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Exploratory and confirmatory factor analyses of the symptom structure for autism spectrum disorders using the baby and the infant screen for children with autism traits

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EXPLORATORY AND CONFIRMATORY FACTOR ANALYSES OF THE SYMPTOM STRUCTURE FOR AUTISM SPECTRUM DISORDERS USING THE BABY AND INFANT SCREEN FOR CHILDREN WITH AUTISM TRAITS

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Table of Contents

Abstract

Since autism spectrum disorders (ASD) were first identified, the diagnostic criteria and conceptualization of symptom structure have undergone many revisions. Currently, under the *Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition-Text Revision* (*DSM-IV-TR;* American Psychiatric Association (APA), 2000), ASD is defined by three symptom categories: impairments in socialization, deficits in communication, and repetitive/restricted behaviors. With the publication of the *DSM-5* (APA, 2011), however, ASD will be defined by a two symptom cluster structure in which the main impairments are in the areas of social communication and restricted/repetitive behaviors. With these changes, many assessment measures will need to be re-examined to ensure they align with the new diagnostic criteria. As such, the purpose of the current study was to examine the structure of the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT), a measure used to screen and diagnose ASD in children aged 17 to 37 months. For the first part of the study, an exploratory factor analysis (EFA) was conducted to replicate findings from a previous EFA study on the BISCUIT. The results of the current EFA were largely comparable to the previous findings. The results of the EFA were then used to assist in conducting more theory driven confirmatory factor analyses. These confirmatory analyses examined a two and three factor structure for the BISCUIT separately, and then also directly compared the two models. Measures of model fit supported both the two and three factor models relatively well. When directly compared, the three factor (*DSM-IV-TR*) model was found to be preferred over the two factor (*DSM-5*) model, though this finding should be interpreted with some caution. The implications of these findings are discussed in terms of impact on the BISCUIT and changes to be expected with the new *DSM-5*.

Introduction

Autism spectrum disorders (ASD) are a set of neurodevelopmental disorders currently defined by impairments in the core symptom areas of socialization, communication, and repetitive/restricted behaviors (Cederlund, Hagberg, & Gillberg, 2010; Charman et al., 1997; Honey, Leekam, Turner, & McConachie, 2007; Matson, Boisjoli, Hess, & Wilkins, 2010; Matson, Wilkins, & Fodstad, 2010). These three symptom domains are consistent with the current diagnostic system, the *Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition-Text Revision* (*DSM-IV-TR;* American Psychiatric Association (APA), 2000). The *DSM-IV-TR* defines five different disorders under ASD, including Autistic Disorder (AD), Asperger's Syndrome (AS), Rett's Disorder, Childhood Disintegrative Disorder, and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). In the upcoming months, however, the *DSM-5* will be released (APA, 2011). As one of the new revisions, ASD will no longer be defined by three symptom clusters but instead by two clusters: impairments in social communication and restricted/repetitive behaviors. The change in the number of symptom clusters is largely due to research supporting the close overlap and indivisibility of social and communication domains (Carpenter, Nagell, & Tomasello, 1998; Dube, MacDonald, Mansfield, Holcomb, & Ahern, 2004), as well as consensus among experts in the field who serve on the *DSM-5* planning committees. In addition, the previous five diagnostic categories will all be subsumed under one diagnosis of Autism Spectrum Disorder, with the exception of Rett's Disorder, which will no longer be included in this category. The current study focused on the change from three to two symptom clusters.

In anticipation of upcoming *DSM* changes, adapting current assessment measures accordingly would be beneficial. Many of the current measures follow a three factor model

consistent with the current diagnostic framework. One such measure used for the screening and assessment of ASD in infants and toddlers is the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT; Matson, Boisjoli, & Wilkins, 2007). A previous exploratory factor analysis (EFA) has revealed a three factor structure (Matson, Boisfoli, Hess, & Wilkins, 2010); however, the BISCUIT could have increased utility if it reflected the changes in the *DSM-5*. One way to examine the applicability of the BICSUIT to the new two factor model would be to use confirmatory, theory driven methods of factor analysis. Therefore, the purpose of the current study was to first re-analyze the factor structure of the BISCUIT using exploratory methods. The second and main purpose of this study was to conduct confirmatory factor analyses (CFA) using the BISCUIT to examine whether the proposed two factor model or the current three factor model was more appropriate in describing the structure of ASD in the current sample. First, CFAs were completed on the two and three factor models independently to determine their fit to the BISCUIT, and then these models were directly compared to determine if one was superior. Examining the factor structure of the BISCUIT will ensure it remains a relevant and appropriate measure with the new diagnostic framework.

Early History of Autism

In 1943, Leo Kanner reported on his observations of 11 children in the article "Autistic Disturbances of Affective Contact." Here, he described that these children shared similar characteristics including the main feature of a detachment from the social world with a lack of social motivation. A variety of other characteristics were also noted, including sensitivity to stimuli in the environment and problems in communication. At the time, the behaviors exhibited from these children were not characteristic of any other recognized psychiatric disorder, and Kanner referred to this phenomenon as "autism."

The main characteristic observed among Kanner's sample was a lack of emotional and affective responsiveness to others. For example, the children were noted to be "happiest when left alone," "in a shell," "acting if people weren't there," and "almost hypnotized." Furthermore, Kanner observed that abnormalities in these children were evident from an early age. One of the first abnormalities noted was a lack of anticipatory posture in preparation of being picked up. Other atypical behaviors, such as preferring objects to people, continued to manifest later in development. The behaviors observed by Kanner were significantly different than those of typically developing children who would seek out and prefer to be around other people.

Another of the main differences about the children Kanner studied was the lack of or impairment in communication, specifically verbal language. Of the 11 children Kanner observed, three exhibited no verbal language, and eight had a lack of functional speech. In those lacking functional speech, other language idiosyncrasies were noted. For example, some children had the ability to articulate well or recite memorized phrases but lacked simple skills like understanding the meaning and use of "yes" or "no."

Kanner also noted other abnormal behaviors in these children, including an instance on sameness, stereotypic behavior, and sensitivity to some stimuli. For example, insistence on sameness was evident through resistance to changes in routine. Some children engaged in stereotypic behaviors, such as rhythmic body movements and repetitive hand movements. Finally, some children displayed increased or decreased sensitivity to stimuli, such as becoming extremely distressed in response to loud noises (e.g., a vacuum).

While impairments in social behavior and communication as well as the presence of abnormal behaviors were noted, Kanner highlighted some other characteristics among the children. Kanner noted that while some of the children seemed to exhibit cognitive deficits, not

all of the children seemed to be impaired in this area; some seemed to be typical intellectually. Additionally, the children appeared physically normal compared to peers with few physical abnormalities observed, such as slightly larger head circumference. In terms of motor skills, the children displayed strengths in fine motor tasks compared to gross motor tasks. Finally, Kanner reported that the children generally came from families with higher intellect professions, such as doctors and lawyers, which he believed led to parents having fewer warm interactions with their children. While this ended up being an inaccurate conclusion by Kanner, this notion led to the false belief that parents were to blame for their child's impairments for many years.

Unfortunately, while Kanner was using the term autism to describe his sample of children, Eugene Bleuler (1913) was using autism to refer to the "idiosyncratic self-thinking" exhibited by people with delusions as a part of schizophrenia. The dual use of the term caused much confusion in the field. For example, Creak (1961) described "childhood schizophrenia" by listing the following nine criteria: abnormalities in social relationships, resistance to change, captivation by parts of objects, unusual body movements and postures, abnormal reactions to tactile input, intellectual disability, lack of speech or loss of the use of speech, and oddities in the use of speech. Clearly, these map onto Kanner's autism and not schizophrenia.

In the following years, the use of the term "autism" in both areas continued and led to debate as to whether Kanner's autism was somehow connected to schizophrenia. As a result, researchers examined the differences between autism and schizophrenia. Eisenberg (1956) conducted some of these early studies and found that autism lacked the presence of psychosis, which is one of the core features in schizophrenia, while the main feature in autism was the desire to be alone and instill consistency in the environment. Rutter (1968) helped to further distinguish between the two disorders. According to his findings, Kanner's autism had an onset

within early infancy, while schizophrenia did not typically develop until adolescence. In addition, autism affected more males than females, and schizophrenia had an equal gender ratio. Parents of children with autism were also typically in a higher social class than parents of people with schizophrenia. Lastly, supporting the differentiation between the two disorders was the finding that having a family history of autism did not increase the likelihood of having schizophrenia.

Around the same time that Kanner was disseminating the first information on autism, Hans Asperger (1944) was studying a similar group of children. The four children studied by Asperger were similar in the social impairments and abnormal behaviors noted by Kanner, but Asperger's sample did not exhibit any cognitive or language impairments. The disorder known as Asperger's Syndrome went on to describe these children. While Kanner and Asperger made similar discoveries around the same time, because Asperger wrote his original article in German, the article did not become well known until it was translated into English in 1991.

Kanner and Asperger were two of the main people credited with recognizing autism and its related disorders; however, Michael Rutter was largely influential in forming a diagnostic framework for these disorders. The criteria laid out by Rutter were as follows: "a profound and general failure to develop social relationships," "language retardation with impaired comprehension, echolalia, and pronominal reversal," and "ritualistic of compulsive phenomena" that were present prior to 30 months of age (Rutter, 1978). These criteria are still the three basic areas used to classify children with autism today in the *DSM-IV-TR (*APA, 2000). In addition to Rutter, Wing and Gould (Gould, 1982; Wing, 1981; Wing & Gould, 1979) disseminated the idea that autism was best represented by a triad of impairments in the areas of social communication, socialization interaction, and social imagination. This triad has been accepted by many

researchers and clinicians, but like Rutter's diagnostic framework it is being challenged by new theories in how to classify autism, which are discussed below.

Development of *DSM* Criteria for ASD

Having discussed the early history of autism, the progression of the classification of ASD over the years is reviewed below to show the progression of its conceptualization and how it relates to upcoming changes in criteria. There are two widely used classification systems for mental disorders: the APA's *DSM-IV-TR* and the World Health Organization's *International Classification of Diseases-Tenth Edition (ICD-10;* WHO, 1992*).* Because the *DSM-IV-TR* is more widely used in the United States, this reference is used when discussing diagnostic criteria.

***DSM-III*.** While autism was first described in the 1940s, it was not until 1980 in the *DSM-III* (1980) that the symptoms of autism were introduced as a diagnosable disorder. The diagnostic category was called Pervasive Developmental Disorder (PDD) and included five different disorders: Infantile Autism, Residual Infantile Autism, Childhood Onset Pervasive Developmental Disorder (COPDD), Residual COPDD, and Atypical Autism (Volkmar & Klin, 2005). Previous to the inception of this category, children with autistic symptoms would have been classified under childhood schizophrenia, which was problematic due to the continuing confusion between the two disorders. The main symptoms of PDD were problems in interpersonal relationships, impairments in communication, and bizarre responses to the environment, with an onset of symptoms before the age of 30 months. The diagnosis of COPDD was introduced to describe children who did not exhibit symptoms until after 30 months of age. Residual Autism was used to describe children who had once exhibited autistic symptoms but had since "outgrown" them. Based on what is believed about autism currently, this diagnosis is not appropriate since autism is conceptualized as a life-long disorder in which symptoms do not

typically remit. The debate of if and how age of onset of symptoms should be used in determining a diagnosis continues today. Using an age criterion has been noted as a weakness due to there often being a difference between age of onset of symptoms and age of recognition of symptoms (Volkmar, Stier, & Cohen, 1985).

DSM-III-R. While the *DSM-III* (1980) was somewhat nondescript in its definition of PDD, the *DSM-III-Revised* (1987) broadened its definition, but operationalized more specific criteria. This broadening resulted in a larger number of children being diagnosed even though the individual criteria were more well-defined. The new diagnosis of AD listed 16 criteria and eight were needed for a diagnosis with an onset in infancy or early childhood. COPDD and Residual Autism were removed, but the diagnosis of PDD-NOS was added to account for children who did not fit neatly into the criteria for AD. The exclusion of a dual diagnosis of autism and schizophrenia was removed, which was present in the previous *DSM-III*.

DSM-IV* and *DSM-IV-TR. After examining the accuracy of the previous versions of the *DSM* and *ICD-10* (WHO, 1992), the *DSM-IV* (APA; 1994) once again narrowed its criteria leading to corresponding changes in prevalence. Age of onset was once again introduced as a criterion and three other disorders were added under the heading of PDD: Rett's Disorder, Childhood Disintegrative Disorder, and AS. These changes were in an effort to make the *DSM-IV* mirror the structure of the *ICD-10* (Volkmar, Klin, & Cohen, 1997). Field trials for the *DSM-IV* showed that these disorders could be reliably distinguished, with inter-rater reliability of k = .85, and this system was better at classifying children than the *DSM-III* (Volkmar et al., 1997). While the most recent version of the *DSM*, the *DSM-Fourth Edition-Text Revision* (*DSM-IV-TR)*, was released in 2000, there were no significant changes to note in regard to PDD criteria and

disorders. The specific diagnostic criteria for some of the current PDD diagnoses are reviewed later.

DSM-5. Currently, the *DSM-5*, to be published by the APA in 2013, is being developed and introduces some changes to the diagnoses and criteria for PDD disorders. The APA website highlights some of these proposed changes (APA, 2011). The name of this class of disorders will be referred to as Autism Spectrum Disorder as opposed to PDD and will be found with other neurodevelopmental disorders, such as Attention Deficit/Hyperactivity Disorder (ADHD) and Learning Disorders. In the *DSM-5*, AD, AS, Childhood Disintegrative Disorder, and PDD-NOS will all be subsumed under this broader category of ASD, eliminating individual labels for the disorders. Rett's syndrome will no longer be included under ASD.

The reasoning behind this dimensional rather than categorical view of ASD is based on several findings. First, researchers have shown that general ASD symptoms are differentiated from other, non-spectrum disorders with high reliability, but the reliability of differentiating among disorders on the spectrum (e.g., high functioning autism versus AS) is significantly lower (Ghaziuddin & Mountain-Kimchi, 1994; Manjiviona & Prior, 1995; Volkmar, State, & Klin, 2009**)**. Additionally, some researchers have pointed out minimal differences for etiology and treatment outcomes among some current ASD disorders, such as high-functioning autism and AS (Howlin, 2003). Furthermore, for some individuals, the most appropriate diagnosis may change throughout a person's lifetime (LeBlanc, Riley, & Goldsmith, 2008). For example, as a child, Kanner's autism may be the most appropriate diagnosis, but in adolescence the child may show more symptoms typical of AS. Finally, the developers of the new *DSM-5* argue that autism "defined by a common set of behaviors is best represented as a single diagnostic category that is adapted to the individual's clinical presentation by inclusion of clinical specifiers (e.g., severity,

verbal abilities and others) and associated features (e.g., known genetic disorders, epilepsy, intellectual disability and others" (APA, 2011). That is to say that while the disorders on the spectrum vary in severity, they share the same core criteria, and it is more of the associated behaviors and characteristics that differentiate the disorders (Matson & Minshawi, 2006; Nebel-Schwalm & Matson, 2008; Eisenmajer et al., 1996; Allen et al., 2001). The proposed *DSM-5* definition of ASD and the current *DSM-IV-TR* diagnostic criteria are reviewed below in detail.

Present and Future Diagnostic Criteria

Current *DSM-IV-TR*. Below, diagnostic criteria for AD, AS, and PDD-NOS are reviewed. As the current study is concerned with the structure of ASD, the specific behaviors in each symptom cluster are detailed. This will highlight changes to be made between the current and upcoming versions of the *DSM*.

***Autistic Disorder (AD)*.** In order to warrant a diagnosis of AD, a child needs to exhibit impairments in the three main symptom areas: communication, socialization, and abnormal behavior. A total of six symptoms need to be present with at least two of these symptoms falling under the socialization domain and one in each of the other areas. The *DSM-IV-TR* also specifies that onset of symptoms needs to be noted by the age of three years.

In each of the domains of the *DSM-IV-TR*, symptoms are described that highlight what impairments in these areas may look like in a child. For socialization, these impairments are defined as (1) marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction, (2) failure to develop peer relationships appropriate to developmental level, (3) a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people, or (4) a lack of social emotional reciprocity (APA, 2000, p. 75). Communication impairments are described as (1) a delay in, or

total lack of, the development of spoken language, (2) in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others, (3) stereotyped and repetitive use of language or idiosyncratic language, or (4) lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level (APA, 2000, p. 75). Finally, the *DSM-IV-TR* operationalized repetitive and/or restricted behavior as (1) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus, (2) apparently inflexible adherence to specific, nonfunctional routines or rituals, (3) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole body movements), or (4) persistent preoccupation with parts of objects (APA, 2000, p. 75).

Asperger's Syndrome (AS). The diagnostic criteria for AS differ from the criteria for AD in several ways. First, no significant delay in communication can be present in AS, only social and behavior impairments. Typical language development is defined as single words used by age two years and communicative phrases used by age three years. Two symptoms in the social domain and one in the repetitive/restricted domain are still required. In addition, while not a criterion for AD, individuals with AS cannot have impairments in cognitive ability or adaptive skills.

Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). The final PDD diagnosis to be discussed here is PDD-NOS, the most commonly diagnosed PDD (Chakrabarti & Fombonne, 2001). Like many of the other diagnostic classes in the *DSM-IV-TR*, this category is meant to account for individuals who do not fit neatly in other diagnoses but still exhibit symptoms consistent with the class of disorders. Unfortunately, the criteria for this disorder are vague and somewhat subjective; there are no cutoff points for what should be

considered AD or AS versus PDD-NOS. As a result, PDD-NOS is often defined as what it is not (Matson & Boisjoli, 2007). That is, the symptoms exhibited by the child do not meet criteria for AD or AS but are still autistic-like, so PDD-NOS is diagnosed. Willemson-Swinkels and Buitellar (2002) highlighted four instances in which a diagnosis of PDD-NOS would be warranted: (1) onset of symptoms occurs after the age of three years, (2) atypical symptoms that fall outside of the main criteria for autism are exhibited, (3) symptoms are not of a high enough severity, or (4) the pattern of symptoms (i.e., less than two social impairments or no communication impairment or behavioral impairment) do not meet for another ASD.

Proposed *DSM-5*. While the *DSM-IV-TR* outlines five different disorders, the new *DSM-5* (APA, 2011) is proposing to only have one disorder called Autism Spectrum Disorder with two symptom categories: impairments in social communication and social interaction, and restricted, repetitive patterns of behavior. Each of the symptom clusters are reviewed below by outlining the new criteria as well as some of the literature surrounding the symptoms. Additionally, while the *DSM-IV-TR* specified that these symptoms must be present by age three years, the *DSM-5* only dictates that symptoms be present in early childhood. The proposed change suggests that while onset is in early childhood the appearance of interfering problems might vary depending on when social and environmental demands exceed the child's capabilities. One last change in the proposed criteria is the use of a severity rating based on a three point scale, with 1 meaning "requiring support," 2 meaning "requiring substantial support," and 3 meaning "requiring very substantial support." According to the APA website, a severity rating system will be used to help describe the specific case presentation (APA, 2011). These ratings would be given in both of the two symptom areas.

Social Communication Symptoms. Based on the proposed *DSM-5* criteria, individuals will need to exhibit all three of the symptoms outlined in the social communication domain. These behaviors are (1) impairments in social-emotional reciprocity, (2) deficits in nonverbal communicative behaviors used for social interaction, and (3) problems with developing and maintaining relationships, appropriate to developmental level. Within each of these items, several examples and ranges of behaviors for what would be considered abnormal are outlined. The collapse of communication, specifically nonverbal communication, and socialization is based on findings in the literature suggesting a large overlap between these areas that leads to difficulty distinguishing if behavioral difficulties are related to communication solely, socialization solely, or more likely than not, an interaction between the two areas (Carpenter et al., 1998). Additionally, a thorough review of factor analyses supporting the combination of socialization and communication is presented below. The criterion for a delay in language was removed, as it is not specific to ASD and is characteristic of several other disorders seen in childhood (Demouy et al., 2011).

Support for the combination of the previously separate communication and socialization can be gleaned by looking at specific behaviors and impairments exhibited by children with ASD. The behavior of joint attention is commonly cited in the literature to highlight the strong link between social and communication behaviors (Dube et al., 2004). Joint attention is reviewed below to explore this relationship, and then other behaviors are reviewed to support the combination of social and communication domains.

In regards to nonverbal social communication, these behaviors have been said to serve two functions. One is nonverbally communicating with others to request an item or assistance (i.e., protoimperative), while the second is communicating for joint attention to indicate an item

of interest (i.e., protodeclarative). The latter, joint attention, has been defined as "coordinating attention between interactive social partners with respect to objects or events in order to share an awareness of the objects or events" (Mundy, Sigman, Ungerer, & Sherman, 1986, p. 657). Another definition is "the use of gestures to share interest with another person about an object or an event" (Paparella, Goods, Freeman, & Kasari, 2011, p. 569). The purpose of joint attention is primarily social, in which the participants are not looking to gain anything from the exchange other than sharing and showing something with another person. Joint attention includes behaviors such as pointing, follow pointing, checking, gaze-following, response to name, and often vocal commenting. As can be seen by the definitions of joint attention, social and communication skills are closely intertwined, with there being social as well as communication consequences to the act of joint attention (Dube et al., 2004). Developmentally, by the age of six months, the first signs of joint attention, coordinated joint looks, are present with this becoming more intentional by the age of 12 months. Between the ages of 10 and 14 months, an infant should use joint attention to refer to an object with another person (Butterworth & Cochran, 1980).

In those with ASD, there are mixed findings as to whether children with ASD differ from typically developing children in their ability to request an item or assistance from others (i.e., protoimperative); however, most evidence suggests that there are significant differences between these two groups in regard to joint attention (i.e., protodeclarative) (Phillips, Gomez, Baron-Cohen, Laa, & Riviere, 1995). Children with ASD exhibit impairments in both responding to (i.e., following another's gaze or point) and initiating (i.e., coordinating joint looks, pointing, showing) joint attention at an early age (Paparella et al., 2011). Some studies, however, suggest that impairments in initiating joint attention are more severe in some children with ASD while

there may be no differences in responding to joint attention compared to their peers (Mundy, Sigman, & Kasari, 1994).

In both initiating and responding to joint attention, impairments can cause difficulties in the areas of socialization and communication. The subsequent impairments in both of these areas support the overlap between social and communication domains of behavior. Furthermore, researchers have found large overlaps statistically between these two areas, meaning social and communication scores are often correlated (Hattier & Matson, 2012). In regard to language ability, a relation exists between the development of joint attention and later language ability (Charman et al., 2003; Mundy et al., 1994). When comparing children with ASD, developmentally delayed children, and typically developing children who were matched for mental age, joint attention was the best predictor of language ability (Dawson et al., 2004). More specifically, joint attention is related to the rate of learning expressive vocabulary (Smith, Mirenda, & Zaidman-Zait, 2007).

In addition to language impairments, social impairments are also consequences of difficulties in joint attention. For example, joint attention impairments have been implicated in later deficits in social cognition and impairment in theory of mind (Roeyers, VanOost, & Bothuyne, 1998). Responding to joint attention has been related to social competence and withdrawn behaviors in three-year-olds with ASD (Sheinkopf, Mundy, Claussen, & Willoughby, 2004). With impairments in joint attention evident in early childhood, the consequences of these impairments are also evident at an early age (Smith et al., 2007).

In addition to joint attention, the overlap between socialization and communication can be highlighted when examining other social skills typically discussed in the ASD literature. Social skills have been defined in many ways due to the heterogeneity in the behaviors included

under this construct. One definition is "behaviors that enable an individual to interact effectively with other people and avoid socially unacceptable behavior" (Gresham & Elliott, 1984, p. 20). The behaviors within this construct cover a large span topographically, ranging from making eye contact, conversational skills, asking questions, smiling appropriately, playing or interacting with peers, calling others by their names, and so on. Children manifest symptoms in a variety of ways and may have impairments that look very different. This heterogeneity has also been found in the genetic make-up to these children (Ronald, Happe, Bolton, et al., 2006; Ronald, Happe, Price, Baron-Cohen, & Plomin, 2006).

In many cases, social behaviors inherently require communication, which supports the combination of social and communication domains (Carpenter et al., 1998). For example, a child cannot engage in social conversation or social greetings without the use of some sort of language, be it vocal, sign, or using pictures. The appropriate use of smiling also requires the child to have receptive language abilities to understand what others are saying or to interpret nonverbal language and respond appropriately. Simple play interactions also have communication embedded. Therefore, if a child has communication deficits, socialization will likely suffer and vice versa (Stanton-Chapman & Snell, 2011). Examples such as these are numerous in the discussion of social skills in children with ASD. These examples support the intertwining between socialization and communication that will be reflected in the upcoming changes of the *DSM-5*.

Repetitive and/or Restricted Behavior. For the *DSM-5* second symptom cluster, repetitive/restricted behavior, two of the four behaviors outlined need to be present: (1) stereotyped or repetitive speech, motor movements, or use of objects; (2) excessive adherence to routines, ritualized patterns of verbal or nonverbal behavior, or excessive resistance to change;

(3) highly restricted, fixated interests that are abnormal in intensity or focus; (4) hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of environment. When compared to current diagnostic criteria, the inclusion of repetitive or stereotypic speech (previously under the category of communication impairments) and the inclusion of sensory abnormalities are new changes.

While there is strong evidence supporting the first three criteria listed above (Bodfish, Symons, Parker, & Lewis, 2000; Lewis & Bodfish, 1998), the fourth criterion has only recently gained enough support to warrant its inclusion as a symptom (Ben-Sasson et al., 2009). One reason for its inclusion is the large overlap of sensory abnormalities with repetitive and restricted behavior (Gabriels et al., 2008). Researchers have outlined three types of sensory abnormalities common to children and persons with ASD (Baranek, David, Poe, Stone, & Watson, 2005). The first is hyper-responsiveness, in which the child may over react to stimuli that others are not typically bothered by, such as the noise of vacuum cleaners or the feeling of certain textures of clothing. Conversely, some children may exhibit hypo-responsiveness to stimuli and exhibit very limited responses to things like their name being called or pain. Lastly, some children exhibit a pattern of sensory seeking in which they pursue sensory activities to stimulate themselves more than would be typical. For example, some children engage in staring at lights or spend excessive amounts of time swinging on a swing set. These three patterns of sensory abnormalities can occur together or individually within one child, but overall many children with ASD do have some sort of sensory difficulty (Baranek et al., 2005).

The new criteria in this domain (i.e., requiring two of the four symptoms) place a heavier emphasis on repetitive/restricted behaviors than in the past. Previously, many children who did not exhibit repetitive/restricted behaviors would have been assigned a diagnosis of PDD-NOS.

Now, those children will likely no longer meet criteria for ASD, but may be more likely to receive the new diagnosis of Social Communication Disorder (Happé, 2011). These changes will likely lead to fluctuations in the prevalence rate, which will be discussed more thoroughly below.

Differential diagnosis. When determining a diagnosis for a child who is being assessed, differential diagnosis must be considered in order to distinguish which diagnosis or diagnoses are most appropriate for the child. Currently, in the case of PDD, the clinician needs to determine if the child has an ASD or some other disorder, and then also needs to differentiate among the five disorders on the spectrum. In some cases, there is a great deal of overlap among diagnoses. The latter differentiation within the spectrum will not be necessary with the *DSM-5* as all children will be labeled with the diagnosis of ASD.

Based on the current diagnostic system, researchers have examined what distinguishes among different ASD. Finding these distinctions in some cases is a difficult task given that all ASD share similar characteristics, meaning the triad of impairments, with variations in symptom severity and profiles. Some disorders are more easily distinguished. For example, the distinction between a lower functioning child with AD and a higher functioning child with AS is more straightforward due to the lack of communication delay and cognitive deficits with AS; however, differentiating between AD and PDD-NOS can be more troublesome. In addition to the broad reasons why a diagnosis of PDD-NOS may be given instead of AD, outlined above by Willemson-Swinkels and Buitellar (2002), other researchers have looked at what specific behaviors may differentiate disorders. Looking at specific symptomatology, Mayes, Volkmar, Hooks and Cicchetti (1993) described seven reliable criteria that have been determined to aid in distinguishing PDD-NOS and AD: choosing solitary activities over group activities, poor social

signals, abnormal comfort seeking, a lack of social usage in communication, impaired make-believe, impaired conversation, and interest in non-functional aspects of objects. These behaviors are seen to a greater extent in children with AD as opposed to PDD-NOS. More research is warranted considering that PDD-NOS is the most commonly diagnosed disorder on the spectrum and cutoffs between the disorders are difficult to determine (Mayes et al., 1993).

In addition to differences in symptoms among ASD, stability of diagnosis is another issue to be considered in differential diagnosis. Over a person's lifetime, they may meet criteria for different disorders at different times (Eaves & Ho, 2004; Gillberg, 1998; Kleinmen et al., 2008; Lord et al., 2006; Worley, Matson, Mahan, Kozlowski, & Neal, 2011). It is not uncommon for children to meet criteria for AD at one point and PDD-NOS at another or vice versa; however, it is less likely that a child who meets criteria for an ASD earlier in life will go on to no longer warrant a diagnosis on the spectrum (Lord et al., 2006). This finding has also been replicated in younger samples of infants and toddlers aged 17 to 37 months (Worley et al., 2011).

While differential diagnosis has been examined with the *DSM-IV-TR* criteria, the question becomes what will happen with the *DSM-5*? Differentiation within the spectrum will no longer be needed as all children meeting the new criteria will receive the diagnosis of ASD. Differentiation among other disorders, such as communication disorders, intellectual disability, and the newly proposed Social Communication Disorder, will still be needed. Currently, by having more diagnostic categories in PDD, some specific information can be conveyed with a diagnosis. For example, a clinician beginning to treat a child with a previous diagnosis of AS will have a general idea about what type of symptom presentation to expect (Howlin, 2003). This argument can be countered, however, in that currently even within the same diagnosis, such as AD, two children can have very different symptom profiles and present in very different ways.

The *DSM-5* emphasizes using specifiers and associated features, such as intellectual disability, to describe children as opposed to the different diagnostic labels. A last consideration surrounding the *DSM-5* and differential diagnosis is that children may appear more symptomatically similar with less heterogeneity since criteria are more stringent. The possible consequences of *DSM-5* revisions are further explored in the discussion of epidemiology.

Symptom Structure of ASD

The *DSM-IV-TR* diagnostic criteria for PDD, as well as the new *DSM-5* criteria, are defined by behavioral symptoms as specific genes or brain abnormalities have not been pinpointed to indicate the cause of these disorders (Sweeten, Posey, Shekar, & McDougle, 2002). As a result, the structure of PDD are outlined and defined by the behaviors that make up the symptom clusters. A relatively large amount of research has been conducted to determine the underlying structure of ASD. The support for the number of symptom clusters that should be used comes from multiple sources including factor analysis on the structure of ASD as well as expert clinical judgment and observation.

In order to examine the structure of ASD, a number of factor analysis studies are described here. Some studies examine several structures within the same study. First, those studies that support the three symptom class structure in line with the current *DSM-IV-TR* are discussed. Next, studies that found structures differing from the *DSM-IV-TR* are reviewed. Some of these studies support one underlying construct of autism while others support a greater number of factors that differ from the current *DSM-IV-TR*. The final studies discussed support of the upcoming changes with the *DSM-5*. The findings from these factor studies vary based on the assessment measures used, sample characteristics, and statistical methods. Some studies use structured interviews while others rely on observational measures to obtain data. Sample

characteristics vary in terms of age, diagnosis, and level of functioning, and statistical methods also vary based on if each item versus whole subscales are analyzed (Snow, Lecavalier, & Houts, 2009; Frazier, Youngstrom, Kubu, Sinclair, & Rezai 2008). Additionally, some researchers rely on exploratory methods, such as exploratory factor analysis, that are hypothesis generating as opposed to the more powerful theory driven methods, like CFA (Field, 2005). Lastly, while some researchers found a certain number of factors through statistical methods, they conclude that a different number of factors are actually best suited to describe the structure of ASD (Dworzynski, Happe, Bolton, & Ronald, 2009).

Before reviewing specific studies, additional attention to the differences between exploratory and confirmatory statistical methods is warranted. EFA is more commonly used during the scale development phase (Costello & Osborne, 2005). This is especially true when the area being investigated may be lacking in previous theory or research; it is hypothesis generating, not theory driven. CFA, on the other hand, is used to explicitly test a model based on existing theory. The number of factors for a CFA will already be set, and the fit of the model is determined using a variety of fit indices (to be discussed in the Methods section). In EFA, the number of factors to be retained needs to be determined based on a few different strategies (e.g., Kaiser criterion, scree plot), so depending on the strategy used, a different number of factors may be retained. Overall, the goal of the EFA is to maximize the amount of variance explained by the factors (Costello & Osborne, 2005). Items in EFA are also allowed to load onto more than one factor, with the factor on which the item load the heaviest being the main factor for that item. This can be problematic when items may correlate with more than one factor. Alternatively, with CFA, items are specified to load onto one factor only. This is determined based on previous theory and literature. EFA and CFA also address correlations between items differently. In

EFA, if items are thought to be correlated, an oblique rotation can be used to aid in interpretation but specific correlations between items are not stated. On the other hand, with CFA, specific items can be correlated in the model before it is tested which can improve the fit of the model. Because of the differences between the two methods, it is common that a CFA will not replicate the results from an EFA (van Prooijen & Van Der Kloot, 2001).

While this is a very brief comparison of these two statistical methods, one can see there are numerous similarities and differences to both methods. In general, between EFA and CFA, it is recommended that conclusions based on CFA may be more meaningful than those made on EFA (Costello & Osborne, 2005). It has also been said that "confirmatory common factor analysis is a logical sequel to exploratory common factor analysis" so that the hypotheses generated during EFA can be explicitly tested with CFA (Mulaik, 1987, p. 302). In the review below which outlines some studies examining the factor structure of ASD, both methods are used.

Current *DSM-IV-TR* Structure. Not surprisingly, many studies support the current structure of the *DSM-IV-TR* symptoms. Lecavalier, Gadow, DeVincent, Houts, and Edwards (2009) examined the structure of ASD using the Early Childhood Inventory (ECI-4; Gadow & Sprafkin, 2000) and Child Symptom Inventory-4 (CSI-4; Gadow & Sprafkin, 2002). In a sample including a range of ages (3 to 12 years) and varying levels of functioning, their CFA supported a three factor model over the one or two factor model. These factors mapped onto the factors of the *DSM-IV-TR*. The authors also examined participant characteristics for fitting the model and found that higher functioning individuals fit the model better than lower functioning children. They did not provide an explanation for this result.

Another study that used exploratory methods was conducted by Dworzynski, Happe, Bolton, and Ronald (2009). Using the Development and Wellbeing Assessment (DAWBA, Goodman, Ford, Richards, Gatward, & Meltzer, 2000), a diagnostic interview appropriate for children, five factors were found that explained 45% of the variance in the sample. The five factors were (1) communication, (2) social, (3) repetitive or restricted behaviors or interests-repetitive, (4) language milestones, and (5) insistence on sameness. While factors 1 and 4 as well as factors 3 and 5 seem to overlap, the authors showed that the low correlation between these pairs does support separate factors. That is, a child could have impairments in language milestones, but have no impairments in language later on. In discussing the upcoming changes to the *DSM-5*, the authors also argue that even with unavoidable flaws that plague all statistics, the correlation between factors of communication and socialization were still only modest at .63. Thus, Dworzynski and colleagues would not support the combining of social and communication domains proposed in the *DSM-5*.

While most researchers examine the structure of ASD using assessment tools appropriate for older children and young adults, it is also important to examine this structure in younger children. This point is particularly cogent since professional guidelines recommend diagnosis as early as possible. Using exploratory methods, the factor structure of the BISCUIT was examined (Matson, Boisjoli, & Wilkins, 2007*)*, which is appropriate for children aged 17 to 37 months. The authors found a three factor solution, which they state is similar to the current *DSM-IV-TR* structure. The first factor was labeled "socialization/nonverbal communication," the second factor "repetitive behavior/restricted interests," and the third factor "communication." While the authors concluded that the structure was similar to the current *DSM*, one can see how the social and communication factors overlap in factor one. In addition, Matson and colleagues

highlighted that sensory items also loaded onto factor two, which is consistent with the proposed *DSM-5* criteria.

A Single ASD Factor. In contrast to those studies that support the current structure of the *DSM-IV-TR*, a few studies support the underlying structure of autism as one single factor. Constantino and colleagues (2004) found that 30% of the variance in their sample was accounted for by a single autism factor using data from the Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & LeCouteur, 1994) Social Responsiveness Scale, with the next most influential factors only explaining 7% of the variance. On the other hand, when using the full ADI-R, two factors emerged. The first factor was broad and included social behaviors but also non-verbal and verbal communicative behaviors, and the second factor included broader behaviors from the other symptom categories, such as repetitive behaviors. In the end, the authors conclude a one factor structure had a better fit over the two factor model.

Similarly, Szatmati and colleagues (2002) explored whether a single autism factor best accounted for symptoms of ASD, but also included level of functioning as measured by the Vineland Adaptive Behavior Scales (Sparrow, Cicchetti, & Balla, 1984). Their findings supported a two factor structure, the "autism" factor and a level of functioning factor. This structure explained approximately 70% of the variance in their sample, which included both higher and lower functioning individuals. By using a descriptor to explain level of functioning, the authors concluded that the autism factor could stand alone as a single factor for autism.

Using slightly different methodology, Tanguay, Robertson, and Derrick (1998) found support for a one symptom cluster describing autism. Tanguay and colleagues examined if the social communication factor alone from the ADI-R (Lord et al., 1994) alone could be useful in assessing autism, specifically lesser forms of ASD. The authors studied children aged 3 to 16

years with AD, AS, and PDD-NOS. They performed a factor analysis of only the social communication items and found three factors: affective reciprocity, joint attention, and theory of mind. The authors then examined correlations among the social communication factor and the three symptom clusters in the *DSM-IV*. Not surprisingly, social symptoms in the *DSM-IV* were highly correlated with the social communication factor. Communication symptoms were moderately correlated with social communication items. The authors highlight that the *DSM –IV* includes both pragmatic communication and social communication under the communication domain of symptoms. They suggest that the pragmatic communication impairments should be thought of as being comorbid to autism, like intellectual disability, but should not be necessary for a diagnosis. Finally, repetitive and restricted interests or behaviors did not correlate well with the social communication factor; however, the authors argue that almost half of the children with previous diagnoses of ASD in their sample did not have these RRBI present in the first place. In sum, Tanguay and authors argue that social communication is the most useful symptom cluster in examining autism. They suggest that diagnostic changes should include the removal of pragmatic language deficits as well as RRBI in the diagnostic criteria of ASD. They also feel that this would likely allow for the recognition and diagnosis of those people with lesser forms of ASD.

Other ASD Structures. Most researchers examining the structure of autism find a structure that is not in line with the current *DSM*, but has more than one factor. Tadevosyan-Leyfer and colleagues (2003) used the majority of items from the ADI and ADI-R to examine factors using principle components analysis. Their analysis supported six different factors including spoken language, social intent, compulsions, developmental milestone, savant skills, and sensory aversions. The first three of these factors map well onto currently diagnostic criteria

while the final three were more variable from child to child. There were also significant correlations between certain factors, the highest of which was between social intent and spoken language. This finding was likely because the factor for social intent also included factors such as spoken greetings that incorporate social and communication together. Furthermore, within the spoken language factors, children seemed to separate into two groups, those with severe, specific language impairment and those that had developed more normal language. The authors suggest that this specific language impairment may be something that subtypes autism, but does not specifically define it. Tadevosyan-Leyfer and colleagues (2003) concluded that while their factor analysis resulted in six factors, the two factors, "the inability of the children to relate themselves to others in the usual way" and "the obsessive desire for the maintenance of sameness," have the most clinical utility for diagnosis. In this case, subsequent analyses, such as CFA, would have been useful to aid in confirming the authors' interpretations and hypotheses.

Georgiades and colleagues (2007) used exploratory and then confirmatory methods to explain the autism phenotype. They used a sample of 209 children with PDD and data obtained using the ADI-R subdomains to extract three factors (i.e., social-communication, inflexible language and behavior, and repetitive sensory and motor behavior) using exploratory methods that explained approximately 50% of the variance. A two factor model only explained 40% of the variance. Four and five factor models also produced eigenvalues greater than one, but had some factors with only one item and had cross-loadings across factors. CFA also supported the fit of the three factor model over the current *DSM-IV-TR* three factor structure.

van Lang and colleagues (2006) also examined several models using data from the *ADI-R* (Lord et al., 1994) with structural equation modeling. There were five models tested in all: two using the current *DSM* criteria (the 4 to 5 age range and current behavior), one using a three

factor model (i.e., impaired social communication, stereotyped language and behaviors, and impaired make-believe and play skills), one examining one single "autistic features" factor, and one model examining only two factors of social communication and RRBI. The two models based on *DSM-IV-TR* criteria did not work out due to high correlations between the socialization and communication domain. The best model was found to be the one examining impaired social communication, stereotyped language and behaviors, and impaired make-believe and play skills, which explained 34% of the variance in the sample. The one and two factor models were not adequate. While the favored model here is still a triad of symptoms, the authors point out that it differs significantly from the current triad.

While many of the studies reviewed use the ADI-R in determining the structure of autism, some studies have used other measures. In examining the psychometric properties of the Autism Behavior Checklist (ABC; Krug, Arick, & Almond, 1980), Wadden, Bryson, and Rodgers (1991) assessed whether a one factor model or the five factor structure found by Volkmar and colleagues (1988) was more appropriate. Neither the one nor five factor models were adequate in explaining the structure of ASD. Using a sample of children with and without autism, aged 6 to 15 years, the authors found a three factor model was supported that explained 32% of the variance. These three factors were not the same as in the *DSM-IV* but were labeled as "nonresponsive," "aloof/repetitive," and "infantile/aggressive." Overall, by examining the studies presented here, one can see how many variations have been supported as the underlying structure of ASD.

***DSM-5* ASD Structure.** With the new changes coming with the *DSM-5*, it is not surprising that support exists for the combination of the social and communication factors, with a separate factor of repetitive/restricted behaviors. Lecavalier and colleagues (2006) examined the

factor structure of the ADI-R (Lord et al., 1994) using exploratory methods. They found similar results to the algorithm of the measure with one exception: the non-verbal communication loaded more with socialization items than verbal communication items. This factor accounted for the largest amount of variance at 21% of the total 38% for the model as a whole. The authors argue that nonverbal communication should be examined along with socialization.

A similar study was conducted by Frazier and colleagues (2008). They used the ADI-R (Lord et al., 1994) subscale scores from a larger sample of 1,170 individuals ranging in age from 2 to 46 years with PDD. Their findings supported a two factor model with the full combination of social and communication factors, not a differentiation based on verbal or non-verbal, along with a repetitive/restricted behavior factor. A second model showed some support for a three factor structure in which, along with the repetitive/restricted behavior factor, there were also factors of peer relationships and play, and other social and communicative behaviors.

Related to the study by Frazier and colleagues (2008), Snow et al. (2009) examined the structure of the ADI-R (Lord et al., 1994) but used all items as opposed to the subscale scores. Their sample was composed of 1,861 children with PDD from ages 4 to 18 years. Children with and without verbal abilities were analyzed separately. Based on CFA, some support was found for both a two and a three factor model, and these were more appropriate than the one factor model. Using an EFA, the two factor model was found to be superior to the three factor model, with the two factors being described as social communication and repetitive/restricted interests.

Another study supporting the combination of social and communication symptoms used a sample of higher-functioning individuals (i.e., IQ 70 and above) with PDD to examine the structure of the ADI-R and the Autism Diagnostic Observation Schedule (ADOS; Kamp-Becker, Ghahreman, Smidt, & Remschmidt, 2009). The overall factor analysis for the ADI-R supported

a four factor solution, with the first factor being social and communication symptoms that explained almost 18% of the variance and included almost half of all of the items. The other factors were anxiety and compulsions, stereotyped behavior, and inadequate behaviors. The ADOS on the other hand delivered a five factor structure; however, once again the first factor, which explained 26% of the variance, was a combination of social and communication items. The conclusions from Kamp-Becker and colleagues were that the current structure of the *DSM-IV-TR* is not in line with the actual factor structure of autism based on the factor analyses. And while this study found more than two factors, the authors conclude there is strong support for the combination of the social and communication factors and the changes in the *DSM-5*.

While the previous studies utilized the ADI-R, Mandy, Charman, and Skuse (2012) compared the structure of the proposed *DSM-5* and the current *DSM-IV-TR* using the Developmental, Dimensional and Diagnostic interview (3Di; Skuse et al., 2004) in children and young adults aged 2 to 21 years with PDD. The CFA supported that the combination of social and communication symptoms was superior to the current *DSM* model. Additionally, this model was still supported across different sample characteristics such as age, gender, and symptom severity. Sensory symptoms were also appropriately incorporated into the repetitive/restricted behavior domain.

As can be seen from the review of studies above, a lack of consensus exists on the best structure to describe ASD. Methods and samples vary, making it difficult to draw overall conclusions. Confirmatory methods may be more valid than exploratory methods in answering the question of the structure of autism as they are theory driven as opposed to more correlation in nature (Field, 2005). A review by Kuenssberg, McKenzie, and Jones (2011) suggests that most

models are moving towards the combination of socialization and communication symptoms, which is in line with the upcoming changes to the *DSM-5*.

ASD in Infants and Toddlers

Having reviewed the evolution of the *DSM* and evidence for the possible structure of ASD, the discussion will now shift to ASD in young children. First, the age of onset for symptoms will be reviewed. This will be followed by a summary of first emerging symptoms in young children and the stability of these symptoms at a young age.

Age of Onset of Symptoms. The first signs of ASD have been noted to start in early childhood (Rogers & Dilalla, 1990; Werner, Dawson, Osterling, & Dinno, 2000). This fact has been reflected in versions of the *DSM* that require the onset of symptoms before the age of three years (APA, 2000). Researchers have shown that in many cases, there are early signs of ASD even before the age of three years, with reports indicating signs may be evident as early as age one or two years (Clifford, Young, & Williamson, 2007; Wetherby et al., 2004). In some rare cases, however, the first signs of ASD may not be recognized until a later age. While this does not mean that symptoms were not present earlier, it indicates that the environment plays a role in the impairment the symptoms cause. For example, some young children may not have opportunities to be around peers or develop relationships with others. As a result, their social skill deficits, while present earlier on, may not be recognized as problematic until a later age. The delay in recognition of symptoms has been reflected in the proposal for the new *DSM-5* criterion that states symptoms must "be present in early childhood (but may not become fully manifest until social demands exceed limited capacities)" (APA, 2011). Additionally, some low socioeconomic status parents may not understand what behavior is typical versus atypical for a young child which may lead to a delay in diagnosis (Fountain, King, & Bearman, 2011).

Overall, in the majority of cases, certain symptoms will raise concern about the child's development at an early age even though a diagnosis may not be made until later on.

First Emerging Symptoms. In determining the first symptoms that typically emerge in young children, there are a variety of methods used by researchers. These methods include case studies, retrospective parent report, retrospective video analysis, and prospective studies. Each of these methods has its own limitations, but by looking at a variety of literature, one can glean information on the early signs of ASD in children. First, a few case studies are highlighted, then general findings regarding early symptoms of ASD are reviewed.

Case studies, while having the disadvantage of only examining one or a few children, can provide unique information regarding ASD in early childhood. The first study of autism was a case study by Kanner (1943) who examined school-aged children to provide much of the early information regarding ASD. Other case studies have also provided some insight regarding what signs are first noted in infancy. Some of the commonalities found across studies include hyper- or hyposensitivity to sensory stimuli, a lack of interest in social interactions, impaired nonverbal communication, and a lack of eye contact (Dawson et al., 2000; Klin et al., 2004; Rutherford, 2005). In several of these studies, children were observed as young as six months old.

Other than case studies, researchers use several other methods to obtain information about a child in their first years of life. One retrospective option is to return to parents whose children have received a diagnosis on the spectrum and obtain information from them about their child's previous behavior as an infant. Retrospective parent report has several limitations, such as the error in reporting past behavior and the influence of parental variables, such as age and intelligence. The other retrospective option is to examine home videos of the children and to code and analyze behavior at that young age. This method aids in removing some of the biases

parent reporting may elicit. The last option used to determine early symptoms in children with ASD is prospective studies. These studies obtain information on a wide range of children before it is known if they have ASD, and then at a later age when the child has received a diagnosis, analysis of the data can be completed.

From these studies, general conclusions can be drawn about what types of ASD behaviors emerge in infancy and toddlerhood. For example, general difficulties with socialization, verbal and nonverbal communication, and repetitive and/or restricted behaviors were found to be more prominent in infants and toddlers with ASD than those with developmental disabilities or intellectual disabilities (De Giacomo & Fombonne, 1998; Matson, Boisjoli et al., 2010); however, this is not surprising considering these are the three main symptom areas for ASD. Instead, it may be more helpful to examine very specific behaviors that have good predictive value in regards to the development of ASD.

Some of the more commonly cited behaviors evident in early childhood have been found in one or more studies using a variety of methods. Lack of response to the child's name is a commonly cited impairment (Clifford et al., 2007; Nadig et al., 2007; Wetherby et al., 2004; Wetherby, Watt, Morgan, & Shumway, 2007; Baranek, 1999; Osterling, Dawson, & Munson, 2002). Other behaviors indicative of ASD in early childhood include a deficit in initiating joint attention (e.g., gaze shifting, protodeclarative pointing/showing), affect (Charman et al., 1998; Clifford et al., 2007; Wetherby et al., 2004), use of gestures (Clifford et al., 2007; Wetherby et al., 2007), interest in peers (Clifford et al., 2007), eye contact (Clifford et al., 2007), imitation and pretend play (Baron-Cohen et al., 1996; Charman et al., 1998), and stereotypic behavior (Wetherby et al., 2004). While some of these studies only compared children with ASD to typically developing peers, it is more informative to compare children with ASD to infants and

toddlers with other developmental disorders. Vostanis and colleagues (1998) compared young children with ASD to children with other DD, such as learning disability and language disorders, and found repetitive play with toys, a lack of appropriate pointing, and appearing to be deaf to be the most indicative of ASD. Using an atypically developing comparison group is important since some behaviors may not be specific to ASD but developmental disorders in general. For example, though stereotypies are commonly seen in young children who go on to be diagnosed with ASD, they are not as strong of a predictor for ASD since stereotypies may be exhibited by children with other disorders as well as typically developing children (Saint-Georges et al., 2009). Some researchers have examined if a group of certain behaviors when taken together can be predictive of later ASD diagnoses. By examining poor response to name, poor quality of eye contact, peer interest, and affect, Clifford and colleagues (2007) correctly classified 79% of their sample as having ASD or DD/ID.

Stability of ASD Symptoms in Early Childhood. Because children are so young when looking at early symptoms of ASD, questions often arise regarding symptom stability at this age. Some instability in symptoms has been found at this early age, specifically when looking at more specific behaviors. For example, responding to one's name differed in ASD versus non ASD children at six months of age but did not significantly differ when measured again at 12 months (Nadig et al., 2007). In addition, at this early age it is sometimes the case that abnormal behaviors indicate that a child is not typically developing, but it is more difficult to pinpoint what specific disorder may be present. On the other hand, some researchers suggest that while specific behavioral symptoms (e.g., not engaging in pretend play) may change over time, the overall symptom domains (e.g., socialization) remain stable at this young age. Worley and colleagues (2011) found that in a sample of 114 toddlers, the correlation between symptoms of ASD from

time one to time two (up to one year later) were significant, indicating stability across time. Therefore, examining broad symptom classes and severity may be more useful than investigating specific behaviors when examining symptom stability in this young population.

Early Screening and Diagnosis of ASD

With signs and symptoms of ASD being evident in early childhood, emphasis has been placed on screening for ASD in young children. Ideally, early screening can lead to earlier diagnosis via a more thorough assessment and can lead to earlier treatment, which is often associated with a better outcome (Ben Itzchak & Zachor, 2011). Recommendations for early screening and diagnosis are made by a variety of organizations such as the American Academy of Pediatrics, Pediatric Committee on Children with Disabilities, National Academy of Sciences, American Academy of Neurology, and the Child Neurology Society (Coonrod & Stone, 2005).

Screening measures vary from broad, in that they are administered to all children during well-child visits at pediatricians' offices, to more specific screeners, in that they are used for children already suspected of having a developmental delay. In general, the purpose of ASD screening measures is to identify children who have problems consistent with ASD so that the children can go on to receive a more thorough diagnostic evaluation. In examining the psychometrics and usefulness of these screening tools, researchers often examine sensitivity and specificity, as well as the rate of false positives and false negatives. For screening tools, high sensitivity is often desired, meaning that all children who have the disorder are identified via the screen (i.e., a true positive). Because of this, some screening tools result in a fair number of false positives. That is, some children who do not have the disorder fail the screen. While this may result in some children undergoing full assessments even though they do not have ASD, this is

preferred to having a child with ASD going undiagnosed because the child was not identified by the screening tool.

Below, three of the more commonly used screening tools are reviewed: the Modified Checklist for Autism in Toddlers (M-CHAT; Robins, Fein, Barton, & Green, 2001), the Pervasive Developmental Disorders Screening Test- Second Edition (PDDST-II; Siegel, 2004), and the BISCUIT-Part 1 (Matson, Boisjoli, & Wilkins, 2007). For each, a brief description of the measure is provided along with some of the important psychometric studies.

M-CHAT (Robins, et al., 2001). The M-CHAT is an updated version of the original CHAT (Baron-Cohen et al., 1996). The M-CHAT is appropriate for children aged 16 to 30 months. Unlike the original CHAT, the M-CHAT only uses parent report and no clinical observation. The removal of the observational component was in an effort to make the M-CHAT usable across a variety of cultures and settings in which the observation was not as feasible. Because of the removal of the observational aspect, the parent-report questions are broader to capture a greater range of behaviors. The 23 items are answered with a "yes"/ "no" format and require about five minutes to administer. In scoring the measure, there are six critical items. The screener is failed if the child fails two of these critical items or if the child fails three of any of the 23 items.

Psychometrics of the M-CHAT were examined using a sample of 1,122 children aged 18 to 24 months during well-baby checkups and 171 children with previously diagnosed *DSM-IV* disorders (Robins et al., 2001). In terms of internal consistency, Cronbach's alpha was .85 for all items and .83 for critical items. Further investigation revealed a positive predictive power of .80, a negative predictive power of .99, sensitivity of .87, and specificity .99. The M-CHAT attempted to strengthen its specificity by decreasing the cutoff score for a positive screen when

compared to the CHAT (Coonrod & Stone, 2005; Robins et al., 2001). A limitation of this study, however, was that diagnoses were not confirmed with follow-up evaluations, so conclusions from this study should be interpreted with caution. Other studies examining the psychometrics of the M-CHAT have revealed fair to excellent internal consistency, .77 for critical items and .92 for total scores; however, specificity was still found to be lacking at .43 and .27, respectively (Eaves, Wingert, & Ho, 2006). The use of the M-CHAT should be used with the understanding that the likelihood for a false positive is relatively high and a thorough diagnostic work-up should be completed to confirm diagnoses.

PDDST-II (Siegel, 2004). The PDDST-II (Siegel, 2004) was developed as a broad screening instrument to be administered by non-specialist clinicians. While the PDDST-II is described as a broader screening tool, it was standardized with children having other neurodevelopmental disorders (e.g., ADHD, ID, language disorders), which allows for ASD to be differentiated from other disorders seen in early childhood. The PDDST-II is made up of three parts, with the first part screening for broad problems and the latter parts differentiating among disorders.

There are three parts that are administered in different stages: Primary Care Screener, Developmental Clinic Screener, and Autism Clinic Severity Screener. Stage one assesses 23 behaviors in relation to the behavior of typically developing peers. Using the cutoff of five to indicate the screen was failed, a sensitivity of .92 and specificity of .91 were found in a sample of at-risk children (Siegel, 2004). Part one of the assessment is promising, but results on the sensitivity and specificity for stage two and three of the PDDST-II are insufficient (sensitivity = .73 and specificity = .49; sensitivity = .58 and specificity = .60, respectively). If psychometrics

for the latter two stages could be improved, the three tier structure of the PDDST-II would be useful in application.

BISCUIT (Matson, Boisjoli, & Wilkins, 2007). The BISCUIT (Matson, Boisjoli, & Wilkins, 2007) is a three part screening and diagnostic instrument that is to be administered to the parent or caregiver of a child aged 17 to 37 months. Part 1 is the diagnostic section that obtains information on the core symptom areas of ASD. Part 2 gleans information on comorbid symptoms that are commonly seen in young children with ASD and other developmental disabilities (e.g., tic disorders, ADHD, Obsessive Compulsive Disorder, and Specific Phobia). The final part addresses the presence of challenging behaviors (e.g., self-injury, aggression, disruption, and repetitive behaviors). The three parts together are advantageous since comorbid symptoms and challenging behaviors are common with young children with ASD and should be addressed during assessment and treatment (Matson & Nebel-Schwalm, 2007). The BISCUIT-Part 1 can be used alone as a screening tool, or all three parts can be used diagnostically, in conjunction with other methods (e.g., clinical observation). The BISCUIT can also be used for symptom tracking, though the sensitivity of the instrument to track treatment changes has yet to be determined.

Items for the BISCUIT were developed based on a comprehensive review of the literature, review of the *DSM-IV-TR* (APA, 2000) and the *ICD-10* (WHO, 1992), and consultation with a clinician who has expertise with this population and over 35 years of experience in the field of developmental disabilities. While the original item pool included 71 items, several items were removed due to low endorsement rates and low inter-item correlations, which resulted in the final 62 items. Each item is scored on a three-point Likert scale (0 = not different, no impairment; 1 = somewhat different, mild impairment; or 2 = very different, severe

impairment). Additionally, an appendix provides scoring information about what is considered typical and atypical behavior for particular age ranges. Those administering the BISCUIT should hold at least a bachelor's degree in the health services field and be familiar with ASD.

For the BISCUIT- Part 1, scoring has been developed based on the total score. The chosen cutoff scores were based on optimizing sensitivity and specificity. This led to a score of 17 to differentiate between atypical development and PDD-NOS, and a score of 39 to differentiate between PDD-NOS and AD (Matson, Wilkins, Sharp, Knight, Sevin, & Boisjoli, 2009). The scores on the BISCUIT were compared to diagnoses that were made by a licensed psychologist with over 35 years of experience in the area of developmental disabilities. Information used to come to these diagnoses included M-CHAT scores, Battelle Developmental Inventory-Second Edition (BDI-2; Newborg, 2005) scores, and *DSM-IV-TR* criteria. Using these cutoffs, sensitivity and specificity were .93 and .86, respectively. While the total score of the BISCUIT is used to determine what diagnostic category may be appropriate for the child, exploratory factor analysis supported that three subscales make up the BISCUIT. These subscales are consistent with the three current *DSM-IV-TR* symptom clusters: socialization/non-verbal communication, communication, and restricted/repetitive behaviors. CFA has not been conducted yet on the BISCUIT.

Epidemiology

Current. During the early years when autism was first studied, prevalence was estimated at .41 per 1,000 individuals (Lotter, 1966). Since this time, much research has been completed regarding the prevalence of ASD. The Center for Disease Control estimated that 6.7 per 1,000 people had a diagnosis of ASD in 2000 and this number increased to 9 per 1,000 in 2006. Fombonne (2005) examined the epidemiology of each individual ASD diagnosis. The

estimates were as follows: 6.0 per 1,000 for all ASD, 1.3 per 1,000 for AD, 2.1 per 1,000 for PDD-NOS, 0.26 per 1,000 for AS, and 0.02 per 1,000 for Childhood Disintegrative Disorder.

Many of the prevalence studies indicate an increase in prevalence rates over the past years, and several hypotheses have been posed to explain this phenomenon. One possible reason for the increase is due to changes in *DSM* and *ICD* criteria that influence identification (Wing & Potter, 2002). For example, diagnostic criteria were broadened from the *DSM-III* to the *DSM-III-R*, which led to more children meeting criteria (Spitzer, Endicott, & Robbins, 1978). These changes specifically affect individuals at the margins for meeting diagnostic criteria. This argument is especially relevant with the upcoming changes in the *DSM-5*, which is discussed below.

Diagnostic substitution is another possible reason for the increase in ASD diagnoses. Diagnostic substitution refers to the idea that due to increased awareness and popularity of ASD children who may have previously been diagnosed with another disorder, such as intellectual disability, might now receive diagnoses of ASD. Leonard and colleagues (2010) describe two types of diagnostic substitution. The first instance is when clinicians misdiagnose a disorder that overlaps in symptomatology with ASD, such as Fragile X syndrome. The second instance is when a clinician may diagnose an ASD even if the child does not meet full criteria because an ASD diagnosis opens more opportunities for services and intervention. Researchers such as Shattuck (2006) have empirically supported the phenomenon of diagnostic substitution by looking at how prevalence of ASD increases as prevalence of other disorders such as intellectual disability decrease.

Since the inception of autism, awareness and knowledge about the disorder have increased substantially. Research in this area has grown exponentially which has furthered our

knowledge, and ASD has received a substantial amount of media attention (Matson & LoVullo, 2009). This increase in dissemination has led to clinicians being more aware of ASD, but it has also increased awareness among those who refer children for a diagnostic assessment, such as parents, teachers, and pediatricians (Leonard et al., 2010; Mandell & Palmer, 2005). These increases in awareness likely affect prevalence rates.

While there are several arguments for why the increase in prevalence of ASD is not necessarily a true increase in occurrence of the disorder, others argue that there has been a true increase in prevalence. Blaxill, Baskin, and Spitzer (2003) have argued that methodological flaws lead to findings that point to outside variables in increasing prevalence while the true rate of ASD has actually increased. Similarly, Hertz-Picciotto and Delwiche (2009) reported that while the factors identified above (i.e., less stringent criteria, diagnostic substitution, etc.) can account for some of the increases, they cannot account for the total increase in prevalence, which indicates there is a true increase occurring. It seems likely that perhaps all of these factors contribute to the increase in prevalence rates over the past decades.

Influence of *DSM-5*. While researchers are able to estimate prevalence rates of ASD using the current *DSM-IV-TR* criteria, it is likely that the changes with the new *DSM-5* will affect the rates of diagnosis. Most researchers argue that the new ASD criteria are more stringent and thus fewer children will be diagnosed, even if their symptoms are still present. More specifically, the new criteria require the presence of repetitive/restricted behaviors, which may preclude some children from obtaining diagnoses.

Several studies have examined these possible effects empirically. One study by Worley and colleagues (2011) used the *DSM-IV* and *V* criteria to determine diagnostic classifications. The findings indicated that those children who met ASD criteria for *DSM-IV-TR* but not *DSM-5*

were not significantly different on a measure of autism symptoms and severity. This indicates that children who did not meet criteria according to the *DSM-5* are still exhibiting significant symptoms of ASD. A similar epidemiological study was completed by Mattila and colleagues (2011) with a sample of children from Finland. Similar to the findings by Worley et al. (2011), the *DSM-5* criteria were less sensitive, specifically for those children with higher levels of functioning. An important note in this study, however, is that children with PDD-NOS, the largest diagnostic category in ASD, were not included. Matson, Kozlowski, Hattier, Horovitz, and Sipes (2012) also examined changes in prevalence rates based on *DSM-IV-TR* and *DSM-5* criteria using a sample of infants and toddlers. While the group that met criteria on the *DSM-5* exhibited significantly more symptoms than those who met criteria only on the *DSM-IV-TR,* both groups still exhibited significant ASD symptoms. This finding was replicated in an adult sample as well (Matson, Belva, Horovitz, Kozlowski, & Bamburg, 2012). One final study by McPartland, Reichow, and Volkmar (2012) found high specificity for *DSM-5* criteria but lower sensitivity, especially for diagnoses such as AS. Overall, if these studies indicate things to come from *DSM-5* changes, fewer individuals will be receiving diagnoses and subsequent treatments though symptoms of ASD are still present.

Related to the debate regarding prevalence rates is how screening and assessment tools will need to be adapted to accommodate the *DSM-5*. Measures such as the ADI-R (Lord, Rutter, et al., 1994) have a three factor scoring structure while other measures such as the BISCUIT (Matson, Boisjoli, & Wilkins, 2007) have an underlying three factor structure based on exploratory methods. It would likely be beneficial if these instruments were re-examined using the new criteria proposed in the *DSM-5*. This may include adapting scoring procedures to reflect the two factor structure.

Purpose

Currently, the main diagnostic features of ASD are organized in the three domains of communication, socialization, and repetitive/restricted behaviors; however, with the new *DSM-5* only two symptom domains, social communication and repetitive/restricted behaviors, will be used. While no consensus has been reached regarding the number of factors in ASD, a majority of studies have supported a two factor structure or at least supported the combination of social and communication symptom domains (Frazier et al., 2008; Kuenssberg et al., 2011; Lecavalier et al., 2009; Mandy et al., 2012; Snow et al., 2009). Regardless of the controversy that exists among researchers, however, a two factor model of ASD will likely be adopted in the near future. It has been posited that these changes may lead to consequences in terms of prevalence rates due to more stringent criteria, specifically the requirement of repetitive/restricted behavior and the subsuming of individual diagnoses all under ASD (Mattila et al., 2011; Worley et al., 2011). Many diagnostic tools (e.g., Lord et al., 1994) currently utilize a three factor structure as part of their scoring system, in line with the *DSM-IV-TR* (APA, 2000). Changes with the *DSM-5* may result in these measures being somewhat obsolete once new diagnostic criteria are implemented; hence assessment tools should be re-examined with the new criteria in mind.

The BISCUIT is one such measure used to screen and diagnose young children with ASD. Examining the factor structure of the BISCUIT is beneficial for several reasons. First, the BISCUIT is appropriate for the assessment of infants and toddlers, which is important as there has been a large push to assess and diagnose children at younger ages (Moore & Goodson, 2003). Few measures exist that specifically target assessing ASD in a young population. Secondly, while other measures may only consider core symptoms as a part of their measure, the BISCUIT also offers the benefit of assessing comorbid symptoms and challenging behaviors in

two separate sections. This means that it allows for a full diagnostic picture of the child. While total BISCUIT scores, rather than factor scores, are currently used to determine if a diagnosis is warranted, a three factor structure has previously been supported for the measure via exploratory methods (Matson, Boisjoli et al., 2010). As pointed out above, however, exploratory methods are more often used for earlier stages of measurement development and not theory testing. Exploratory analyses should be accompanied by confirmatory methods when possible. Therefore, it would be beneficial to examine the BISCUIT using these more theory-driven methods.

The purpose of the current study was to first re-conduct an EFA on the BISCUIT- Part 1 using a sample of infants and toddlers who met criteria for ASD. This assisted in determining how items should be assigned during latter parts of the study. Next, CFAs were used to examine the symptom structure of the BISCUIT. Both the two (*DSM-5*) and three factor (*DSM-IV*-TR) structures were examined individually and then jointly to determine which was most appropriate. The direct comparison of the two structures has not been thoroughly examined in the literature. In addition, using both exploratory and confirmatory methods within the same study is not often done. These analyses will help ensure that the BISCUIT continues to be a relevant and useful measure in diagnosing ASD.

Methods

Participants.

Participants for the current study were sampled from a larger pool of infants and toddlers whose data had already been collected (2008 to 2012). The participants in this larger pool were 4,196 infants and toddlers who participated in the EarlySteps program funded by the State of Louisiana. EarlySteps is Louisiana's Early Intervention System housed under the Individuals with Disabilities Education Act, Part C. Infants and toddlers from birth to 37 months of age who had developmental delays or a medical condition likely to result in a developmental delay qualify for services.

Children for the current study include those in the age range appropriate for the BISCUIT, ages 17 to 37 months. Participants were required to meet criteria for a diagnosis (based on diagnostic methods described below) of AD or PDD-NOS based on *DSM-IV-TR* criteria *or* a diagnosis of ASD based on *DSM-5* criteria. Using either *DSM-IV-TR* or *DSM-5* diagnoses ensured the data from the sample would not bias the results. That is, if children were required to meet criteria for both diagnoses, the findings would inherently favor the two factor structure since some believe the *DSM-5* criteria may be too strict and actually exclude some children who warrant a diagnosis. Instead, either of the diagnoses was acceptable to meet criteria for inclusion. For the EFA, a sample size with a participant to item ratio of 2 to 10 participants per one item is commonly cited in the literature (Costello & Osborne, 2005), while a sample of over 200 (Decoster, 1998; Ullman, 2007) with a participant to variable ratio ranging from 4 to 10 participants (MacCallum, Widaman, Preacher, & Hong, 2001) is desirable for the CFA analysis. This ratio ensures adequate power to detect significant results when using structural equation modeling techniques for CFA.

From the original sample of 4,196, 1,042 children met criteria for ASD on either the *DSM-IV-TR* or *DSM-5*. Of these participants, 1,011 remained after those with missing data were removed (i.e., due to missing M-CHAT, more than six BISCUIT items, etc.). Descriptive statistics on demographic variables and the number of children meeting on either or both diagnostic criteria are presented in Table 1 for the total sample. Seventy-two percent of the sample was male; and most children were either white or African-American (48.5% and 39.7%, respectively). In terms of diagnoses (as made per description in the procedures), 48% of children met criteria on both *DSM-IV-TR* and *DSM-5* criteria, 47% only received a diagnosis of ASD on the *DSM-IV-TR* criteria, and about 5% met on only *DSM-5* criteria.

Table 1. Total Sample Descriptive Statistics

	Mean	SD
Age (months)	26.26	4.74
	N	%
Sex		
Male	729	72.1
Female	277	27.4
Missing	5	.5
Ethnicity		
White	490	48.5
African American	401	39.7
Hispanic	20	2.0
Other	55	5.4
Missing	45	4.5
ASD Criteria met		
DSM-IV-TR only	478	47.27
Autistic Disorder	153	15.13
PDD-NOS	325	32.14
DSM-5 only	45	4.45
Both DSM-IV-TR AND *DSM-5*	488	48.27

Next, a random sample of 400 children was selected from the sample of 1,011 children that was used for the CFA, and the remaining 611 children were used for the EFA. Four hundred was chosen as the CFA sample size as this created a 6 to 1 participant to item ratio, which as stated above is within the recommended range. The descriptive statistics for each of the subsamples, referred to as EFA sample and CFA sample from this point forward, are presented in Tables 2.

Table 2. EFA and CFA Sample Descriptive Statistics

	EFA Sample		CFA Sample	
	Mean	SD	Mean	SD
Age	26.23	4.69	26.30	4.82
	N	%	N	%
Sex				
Male	431	70.5	298	74.5
Female	175	28.6	102	25.5
Missing	5	0.9	0	0.0
Ethnicity				
White	301	49.3	189	47.3
African American	236	38.6	165	41.3
Hispanic	12	2.0	8	2.0
Other	33	5.4	22	5.5
Missing	29	4.7	16	4.1
ASD Criteria met				
DSM-IV-TR only	282	46.15	165	41.25
Autistic Disorder	78	12.76	57	14.25
PDD-NOS	204	33.38	108	27.0
DSM-5 only	27	4.42	18	4.5
Both DSM-IV-TR AND *DSM-5*	302	49.42	217	54.25

Measures.

M-CHAT. Developed as the successor to the original CHAT (Robins et al., 2001), the developers of the M-CHAT aimed to extend the age range to 16 to 30 months. The M-CHAT comprises 23 yes/no format items that are answered by a primary caregiver of the child. Of these

23 items, six are considered critical items. If two of these critical items are failed, the child is considered to have screened positive for ASD. Alternatively, if any three of the total 23 items are failed, this also constitutes a positive screening. The full measure requires approximately five minutes to administer and is easily scored by hand.

The psychometrics of the M-CHAT have been determined to be adequate. Robins and colleagues (2001) used a sample of 1,122 children aged 18 to 24 months during well-baby checkups as well as 171 children with previously diagnosed *DSM-IV* disorders. In terms of reliability, internal consistency (i.e., Cronbach's alpha) was .85 for all items and .83 for critical items. Another study found fair to excellent internal consistency, .77 for critical items and .92 for total scores (Eaves et al., 2006). Further investigation revealed a positive predictive power of .80, a negative predictive power of .99, a sensitivity of .87, and a specificity .99.

BDI-2. The Battelle Developmental Inventory, Second Edition (BDI-2; Newborg, 2005) assesses developmental skills in children from birth to 7 years and 11 months. This normed and standardized measure assesses five domains of behaviors including adaptive, personal-social, communication, motor, and cognitive, each of which is considered as a part of an overall developmental quotient (DQ). Administered to a parent or caregiver, the 450 items require one to two hours to complete. For each domain and for the overall DQ, a standard score is determined with a mean of 100 and standard deviation of 15.

The authors used a sample of children from birth to 7 years and 11 months of age to examine the psychometric properties of the scale. Based on this sample, test-retest reliability was adequate ($r > .80$ in all domains and for the overall DQ). Internal consistency was also excellent for the domains, with Cronbach's alpha ranging from .98 to .99 (Newborg, 2005).

Newborg (2005) used expert review and convergent and divergent validity to establish content and criterion validity.

***DSM-IV* and *5* Criteria.** *DSM-IV-TR* (APA, 2000) and *DSM-5* (APA, 2011) criteria were used as data for the determination of ASD diagnoses. The *DSM-IV-TR* stipulates that a child must meet two of the socialization items, one of the communication criteria, and one item for repetitive/restricted behaviors to qualify for a diagnosis of AD. The criterion of age of onset was met as children were at or under the age of three years. For a diagnosis of PDD-NOS, children needed to meet some but not all of the ASD criteria. For example, the child may not meet the communication criterion or repetitive/restricted behavior criterion or may only have one socialization impairment. For the *DSM-5*, the child is required to meet all three criteria on the social communication symptom cluster and at least two criteria on the repetitive/restricted behavior domain to qualify for a diagnosis of ASD. The specific criteria for both of these diagnostic systems are outlined in more detail in previous sections. As discussed in the procedures section below, the diagnostic determination was made by the diagnosing clinical psychologist using these criteria along with other data (i.e., M-CHAT and BDI-2).

BISCUIT. Appropriate for infants and toddlers aged 17 to 37 months, the BISCUIT is composed of three parts (Matson, Boisjoli, & Wilkins, 2007). The first part obtains information on the core symptom areas of ASD using 62 items. Items on this scale are answered in a Likert format with 0 indicating not different or no impairment, 1 indicating somewhat different or mild impairment, and 2 indicating very different or severe impairment. Parts 2 and 3 will not be reviewed thoroughly here as they are not used in the current study; however, Part 2 gleans information on comorbid symptoms that are commonly seen in young children with ASD (e.g., tic disorders, ADHD, Obsessive Compulsive Disorder, and Specific Phobia), and Part 3

addresses the presence of challenging behaviors (e.g., self-injury, aggression, disruption, and repetitive behaviors). Together, all three sections can be used as components of a diagnostic assessment, or Part 1 can stand alone as a screening tool. For the current study, only Part 1 will be used. To score this section, a total score is calculated by summing item scores. The child's score then falls in a range with a score of 17 differentiating between atypical development and PDD-NOS and a score of 39 differentiating between PDD-NOS and AD (Matson, Wilkins, Sharp et al., 2009). These cutoffs were determined using a sample of 1,007 infants and toddlers and resulted in the highest sensitivity and specificity.

Researchers have supported adequate psychometric properties for the BISCUIT- Part 1. Exploratory factor analysis indicated a three factor structure (i.e., socialization/nonverbal communication, repetitive behavior/restricted interests, and communication) (Matson, Boisjoli et al., 2010). The internal consistency for the entire measure was .97. For each of the subscales, socialization/nonverbal communication, repetitive behavior/restricted interests, and communication, Cronbach's alpha was .93, .91, and .82, respectively (Matson, Wilkins, Sevin et al., 2009). Convergent validity was examined via bivariate correlations (Pearson's *r)* with the measure being strongly correlated with the M-CHAT (r = .80; Robins et al., 2011) and moderately correlated with the personal-social domain of the BDI-2 (r = -.50; Newborg, 2005). Divergent validity was similarly assessed with the adaptive domain of the BDI-2 being weakly correlated (r = -.19; Matson, Wilkins, & Fodstad, 2011). Based on the cutoff scores described above, sensitivity and specificity were .93 and .86, respectively, with an overall correct classification rate of .88.

Procedure.

As part of the EarlySteps screening process, children's caregivers were administered the BDI-2, M-CHAT, and BISCUIT. When possible, observations of the child were also incorporated into the assessment. Clinicians administering these measures had all been through training regarding EarlySteps procedures and administration of the measures in a standardized manner. Clinicians were professionals in areas such as physical therapy, occupational therapy, social work, education, speech–language pathology, and psychology who had all attended trainings on ASD. The Louisiana State University Institutional Review Board and Louisiana's Office for Citizens with Developmental Disabilities provided prior approval for this study. Informants were the legal guardians of the infants and toddlers included in this study and provided informed consent. These data from EarlySteps have been collected over several years (2008 to 2012).

Using the preexisting data, a licensed doctoral level clinical psychologist with over 35 years of experience in the field of autism and developmental disabilities used an established research method of diagnosis based on test scores to extract diagnoses for the children in the sample (Fombonne et al., 2004). The clinician made diagnoses for two separate datasets. Both datasets were similar in that they included the same children, each child's demographic information, and scores on the BDI-2 and M-CHAT; however, the datasets differed in that one provided *DSM-IV-TR* diagnostic criteria and the second set used *DSM-5* diagnostic criteria. The clinician then used the information provided to determine the most appropriate diagnosis (i.e., AD or PDD-NOS for *DSM-IV-TR* criteria or ASD for *DSM-5* criteria). Identification numbers were used to ensure the clinician was blind to diagnoses given in the other dataset. Additionally, a second clinician diagnosed a subsample of cases to establish inter-rater reliability on the *DSM-*

IV-TR criteria. The agreement between the two clinicians was found to be excellent with a Kappa value of .95.

For the current study, children needed to have BDI-2 and M-CHAT scores in the database as well as the *DSM-IV-TR* and *DSM-5* criteria, as these data were needed for diagnoses to be assigned. Only those children who received a diagnosis of AD or PDD-NOS using *DSM-IV-TR* criteria *or* received a diagnosis of ASD based on *DSM-5* criteria were included. Additionally, based on Donner's (1982) justification of retaining a participant if less than 10% of the items were missing and replacing these with the mean for that item, children who were missing six or fewer BISCUIT items were still included in the study and those missing items were replaced with the mean for that item. If a child's data were missing more than six items, the child was removed from the sample. The remaining children were then randomly split into two different sub-samples: one for the EFA and one for the CFA.

The current study used both EFA and CFA procedures to examine the factor structure of the BISCUIT. The EFA was conducted in an attempt to replicate the results from the previous EFA of the BISCUIT (Matson, Boisjoli, et al., 2010). Per the methods used in the previous EFA of the BISCUIT, a principle axis factoring was used. Additionally, a promax rotation was used as this is appropriate when factors are likely to be correlated. Internal consistency of each factor's items was then examined using Cronbach's alpha.

The main purpose of the study, however, was to use confirmatory methods which examined the fit of the BISCUIT to the current three factor model and the proposed two factor model. In addition, the current study directly compared the fit of these two models using structural equation modeling to determine if one model was superior. CFA uses *a priori* hypotheses about relationships between observable variables and latent variables. For the

models in this study, the observed variables were the individual items from the BISCUIT- Part 1. In the two factor model, the two proposed latent variables were social communication and repetitive/restricted behavior. Determining on which latent factor the BISCUIT items were anticipated to load was made based on supporting theory and relevant literature. For the three factor model, the proposed latent variables were the current triad of symptoms (i.e., communication, socialization, and repetitive/restricted behavior). Designating which of the latent variables items loaded onto was made by examining the results of both the previous EFA from Matson, Boisjoli, et al., 2010 and the current replication of the EFA. As the results from these two EFAs were not completely equivalent, theory was used when needed to determine which factor an item should load on. That is, most of the items loaded onto the same factors in both iterations of the EFAs; however, for those items that differed on which factor they loaded onto, each item was examined individually and assigned a factor based on theory. For example, if the item "Make believe or pretend play" loaded on the verbal communication domain for one EFA and socialization on the other, theory and research would suggest this item might fit better on the socialization factor (Manning & Wainwright, 2010). For both of the CFAs, the latent variables were correlated within each model as research supports a correlation among symptom domains (Hattier & Matson, 2012; Kuenssberg, McKenzie, & Jones, 2011).

The following indices with corresponding cutoffs were used to interpret model fit for the CFA: Chi-square ($p > .05$), Chi-square/degrees of freedom ratio (CMIN/DF), root mean square error of approximation (RMSEA; < .06), standardized root mean square residual (SRMR; < .08), and comparative fit index (CFI; >.95). Although other fit indices are noted to exist, complete consensus on which indices to examine has not been reached among researchers. The chosen indices are supported by the majority of researchers and are said to indicate several aspects of

model fit without redundancy (Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999; Kline, 2005). Factor loadings of each item and the amount of variance explained due to the inclusion of each item were also examined. Additionally, post hoc modification indices were applied to improve model fit following the initial iteration of each model. These indices were only used when modifications could be supported with theory as suggested by the literature (Jackson, Gillaspy Jr., & Purc-Stephenson, 2009).

Once the two and three factor models were examined independently for model fit, the nested models were directly compared using a Chi-square difference test. A Chi-square value that is not significantly different when comparing the two models would result in the conclusion that the models are equivalent, and the more parsimonious, two-factor model is not significantly better than the three factor model. If the value of Chi-square is significantly different when comparing the two models, the model with the lower Chi-square value will be preferred.

Results

For the replication of the EFA, principle axis factor analysis was used with a promax rotation. This method was used since the goal was to replicate the previous EFA results which already indicated three factors (Leech, Barrett, & Morgan, 2008). With regard to the assumptions included in the analysis, the Saiser-Meyer-Olkin (KMO) measure indicated that there were enough items predicted by each factor (KMO = .916). Additionally, the Bartlett test was significant, indicating that items were highly correlated enough to provide reasoning for factors to be formed ($p < .001$). For the analysis, three factors were entered based on the previous EFA from the BISCUIT. After the promax rotation, chosen due to the correlation between factors, the three factors accounted for 33.66% of the variance. The first factor (repetitive and restricted behaviors) explained 22.42% of the variance followed by the second factor (socialization) which accounted for 6.38% of the variance and then the third factor (verbal communication) which explained 4.87% of the variance. Unlike the original study which removed items with factor loadings less than .30, all items were retained here as the purpose of replicating the EFA was to inform decisions about assigning items to factors in the CFA. Items and their loading are reported in Table 3. In addition, Cronbach's alpha for each factor was calculated to examine internal consistency among items on a factor. Internal consistency was .917 for the repetitive and restricted behavior factor, .897 for socialization, and .791 for verbal communication.

Table 4. EFA Factor Loadings

	Factor 1	Factor 2	Factor 3
39. Interest in highly restricted set of activities*	.665		
33. Sticking to odd routines or rituals that don't have a purpose or make a difference*	.659		
55. Limited number of interests*	.637		
34. Abnormal preoccupation with parts of an object or objects*	.632		

(Table 4 continued)

	Factor 1	Factor 2	Factor 3
58. Abnormal or repetitive motor movements involving the entire body*	.591		
42. Abnormal fascination with the movement of spinning objects*	.590		
27. Restricted interests and activities*	.567		
43. Curiosity with surroundings*	.514		
48. Becomes upset if there is a change in routine*	.514		
4. Engages in repetitive motor movements for no reason*	.513		
13. Reaction to normal, everyday lights*	.513		
57. Abnormal, repetitive hand or arm movements*	.507		
41. Use of facial expressions*	.494		
11. Reactions to normal, everyday sounds*	.487		
30. Reaction to sights and sounds*	.495		
49. Needs reassurance, especially if events don't go as planned*	.456		
32. Facial expressions corresponds to environmental events	.409		
26. Displays a range of socially appropriate facial expressions*	.405		
37. Speaks in monotone	.401		
44. Saying words or phrases repetitively*	.391		
38. Expects others to know their thoughts, experiences, and opinions without communicating them*	.391		
6. Prefers foods of a certain texture or smell*	.369		
36.Reads nonverbal cues of other people	.365		
12. Response to others' social cues	.363		
46. Understanding of age appropriate jokes, figures of speech, or sayings	.348		
60. Respect for others' personal space	.340		
47. Gives subtle cues or gestures when communicating with others	.338		
54. Clumsiness	.336		
15. Rhythm of speaking	.318		
28. Motivated to please others	.317		
7. Ability to recognize emotions of others	.309		
8. Maintains eye contact*	.305		
51. Responds to others' distress	.301		
23. Body posture and/or gestures	.297		
56.Imitiation of an adult or child model	.293		
29. Eye-to-eye gaze*	.289		
21. Able to understand subtle cues or gestures of others	.284		
22.Use of too few or too many social gestures	.273		
17. Shares enjoyment, interests, or achievements with others	.265		
25. Likes affection	.239		
40. Talking to others in a social context	.222		
14. Peer relationships*		.953	
10. Social interactions with other his/her age*		.931	

(Table 4 continued)

	Factor 1	Factor 2	Factor 3
52. Socializes with other children*		.931	
35. Plays appropriately with others*		.870	
18. Ability to make and keep friends*		.843	
59. Development of social relationships*		.810	
19. Interest in participating in social games, sports, or activities*		.470	
62. Participation in games or other social activities*		.465	
61. Isolates self		.417	
31. Awareness of the unwritten or unspoken rules of social play		.384	
20. Interest in another person's side of the conversation*		.305	
9. Use of language to communicate*			.897
5. Verbal communication *			.785
1. Communication skills*			.761
50. Language development*			.723
16. Use of language in conversation with others*			.676
24. Communicates effectively*			.574
53. Use of nonverbal communication*			.372
2. Intellectual abilities			.272
45. Make-believe or pretend play			.250
3. Age appropriate self-help and adaptive skills			.220

Note: * indicates items on factor loads on to corresponding factor from original EFA (Matson, Boisjoli, et al., 2010)

Next, the two and three factor CFAs were analyzed. For both models, it was decided that three of the items from the BISCUIT did not fit in any of the symptom categories and thus were removed. These items were numbers 2. Intellectual abilities, 3. Age appropriate self-help and adaptive skills, and 54. Clumsiness. While cognitive and adaptive impairments and motor skill deficits are common in children with ASD, these characteristics are not necessary in either version of the DSM in order for a diagnosis to be given (Diamond, 2000). Since CFAs should be theory driven and because these three items had low factor loadings in the EFAs (.10, .18, and .33, respectively), their removal was justified. After these items were removed, items were loaded onto the factors as described in the methods section and modification indices were applied.

Overall, both models were found to have good fit on some of the fit indices. The two factor model of social communication and repetitive/restricted behavior had good fit according to the SRMR index (.078) and CMIN/DF (2.80). The RMSEA indicated the two factor model had reasonable fit (.067). Not surprisingly due to its sensitivity to sample size, Chi-square was significant (<.001), indicating poor fit. The CFI was also not significant at .698, indicating poor fit. Similar results were found with the three factor model which separated communication and socialization. The SRMR and CMIN/DF both indicated good fit (.080 and 2.52, respectively). According to the RMSEA index, the three factor model had reasonable fit (.062). And again, the Chi-square statistic was significant (<.001), and the CFI was not significant (0.744).

In both the two and three factor models, the factors themselves were correlated as research supports the relation between symptom areas in ASD (Hattier & Matson, 2012; Kuenssberg, McKenzie, & Jones, 2011). In the two factor model, the correlation between social communication and repetitive and restricted behaviors was .69, a moderate relation. For the three factor model, communication and social domains were correlated at .37; the social domain and behavior symptoms were correlated at .74; and behavior and verbal domains were correlated at .20. Factor loadings, the correlation between each item and the corresponding latent variable, were also examined. For the two factor model, all but five items had factor loadings greater than 0.3: Verbal communication, interest in another person's side of the conversation, likes affection, talking to others in a social context, and language development. Factor loadings of these items ranged from 0.14 to 0.29 and were all on the social communication factor. Within the three factor model, there were also five items that had factor loadings less than 0.3. There was one item on the behavior factor (saying words and phrases repetitively), two items on the communication factor (rhythm of speaking and speaks in monotone), and two items on the

socialization factor (likes affection and talking to others in a social context). Factor loadings greater than .3 on all of the other items suggest those items were appropriately correlated for that specific factor within the model.

Next, in order to directly compare the two models, with the more parsimonious two factor model being nested in the three factor model, a Chi-square difference test was completed. The results were significant at the .001 level, suggesting that the three factor model was preferred to the two factor model. Thus, based on the CFA using the BISCUIT, the factor structure of communication, socialization, and repetitive/restricted behaviors is more appropriate than the two factor structure of social communication and repetitive/restricted behaviors.

Discussion

With the upcoming changes to the conceptualization of symptom categories for ASD, researchers need to re-examine the measures used to assess and diagnose children with autism. There is a large base of literature, as well as concensus by experts in the field that the combination of communication and socialization domains is warranted (Carpenter, Nagell, & Tomasello, 1998; Dube, MacDonald, Mansfield, Holcomb, & Ahern, 2004; Stanton-Chapman & Snell, 2011). The BISCUIT, a measure used to screen and assess ASD symptoms in infants and toddlers, is one of the measures that could benefit from being re-examined as it currently uses a three factor structure. It would be beneficial to determine if the BISCUIT could be adapted to the new *DSM* structure which has been supported by other researchers. Therefore, the current study aimed to examine the two and three factor models for the BISCUIT individually using confirmatory factor analysis and then compare these two models against each other to determine if one had better fit. Examining the factor structure of the BISCUIT will inform what adaptations or changes may be needed to ensure the measure remains relevant and in line with diagnostic criteria.

The purpose of the first part of the current study was to replicate and re-examine the EFA that had previously been conducted on the BISCUIT Part- 1 (Matson, Boisjoli, et al., 2010). The three factor structure found with the current EFA largely replicated the findings from the previous study by Matson and colleagues. The factor solution explained 33.66% of the total variance of the items which was similar to the amount of variance explained from the first EFA, 33.22%. Additionally, the content on each of the three factors closely mirrored those factors found in the previous EFA with the factors largely corresponding to the broader categories of repetitive and restricted behavior, socialization, and verbal communication. Where the results

differed slightly was in what factor some of the individual items loaded onto. For example, in the first study, the item "isolates self" was on the repetitive behavior and restricted interest factor, but in the current EFA, this item fell on the socialization factor. Overall, 61% of the items from the two EFAs corresponded in terms of which factor they corresponded to.

The difference in what factors some items loaded onto was not surprising due to the exploratory nature of the analyses. Researchers have highlighted the difficulties in replicating results of EFAs (Osborne & Fitzpatrick, 2012; van Prooijen & Van Der Kloot, 2001). Even in ideal conditions (e.g., clear factor structure and high factor loadings), reproducing the same results of an EFA can be difficult with loadings of individual items varying across analyses (Osborne & Fitzpatrick, 2012). This is the nature of this type analysis and the reason that confirmatory analyses are often the necessary second step to examine factor structure of measures (Hurley et al., 1997). In the current study, however, replicating the EFA aided in determining which items should be placed on each of the factors during the subsequent confirmatory analyses.

Because of the known weaknesses in exploratory methods described above, the next goal was to examine the two and three factor models using confirmatory methods which allowed for a more theory driven approach to determining the number of symptom clusters in the BISCUIT (Brown, 2006). Results for both the two and three factor models were somewhat mixed with some indices supporting good fit and others not. These mixed findings are not uncommon in the literature. For example, Snow et al., (2009) and Lecaviler et al. (2009) who also used CFA to examine the structure of autism symptoms reported that some indices showed good fit while others showed poorer fit. In the end, it is not necessary for all model indicators to show good fit to conclude that a model structure is appropriate (Xitao & Sivo, 2007).

Another consideration when interpreting factor indices is that some indices are more sensitive to certain variables which may alter results. For example, Chi-square is susceptible to larger sample sizes and can lead to models being dismissed as having poor fit (Xitao & Sivo, 2007). This weakness with the Chi-square statistic is why the CMIN/DF statistic was also used in the current study since it accounts for sample size (Ory & Mokhtarian, 2010). In this case, the CMIN/DF did lead to the conclusion that both models fit the data relatively well, as opposed to Chi-square which indicated poor fit.

In addition to the fit indices, the factor loadings of items for the CFAs should be mentioned. The factor loadings in the CFA indicate how highly the item correlates with the latent factor. In both models, factor loadings for each item were generally high, mostly above 0.3 indicating that most items fit strongly within the designated factor. Some of the items (specified in the results section), however, had factor loadings lower than would be desired. For example, the item "likes affection" had low loadings in both models. Items with low factor could be considered for removal or rewording as the BISCUIT continues to be adapted for the *DSM-5*. For the purposes of the current study, these items were retained in order to examine the BISCUIT in its entirety.

The results from the CFAs for the two and three factor models appeared quite similar when examining the fit indices alone, and it could be concluded that perhaps both models fit the data. However, it would be helpful to determine if one model was superior to the other. Therefore, in order to directly compare the two models, the Chi-square difference test was used. The results from this test were significant indicating the less parsimonious model with three factors was preferred. Consequently, these results suggest that the model which more closely reflects the current *DSM-IV-TR* was preferred over the more parsimonious two factor model

based on changes in the *DSM-5*. The conclusion from these results could also be interpreted as evidence that the social and communication domains should not be collapsed, but other considerations should be made before making these inferences. Some would argue that deeming the three cluster model superior may not be the appropriate conclusion due to weaknesses with the Chi-square difference test. The Chi-square difference test is vulnerable to some of the same limitations as the Chi-square fit test in that large sample sizes can affect the outcome (Brannick, 1995). Unfortunately, a lack of other indices exist for comparing models (Cheung & Rensvold, 2002).

There may be several explanations as to why the results indicated that the three factor model was preferred over the two factor model. First, while not needed for a diagnosis of ASD, verbal communication impairments are very common in this population (Matson & Neal, 2010). Approximately 25% of children with ASD do not develop functional verbal language and most have some sort of functional language impairment (Tager-Flusberg, Paul, & Lord, 2005). The *DSM-IV-TR* states that there may be a delay or lack of spoken language that is not compensated for by some other mode of communication, and many children do experience this delay in language without an alternative way to communicate. As a result, it is not surprising that assessment items about verbal communication were highly endorsed and formed their own cluster. It is extremely important to note though that while these verbal communication deficits might be common, verbal communication impairments are not necessary and do not differentiate children with ASD from children with other developmental disorders. For example, children with other disorders or issues such as intellectual disability, hearing impairments, and developmental delay also often have communication delays (Matson & Neal, 2010). For this reason the *DSM-5* is moving away from categorizing communication and socialization

separately. Instead, the new system emphasizes the relation between communication and socialization impairments in people with ASD.

Also contributing to the reason for the three factor solution being favored over the two factor structure may be the current composition of some items in the BISCUIT. For example, there are items which only address verbal communication and do not incorporate a social component or specifically probe about compensatory methods of communication (e.g., signing, nonverbal communication). While these verbal communication items are very informative and currently contribute to diagnoses based on *DSM-IV-TR* criteria, items that do not incorporate a social component or address compensatory language would bias results toward supporting a three factor model. Therefore, it is likely the case that the BISCUIT, along with many other diagnostic measures which may have used the *DSM-IV-TR* in their development, may need to be revised. That being said, it is not necessarily the case that these items which probe solely verbal communication need to be removed, but perhaps just not included in a scoring algorithm and used instead as additional questions to gain information about the child.

The *DSM-IV-TR* three factor structure may have also been supported over the two factor structure due to some biases in the sample. The sample for the study required that children meet *DSM-IV-TR* criteria, *DSM-5* criteria, or both. These distinctions were chosen in order to ensure a large enough sample size; however, these three groups were not equally represented. That is, 488 children met criteria on both *DSM-IV-TR* and *DSM-5*, while 478 met on *DSM-IV-TR* only, and 45 met on *DSM-5* only. As can be seen by these numbers, the *DSM-5* only group is underrepresented, and hence it would be logical for the two factor structure to have less support since fewer children meet on this classification system. It would have been preferable if all groups could have been represented evenly.

While imbalance in the sample is a weakness in the data, the discrepancies in the group numbers highlight an important change that may result with the new *DSM-5*. That is, some researchers have stated that new criteria will likely exclude some children who currently have ASD diagnoses from meeting criteria under the new system (Dickerson Mayes, Black, & Tierney, 2013; Worley & Matson, 2012). Similar changes in prevalence of disorders have been seen after other revisions of the *DSM* (Spitzer, Endicott, & Robbins, 1978). Specifically, the increased requirement for repetitive and restricted behaviors, needing to exhibit two of the four symptoms, will lead to some children no longer meeting the diagnostic criteria (Frazier et al., 2012). This exclusion of some children leads to many questions about implications for services and what will happen to children who no longer meet criteria for a diagnosis of ASD. Full implications of the new revisions will not be known until the *DSM-5* is used clinically.

In the end, it is likely that a two factor symptom structure that combines social and communication symptoms under one category will be adopted to diagnose ASD, based on supporting literature and consensus from the planning committees. As a result, assessment measures may need to be adapted and re-validated so that diagnoses using the new system criteria can be made using standardized measures. While the Chi-square difference test found the three factor structure of the BISCUIT to be superior to the two factor structure, both models were supported by some of the fit indices. This means that the two factor model for the BISCUIT can be used and adapted for the new diagnostic criteria, which have been supported by other researchers. Therefore, there should be a push in continued development of the BISCUIT as new research becomes available. With the support for the BISCUIT fitting the two factor model, subscales can be re-established and new scoring criteria can be developed. Determining cutoff scores for each symptom domain to ensure symptoms are present in both categories may

be helpful in identifying young children with ASD. It may also be the case that in order to better represent the two factor model supported in this study, some items need to be removed, reworded, or used only to glean descriptive information.

While research supports the combination of the social and communication domains, it should be noted that controversy around this issue and the new DSM-5 criteria exists. Some researches and experts in the field have expressed that the new system will remove diagnoses from children and adults who still present with significant impairing symptoms (Worley & Matson, 2012). In removing diagnoses from people, services that individuals receive will also likely be taken away. In the end, it may take several years to determine the impact that the changes in the *DSM-5* will have on children and adults with ASD; however, clinicians and researchers should continue to use the best tools available to diagnose and treat the people they serve with ASD.

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Appendix

Project Report and Continuation Application

(Complete and return to IRB, 131 David Boyd Hall, Direct questions go to IRB Chairman Robert Mathews 578-8692.)

LSU

Institutional Review Board
Dr. Robert Mathews, Chair
131 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu
lsu.edu/irb

IRB#: 2609 Current Approval Expires On: 09/14/2012

Review Type: Expedited Risk Factor: small

PI: Johnny Matson Dept: Psychology Phone: 225-578-8745

Student/Co-Investigator:

Project Title: Developing the Autism Spectrum Disorder

Number of Subjects Authorized: 2000

Please read the entire application. Missing information will delay approval!
IRB Security of Data Agreement: http://research.lsu.edu/files/item26774.pdf

I. PROJECT FUNDED BY: N/A LSU Proposal #:

II. PROJECT STATUS: Check the appropriate blank(s) and complete the following:

- (●) 1. Active, subject enrollment continuing; # subjects enrolled: 676
- ( ) 2. Active, subject enrollment complete; # subjects enrolled:
- ( ) 3. Active, subject enrollment complete; work with subjects continues.
- ( ) 4. Active, work with subjects complete; data analysis in progress.
- ( ) 5. Project start postponed; date:
- ( ) 7. Project cancelled: no human subjects used.
- ( ) 6. Project complete; end date:

III. PROTOCOL: (Check one).

- (●) Protocol continues as previously approved
- ( ) Changes are requested*
  --List (on separate sheet) any changes to approved protocol.

IV. UNEXPECTED PROBLEMS: (did anything occur that increased risks to participants):
--State number of events since study inception: 0 since last report: 0
--If such events occured, describe them and how they affect risks in your study, in an attached report
--Have there been any **previously unreported** events? Yes/No: n

V. CONSENT FORM AND RISK/BENEFIT RATIO:
Do new knowledge or adverse events change the risk/benefit ratio? Yes/No: n
Is a corresponding change in the consent form needed? Yes/No: n

VI. ATTACH A BRIEF, FACTUAL SUMMARY of project progress/results to show continued participation of subjects is justified; or to provide a final report on project findings.

VII. ATTACH CURRENT CONSENT FORM (only if subject enrollment is continuing); and check the appropriate blank:

- (●) 1. Form is unchanged since last approved
- ( ) 2. Approval of revision requested herewith: (identify changes)

Signature of Principle Investigator: J. L. Matson **Date:** Sept. 4, 2012

IRB Action:
- __V__ Continuation approved; **Approval Expires:** 9/9/13
- ____ Disapproved
- ____ File Closed

Signed Robert Mathews Date 9/10/12

Print Form

ASD STUDY Consent Form

1. **Study Title:** Developing the Autism Spectrum Disorder (ASD)

2. **Performance Sites:** Louisiana State University Psychological Services Center, preschools, grade schools, churches, hospitals or outpatient clinics, organizations, and internet websites.

3. **Contacts:** Johnny L. Matson, Ph.D. (225) 578-8745 Mon-Fri

4. **Purpose of the Study:** Several diagnostic instruments exist that are designed to determine the presence of emotional difficulties and behavior problems in children and adults. Currently, there are no screening instruments that incorporate differential diagnosis of the developmental disorders. The purpose of this study is to develop assessment instruments designed to examine the social skills, challenging behaviors, and symptoms of emotional difficulties in children, as well as autistic traits in adults.

5. **Subjects: Inclusion Criteria:** Parents of children who are ≤ 18 years old receiving services at the Psychological Services Center; children who are receiving inpatient or outpatient medical/behavioral services, or currently attending preschools, grade schools, or church groups; children recruited via websites or organizations such as those for children with ASD or disabilities; and adults residing in the community. **Exclusion Criteria:** Parents, legal guardians, or informants unable or unwilling to provide informed consent or parental consent. **Maximum number of subjects:** 2000

6. **Study Procedures:** Assessment instruments designed to examine the social skills, challenging behaviors, and symptoms of emotional difficulties in individuals will be administered to the sample of 2000 adult participants (i.e., parents of child participants). Participants will receive information about the study and given an opportunity to volunteer through informational mail-outs at their child's school, church, or clinic, etc. or information given to them when calling about services at the Psychological Services Center. Once consent is granted, participants will be given assessment packets regarding the following either in person at the outpatient clinic, mail, or Internet link. Participants will provide information regarding the individual's: 1) demographics (e.g., age, gender, ethnicity, parents' names, number of siblings, etc.); 2) current psychotropic drug use and diagnoses; 3) developmental milestones; 4) social skills (e.g., turns head toward caregiver, initiates verbal communication, complains often, prefers to be alone, disturbs others, interacts positively with others, etc.); 5) challenging behavior (i.e., circumstances which the target behavior occurs); and 6) symptoms of other difficulties (e.g., tantrums, excessive worry or concern, initiates fights, fidgets or squirms excessively, stereotypies, intellectual disability, impaired social interactions, has odd gait when running, language delays, etc.). Participants who receive the packet via mail will receive a follow-up phone call to ensure that they have received the packet and have the opportunity to ask questions. This study will take approximately 1 hour to 1.5 hours for each participant. Additionally, children (recruited from the outpatient clinic) of a subset of the sampled adult participants (i.e., parents of child participants) will be administered an abbreviated assessment of intellectual functioning.

7. **Benefits:** Participants under the age of 18 years may benefit from this study by taking advantage of reduced price assessment services at the Psychological Services Clinic in Baton Rouge, Louisiana. If participants decide to take advantage of this offered benefit, participants will be required to come into the clinic to complete a parent interview and child observation session. If further assessment services are recommended, the participant may receive these services at half of the normal fee. All treatment services will be full price. Further, participants may benefit from professionals developing more reliable and valid assessment measures, suggesting improved diagnostic capabilities and more effective treatment interventions.

8. **Risks/Discomforts:** There is a small possibility of disclosure of personal information associated with this study. There are no other known risks resulting from participating in this study. Risks experienced should be those limited to those commonly experienced when receiving services from a public mental health clinic.

9. **Measures taken to reduce risk:** All participants will be given participant numbers. All data collected will be stored in reference to this number only. There will be one (1) master list which will list patient number by participant number to provide a means by which participants can chose to remove their data from the data set after participation. This list will be the only means by which data collected can be linked to personal information such as name or patient number. This list will be stored in a locked file cabinet, separately from the data collected.

10. **Right to Refuse:** Participation is voluntary. Participants may change their mind and withdraw from the study at any time before the conclusion of the study without penalty or loss of any benefit to which they may otherwise be entitled.

11. **Privacy:** This study is confidential. Data will be kept confidential unless release is legally compelled.

12. **Financial Information:** There is no cost to the participant and no payment will be provided for participation.

13. **Withdrawal:** There are no consequences for terminating participation in this study, which will last approximately 1 hour and 30 minutes in duration for each participant. To withdraw from the study, participants must inform the principle investigator of their desire to do so before the end date of the study.

14. Removal: A participant's data may be removed from the study if it is discovered that there were errors in the administration of any measure for that particular participant.

ASD Consent Form—Detach this page, Complete, and Return

The study has been described to me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigators by contacting Megan Hattier at 225-578-1494 or asdlsu@gmail.com.

If I have questions about subjects' rights or other concerns, I can contact Robert C. Mathews, Chairman, LSU Institutional Review Board, (225) 578-8692. I agree to participate in the study described above and acknowledge the researchers' obligation to provide me with a copy of this consent form if signed by me.

_____Parent/Guardian/Informant Signature _____Date

_____ (Please Print Name of Parent/Guardian/Informant)

_____Signature of Adult Participant (if applicable)_____ Date

_____ (Please Print Name of Adult Participant if applicable)

The participant has indicated to me that he/she is unable to read. I certify that I have read this consent form to the participant and explained that by completing the signature line above he/she has given permission to participate in the study.

_____Signature of Reader _____Date

****

PLEASE FILL OUT THE FOLLOWING CONTACT INFORMATION:
(A research assistant will contact you to obtain additional information and answer any questions you may have before mailing questionnaires or sending email link to survey)

Telephone number(s) where informant can be reached: _____

Best time of day to be reached: _____

Mailing Address: _____

Email Address: _____

Circle to indicate your preference for the question below:

INTERNET (electronic) **MAIL (paper)** Would you prefer to be mailed the questionnaires in paper with a prepaid envelope included OR receive an Internet link via email to the questionnaires to complete the questionnaires electronically on the Internet.

If you answered MAIL (paper), please answer the following additional questions:

YES NO 1. Would you be willing to complete a shorter set of similar questions approximately 2 weeks after completing the first?

YES NO 2. Is there a second adult who knows your child well (other parent,

grandparent, etc.) who would be willing to complete the questionnaires for your child independently from yourself?

YES NO 3. Do you consent to your child's teacher completing a similar set of questionnaires for your child?

Study Approved By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Approval Expires: 9/9/2013

Vita

Originally from Baltimore, Maryland, Megan Sipes received her bachelor's degree at the University of Maryland, Baltimore County in 2008. She then attended Louisiana State University where she received her master's degree in 2010. Her clinical and research interests are in assessing and treating children and adults with autism and other development disorders. She will receive her doctoral degree in August 2013 and plans to work in Baltimore at the Kennedy Krieger Institute upon graduation.