms in the presentation of severe challenging behavior across all age cohorts (Baghdadli et al., 2003; McClintock et al., 2003). The outcomes of this investigation, thus, lends support to the notion that more severe symptoms of autism are more likely to also evince more severe forms of challenging behaviors. For the very young child with ASD, when analyses were conducted to investigate the cumulative effect of risk factors as a group (regression analyses) instead of the effect of individual risk factors (correlation analysis), the relationship between severity of diagnostic symptoms and challenging behavior was most salient for stereotypic behavior (i.e. BISCUIT-Part 3 Stereotypic Behavior subscale). Initial hypotheses that across all of the BISCUIT-Part 3 domains more severe autism symptoms would be predictive and increase the odds of having severe challenging behaviors was unsupported based upon results using this sample. These findings may appear to be inconsequential as stereotypy is encompassed under the restricted/repetitive behavior domain of *DSM-IV-TR* criteria for an ASD diagnosis. However, these results reinforce researchers who suggest that certain stereotypical behaviors may be the first recognizable symptoms of autism in the very young child who is later diagnosed as having the more severe forms of autism (e.g. Autistic Disorder; Bodfish, 2007).

With respect to developmental functioning, there was a significant relationship between certain skills domain areas and challenging behaviors in this sample of young children with ASD. Elevated scores on the BISCUIT-Part 3 Aggressive/Destructive Behavior subscale were more likely to occur in infants and toddlers with ASD who had higher levels of developmental

functioning on the BDI-2, specifically in the areas of communication and motor skills. These findings parallel outcomes of those by Emerson (2001) using a sample of adults with ID in that those who engaged in severe aggression or destructive behaviors had overall greater functioning in areas which required skills (motor ability and communication skills) that are related to being able to aggressive/destructive behaviors. This may be related to the notion that challenging behaviors classified as being aggressive/destructive, in general, encompass either a physical (e.g., hitting, kicking, throwing objects, etc) or verbal (e.g., yelling or shouting, etc) response from the individual. While BISCUIT-Part 3 Aggressive/Destructive Behavior subscale scores appeared to be related to a higher levels of developmental functioning, Stereotypic Behavior and Self-Injurious Behavior subscales were generally found to have significant relationships with more severe delays, with this being more salient in the area of motor skills development. These results appear to support previous researchers who have suggested that severe and frequent self-injurious or stereotypic behaviors may be byproducts of deficiencies in the individual's ability to successfully interact with his/her world in an effort to communicate one's wants and needs or may serve as an intrinsically-driven response to regulate sensorimotor activity (Bodfish, 2007; Carcani-Rathwell, et al., 2006).

Amongst all of the potential risk factors, psychopathology/comorbid problems were determined to have the strongest relationships with the emergence of challenging behaviors. It is important to note that the BISCUIT-Part 2 is not a diagnostic instrument for psychopathology in this very young age cohort. Rather, the BISCUIT-Part 2 is a measure of behaviors which reflect symptoms of broad classes of mental health dysfunctions which are often reported to co-occur in individuals diagnosed as having an ASD. Regardless, findings from this study indicated that increased comorbid symptoms in the broad areas of tantrums and conduct problems,

inattentiveness and hyperactivity, avoidance, anxiety and compulsive/ritualistic behavior, eating dysfunction, and sleeping problems were related to an increased risk for having challenging behaviors. An increased proclivity to engaging in significant aggressive and destructive behavior was found to occur for infants and toddlers with ASD who higher scores in the comorbid areas of impulsivity and inattentiveness, as well as avoidance. Likewise, elevated scores on the BISCUIT-Part 2 Impulsivity/Inattentiveness and Anxiety/Repetitive Behavior subscales were significant predictors of Stereotypic Behavior. Finally, increased scores on the BISCUIT Part 3 Self Injurious Behavior subscale were best predicted by comorbid problems in the areas of Tantrum/Conduct Behaviors and Anxiety/Repetitive Behavior. These findings appear to have various implications. First, outcomes indicate that even in the very young toddler with ASD there appears to be a significant association between the presence of challenging behaviors and symptoms of psychopathology. This parallels findings from the adult ID literature (Bodfish et al., 1995; Borthwick-Duffy, 1884; Emerson, 2001). Second, challenging behaviors in the very young child with ASD may be related to poor impulse control and dysfunction in executive planning skills. Third, challenging behaviors in the very young child with ASD may also function as a basic strategy to cope with heightened levels of anxious arousal or stress until avoidance and escape is possible. These conclusions support literature that suggests individuals diagnosed as having an ASD often develop and engage in obsessions and/or compulsions, anxieties, phobias, hyperactivity, attention problems, rumination, tics, and mood lability (Lecavalier, Gadow, DeVincent, & Edwards, 2009; Leyfer et al., 2006; Matson & Neal, 2009). Furthermore, psychiatric disorders which are commonly diagnosed in tandem to ASD are Social Anxiety, Specific Phobias, Obsessive Compulsive Disorder, and Attention Deficit/Hyperactivity Disorder (Matson & Nebel-Schwalm, 2007; Steyn & Le Couteur, 2003). Thus, it appears that

this relationship between executive planning, complex information processing, and impulse control in those with ASD may be detectable in very young children (Fodstad, Rojahn, Matson, 2010).

Gender and presence of a medical or physical diagnosis were not found to be significant putative risk factors for significant challenging behaviors in this sample of infants and toddlers with ASD. The initial hypothesis that gender would not pose a significant risk for severe behavior problems was supported. This result corroborates findings from previous researchers who have found that no significant differences between genders occur in those with ASD, ID, or general delays in relation to challenging behaviors (Holden & Gitlesen, 2006; Kozlowski & Matson, 2011; Lowe et al., 2007; McClintock et al., 2003; Rivet & Matson, 2010). It is unexpected, however, that the presence of a medical or physical/genetic condition diagnosis was not found to be a significant risk factor for challenging behaviors in young children with ASD. Researchers have implicated certain medical conditions such as congenital blindness, epilepsy, and deafness as being risk factors for challenging behaviors (Maisto et al., 1978; Emerson et al., 2001; Kiernan & Kiernan, 1994). Furthermore, specific genetic syndromes have also been found to be associated with certain aberrant behaviors including Rett syndrome, Smith Magenis syndrome, Prader-Willi syndrome, Cornelia de Lang syndrome, and Fragile X (Oliver et al., 1993; Dykens & Smith, 1998; Symons et al., 1999; Hyman et al., 2002; Symons et al., 2003). A visual inspection of the data (ref Table 6) reveals that the percentage of participants endorsing the aforementioned medical or physical/genetic conditions was low. As such, it is possible that medical or physical/genetic conditions do increase the probability of evincing challenging behaviors, but an adequate representation of individuals endorsing these concerns was not able to be collected. Also, given the early ages of this sample, there is a possibility that these conditions

may not have been diagnosed at the time of data collection. Additional research should be conducted to further deduce the contribution of certain medical, physical, or genetic conditions on challenging behaviors in individuals diagnosed with ASD.

Although this is one of the first studies to explore potential risk factors for challenging behaviors in infants and toddlers with ASD, several limitations exist in the present study which should be considered when interpreting the results. First, the sample consisted of children drawn from a statewide early intervention program that offers free services to children diagnosed as having developmental delays and their families. As discussed in Study 1, it is highly probable that there may be some effects of services rendered to the clients prior to data collection (i.e., lessening of presenting symptoms). However, due to the likelihood that there was no uniform distribution of the type or intensity of services rendered amongst clients nor was there equality in the investment of the individual's family in implementing recommended strategies in the home setting, any confounding effects engendered by EarlySteps services on problem behaviors across the sample would be negligible.

Second, regression analyses were only conducted on infants and toddlers with ASD. As such, there is no true control group by which to compare and contrast the results against. This could be construed as an egregious error on the part of the experimenter. However, it was felt that due to this study being one of the first to investigate potential risk factors for challenging in the very young child with ASD, this study would be best served to be an exploratory and preliminary model building investigation. The main purpose of this study, then, as a predictive analysis rather than a confirmatory or comparative analysis allows for restricting the sample to a single diagnostic group (Tabachnik & Fidell, 2007).

Third, by virtue of the available database, investigating potential risk factors for challenging behaviors was limited to the use of the only one measure each for severity of autism (BISCUIT-Part 1), psychopathology/comorbid difficulties (BISCUIT-Part 2), developmental functioning (BDI-2), and challenging behavior (BISCUIT-Part 3). It is likely that there may be facets of these specific categories which may have not been fully captured by utilizing only one measure. Due to the fact that the BISCUIT battery of assessments were created for infants and toddlers with ASD exclusively (Matson, Boisjoli, et al., 2007; Matson, Boisjoli, et al., 2009; Matson, Wilkins, Sevin et al., 2009), and have been found to be reliable and valid measures it appears that the measures utilized are sufficient for the current study. Various developmental domains on the BDI-2 may not be truly compatible with the desired putative risk factor, specifically the Cognition domain and intellectual functioning. It is important to note that IQ is notoriously unstable this relatively young age and thus estimating the intellectual functioning of participants at this time may not be predictive of later assessments. The BDI-2 Cognition domain is, therefore, a crude estimate of cognitive functioning of the very young child based upon progression across various developmental milestones which are indicative of skills that are indicative of or related to executive functioning and planning. Related to the restrictive nature of the database, only potential risk factors which were inherent to the child with ASD were able to be investigated. Other putative as well as protective risk factors for the severity of challenging behaviors in individuals diagnosed with ASD, ID, or general developmental delays have been proposed in the literature such as social economic status, intense behavioral therapy, psychotropic medication management, family support and/or level of stress, specific genetic conditions (e.g., Lesch-Nyhan, Prader Willi, etc.), and neurotransmitter dysfunction. Although the selection of risk factors investigated were based upon a convenience sample, the

risk factors chosen for analysis were personal characteristics of the individual which, in theory, were unalterable by others and those which have the most support in the literature to date.

Despite the aforementioned limitations, the present study has many important implications. Outcomes of this investigation indicate that there are unique personal factors which appear to increase the probability that a young child with ASD will engage in significant challenging behaviors. As such, knowing that a child has a diagnosis of an ASD does not necessarily mean that he or she will engage in severe challenging behaviors. Rather, this study suggests that broad topographies of challenging behavior (i.e., aggression, SIB, and stereotypies) are multi-determined. Knowing that risk factors including severe core ASD symptoms, a higher degree of comorbid problems in the area of conduct problems, anxiety, and avoidant behavior, as well as specific areas of developmental functioning (i.e., motor skills, communication skills) increase the likelihood of the presence of challenging behaviors can assist with earlier intervention, treatment planning, and protective strategies. Researchers have established that the earlier intensive intervention services can be implemented for children with ASD, the better the long term prognosis becomes. Therefore, any additional information which will assist with service provision will increase the probability of the best possible outcome for children with ASD and their families.

GENERAL DISCUSSION

It has been established that there is something unique about those with ASD which lends itself to a heightened probability of the occurrence of significant challenging behaviors. Persons with ASD and DD, in general, are known to engage in aberrant forms of behaviors which impact their quality of life and hinder their ability to achieve independence across educational, vocational, and social settings (McClintock et al., 2003; Sturmey et al., 2008). Although there is a growing base of literature regarding the relationship between challenging behavior and ASD, very little is known about the early stages of behaviors such as aggression, SIB, and stereotypical behaviors in young children with developmental disabilities. Less is known about these difficulties in the young child with ASD. Preliminary data dictates that not only do challenging behaviors exist in the infant or toddler diagnosed with ASD, but that these behaviors occur at levels beyond that of infants and toddlers who are typically developing or have non-ASD delays (Kozlowski & Matson, 2010). It has also been suggested that infants and toddlers with ASD may have different patterns with respect to the emergence in challenging behaviors from typically and developing infants (Cunningham & Schreibman, 2008; Dominick et al., 2007) while there is meager data comparing those with ASD to those with general developmental delays.

To assist in advancing knowledge about challenging behaviors in the young child with ASD, the purpose of this investigation was to establish specific trends in the emergence of aggressive/destructive behavior, stereotypies, and SIB in infants and toddlers with ASD. In Study 1 it was found that children with ASD do have a unique pattern of problem behaviors which emerge early in life and continue to progress throughout the infant and toddler years. This heightened risk for problem behaviors in young children with ASD was found to be over and

beyond that those with non-ASD general delays. Results from Study 2 were able assist in identifying potential risk markers for challenging behaviors with the most salient being psychopathology or comorbid problems. Severity of autism symptoms as well as developmental functioning was also found to be significant predictors of challenging behaviors. Evidence from early intervention studies has yielded promising outcomes (Zachor et al., 2007). However, the applicability of early intervention techniques for decreasing challenging behaviors is largely unknown. The results of this investigation assist in clarifying the pattern with which challenging behaviors emerge in children with ASD. There is no doubt that further investigation of both the clinical phenomenology as well as etiological underpinnings of ASD is of utmost importance. As such, these findings can initiate further investigations into putative as well as protective risk factors for these behaviors in an effort to enable practitioners to be more adept at identifying and assessing the severity of these acts at an earlier age, results in earlier intervention.

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APPENDIX A

BISCUIT-PART 3 SUBSCALES AND ITEMS

BISCUIT-Part 3 Subscales and Items
<u>Aggressive/Destructive Behaviors</u> Kicking Objects Removal of clothing at inappropriate times Playing with own saliva Throwing objects at others Banging on objects with hands Leaving the supervision of caregiver without permission Aggression toward others Pulling others' hair Yelling or shouting at others Property destruction
<u>Stereotypic Behaviors</u> Unusual play with objects Repeated and unusual vocalizations Repeated and unusual body movements
<u>Self Injurious Behaviors</u> Poking him/herself in the eye Harming self by hitting, pinching, scratching, etc.

APPENDIX B

BISCUIT-PART 3 NORMATIVE CUTOFFS

	No/Minimal Impairment	Moderate Impairment	Severe Impairment
Aggressive/Destructive Behavior	0-9	10-13	14 and up
Stereotypies	0-3	-	4 and up
SIB	0-1	2	3 and up
Total Problem Behavior	0-12	13-18	19 and up

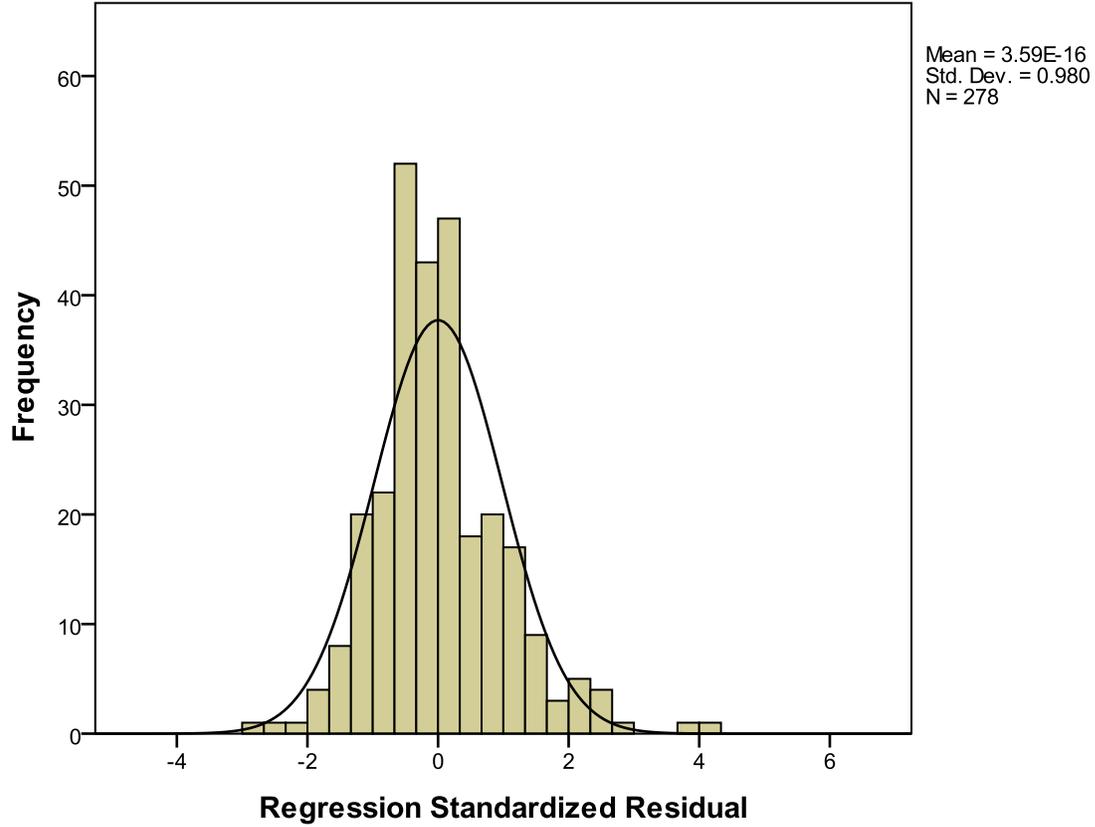
Note: This table was reproduced with permission by the authors. For subsequent information refer to the original article: Rojahn, J., Matson, J.L., Mahan, S., Fodstad, J.C., Knight, C., Sevin, J.A. et al. (2009). Cutoffs, norms, and patterns of problem behaviors in children with an ASD on the Baby and Infant Screen for Children with aUtism Traits (BISCUIT-Part 3). *Research in Autism Spectrum Disorders*, 3, 989-998.

APPENDIX C

BISCUIT-PART 3 MULTIVARIATE REGRESSION P-P AND RESIDUAL PLOTS

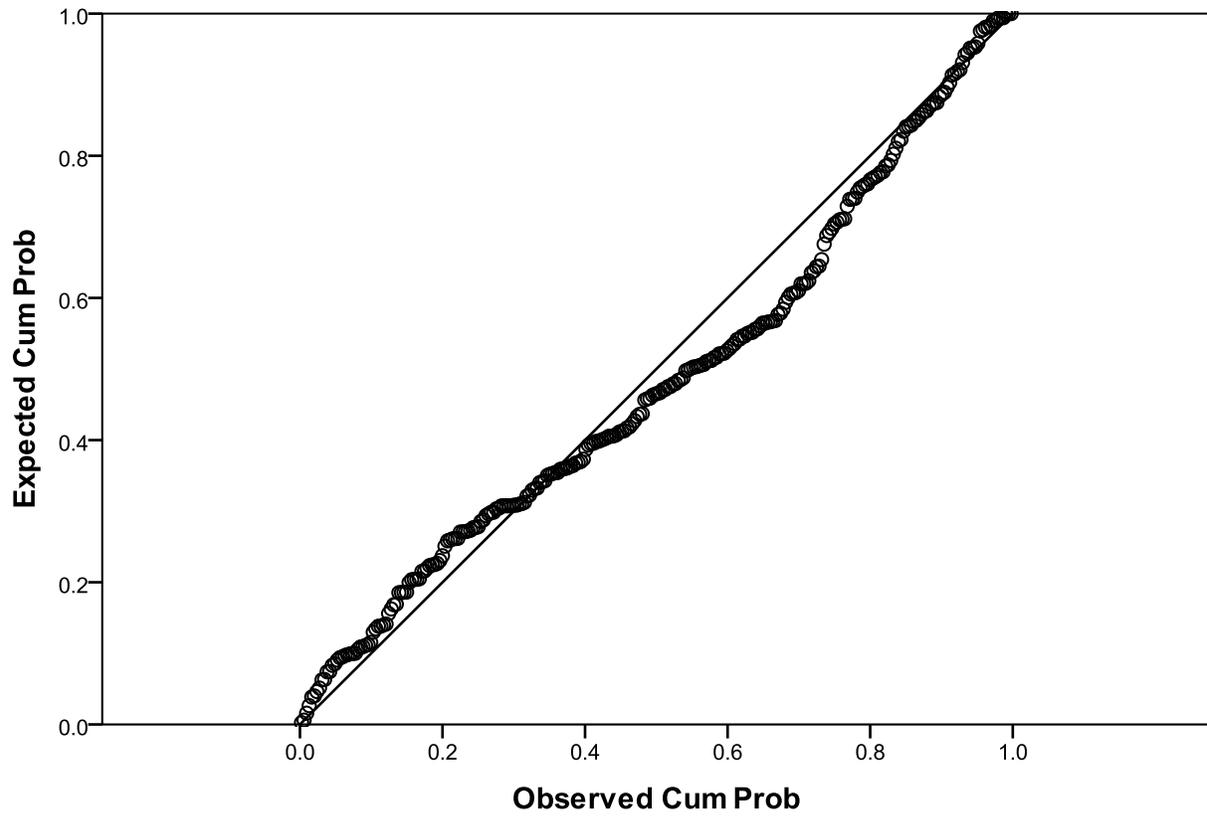
Histogram

Dependent Variable: Aggressive/Destructive Behavior



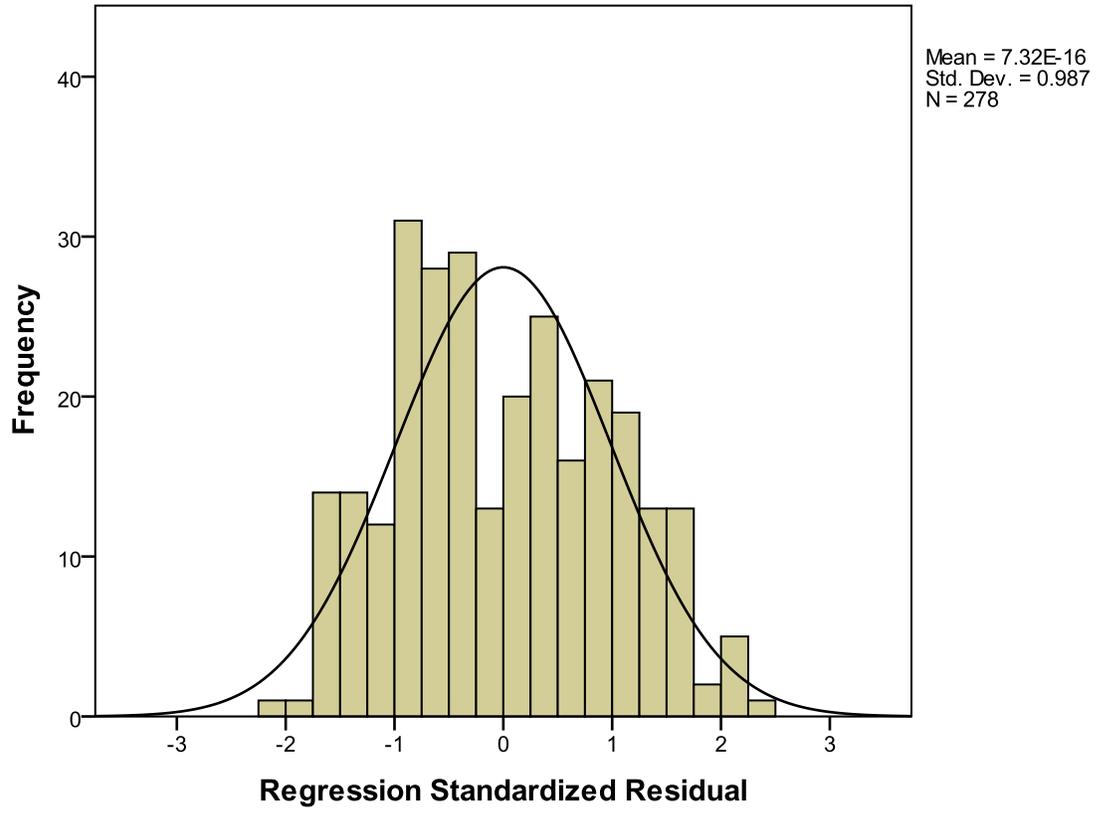
Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Aggressive/Destructive Behavior



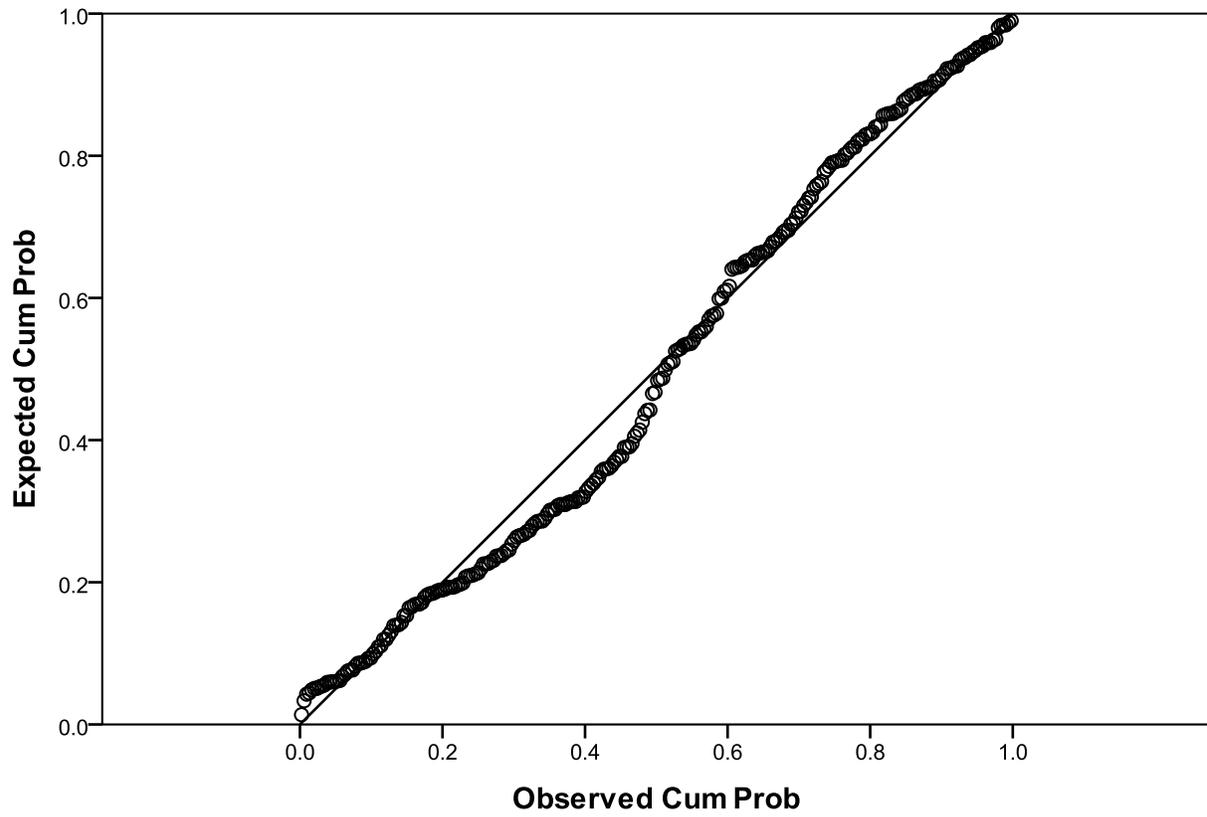
Histogram

Dependent Variable: Stereotypic Behavior



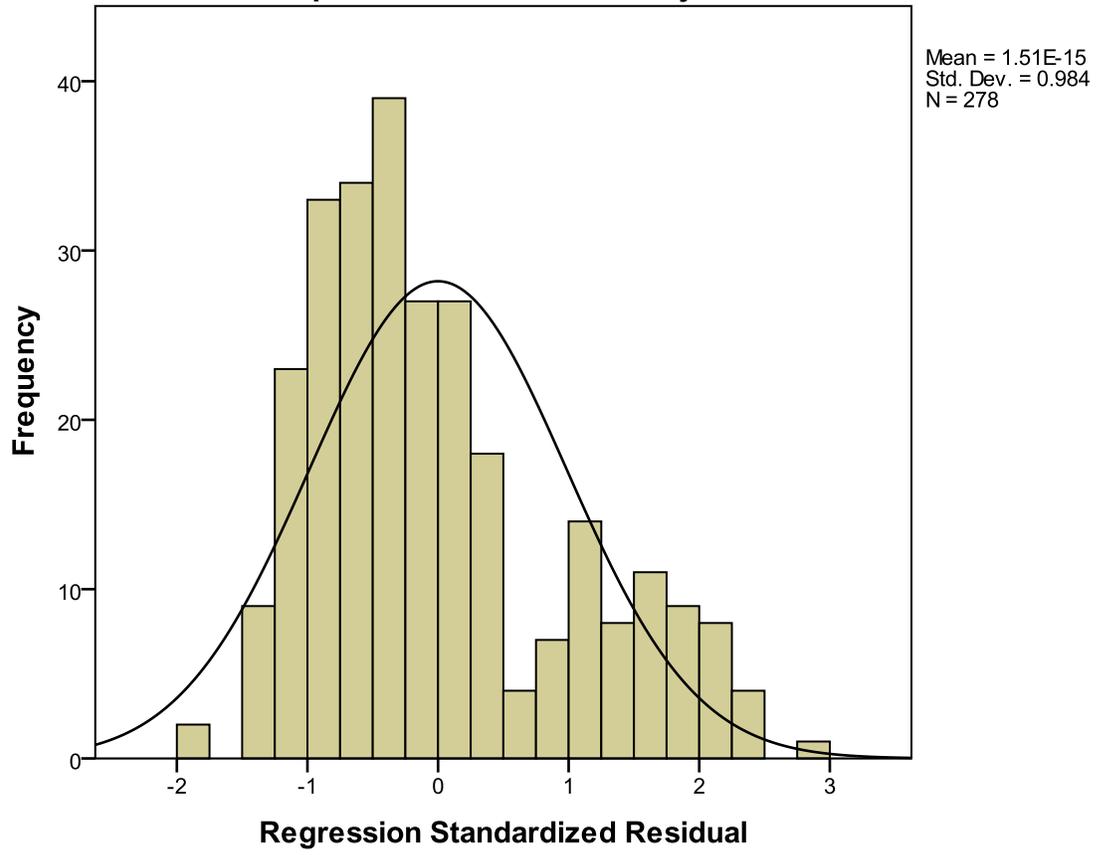
Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Stereotypic Behavior



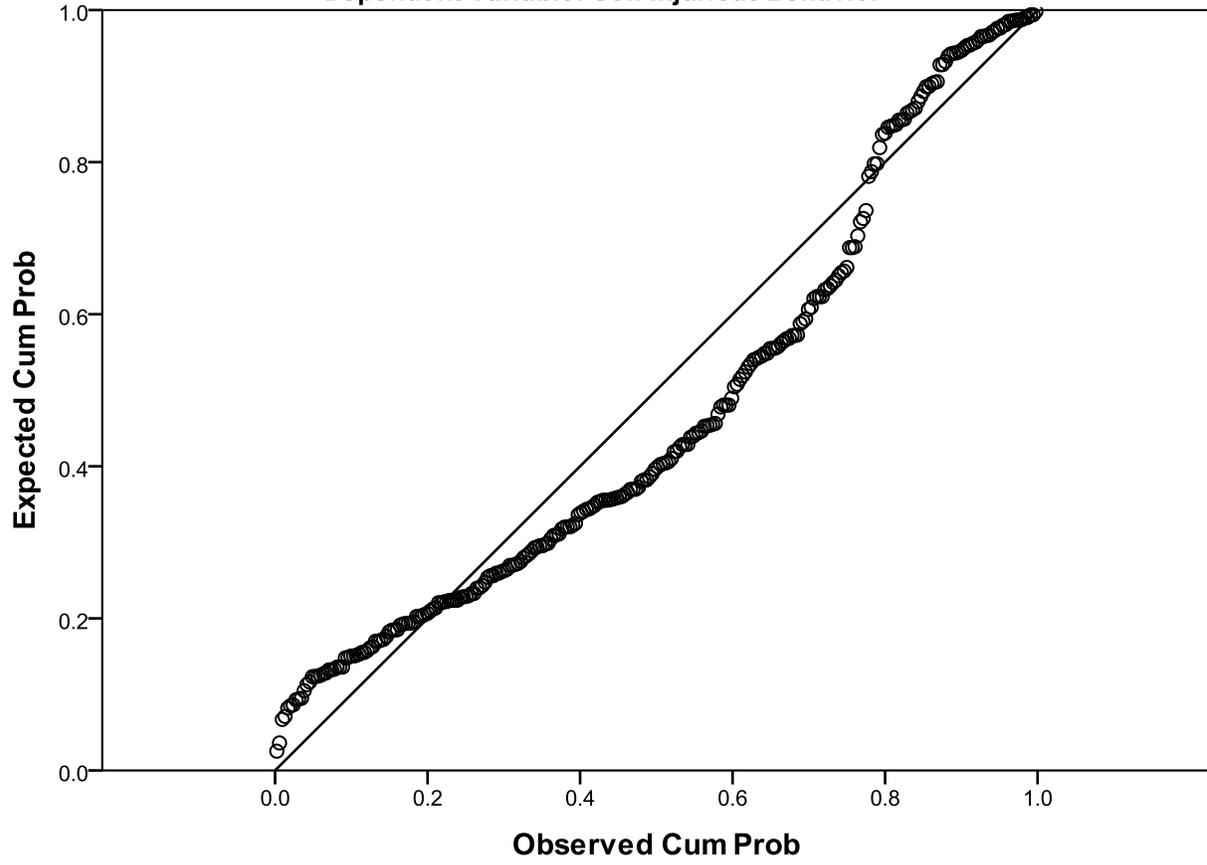
Histogram

Dependent Variable: Self Injurious Behavior



Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Self Injurious Behavior



VITA

Jill Fodstad was born in April 1982 in Gainesville, Georgia. She earned her Bachelor of Science degree in applied psychology and graduated *cum laude* in May 2004 from Georgia Institute of Technology in Atlanta, Georgia. She enrolled in the clinical psychology graduate program at Louisiana State University in August of 2006. Her research and clinical training focused on the assessment and treatment of individuals with intellectual disabilities, autism spectrum disorders, and dual diagnoses. She completed her master's thesis entitled *A Comparison of Feeding and Mealtime Behavior Problems in Intellectually Disabled Adults with and without Autism* and received her Master of Arts degree in 2008. She completed her pre-doctoral internship at the Kennedy Krieger Institute and Johns Hopkins Medical School in Baltimore, Maryland. While training at Kennedy Krieger, she further developed her clinical skills and knowledge of applied behavior analysis while working at the Neurobehavioral Unit-Outpatient Clinic and the Pediatric Developmental Disorders Clinic. Presently, she is completing a post-doctoral fellowship in applied behavior analysis, severe behavior disorders, and developmental disabilities at the Kennedy Krieger Institute and Johns Hopkins Medical School in Baltimore, Maryland. She will receive the degree of Doctor of Philosophy in August 2011.