2011

Comorbid psychopathology in children with Autism Spectrum Disorders - cut-off scores for the Autism Specturm Disorders-comorbidity for children (ASD-CC)

Ryan Thomas Thorson
Louisiana State University and Agricultural and Mechanical College

COMORBID PSYCHOPATHOLOGY IN CHILDREN WITH AUTISM SPECTRUM DISORDERS – CUT-OFF SCORES FOR THE AUTISM SPECTRUM DISORDERS – COMORBIDITY FOR CHILDREN (ASD-CC)

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
In partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by
Ryan Thomas Thorson
B.S., Minnesota State University, Mankato, 2003
M.A., Louisiana State University, Baton Rouge, 2007
August 2011

Acknowledgements

I am grateful to Dr. Johnny Matson, my advisor, for his guidance and for opening so many doors professionally. I am also grateful to my committee members for their expertise throughout my training, including suggestions and guidance on my research. Their unique insight guided my training and development and helped me become who I am today. I also thank many of my peers who helped with data collection, coordination of projects and databases, and with handling documents in person while I was out of the state completing my training. In particular, I thank Ali Kozlowski for her help in this regard. I would also like to acknowledge Dr. Dennis Dixon for his suggestions on improvements of the manuscript.

Above all, I am grateful to my wife, Dr. Ashley Thorson, for her support and encouragement, understanding, patience, and sacrifices during my graduate training. I am also thankful for the support of my parents, Stephen and Renee Thorson, who have supported me and had faith in me throughout the most challenging moments. Lastly, I want to acknowledge my brother Travis, who is no longer with us but has shaped me to become the man I am today.

Table of Contents

Abstract

Once considered rare, Autism Spectrum Disorders (ASD) are increasingly becoming viewed as common disorders. Prevalence rates of ASD have increased drastically in recent years. Recent studies suggest comorbid psychopathology within ASD to be more common than previously thought. Though these deficits exist, specific instruments to diagnose psychopathology in this population do not yet exist. This highlights the underlying need for instruments to identify psychopathology in individuals with ASD. The aim of this study was to establish cut-off scores for the Autism Spectrum Disorder – Comorbidity for Children, an instrument designed to assess for comorbid psychopathology within individuals with ASD.

Introduction

In 1979, the term "autistic spectrum disorder" was coined to describe children with impairments similar to autism, but who did not meet full diagnostic criteria (Wing & Gould, 1979). The autism spectrum is composed of five disorders: Autistic Disorder (AD), Asperger's Disorder (AS), Rett's Disorder, Childhood Disintegrative Disorder, and Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS). Autism and related disorders have gained worldwide attention and is often referenced as Autism Spectrum Disorders (ASD) rather than the traditional encompassing term of Pervasive Developmental Disorders (PDD); this is likely to be reflected in forthcoming DSM-V and is not without criticisms (Wing, Gould, & Gillberg, 2011). The overwhelming majority (>99%) of identified cases are classified under three of the five diagnostic subtypes of ASD; Rett's Disorder and Childhood Disintegrative Disorder account for less than one percent of ASD (American Psychiatric Association, 2000).

A number of diagnostic tools have been developed over the years to help identify the presence of various ASD. Until recently, tools were only designed to identify AD (Gilliam, 1995; Lord, Rutter, & Le Couteur, 1994; Lord, Rutter, Goode, & Heemsbergen, 1989; Schopler, Reichler, & Renner, 1988). More recently, assessments have been developed to identify the presence of AS and to differentially diagnose between AD, AS, and PDD-NOS (Gilliam, 2001; Krug, 2003; Matson, Terlonge, & González, 2006). While more recent assessment instruments are relatively updated and focus on DSM-IV-TR criteria, this is not the case for all AD assessment instruments. A number of assessments still in common use were designed under considerably outdated criteria, including popular assessments such as the Childhood Autism Rating Scale (CARS), the Autism Diagnostic Interview-Revised (ADI-R), and the Autism Diagnostic Observation Schedule (ADOS). While many autism scales are outdated, many of the

more modern instruments geared to measure AS and PDD-NOS are at least normed and keyed to current DSM criteria. Ideally, these more modern assessments help shape the DSM-V and ICD-11 (Wing, et al., 2011).

Differential diagnosis in ASD is challenging as there is significant diagnostic overlap with a number of other disorders. Most notably, there is overlap with negative aspects of psychotic disorders and many facets of various anxiety disorders. In cases where individuals are low-functioning, the reliance on caretaker report increases. Financial or service-related motivations for families seeking particular diagnoses continue to become more troublesome given the vast amount of information available to families regarding ASD. An even more daunting challenge might be the assessment of psychopathology within children with ASD. Comorbid psychopathology within ASD is commonly accepted, though it is poorly understood (Ghaziuddin, Ghaziuddin, & Greden, 2002; Matson & Nebel-Schwalm, 2007). This lack of understanding of psychopathology within ASD is highlighted by high comorbid diagnostic rates as well as practitioners rarely following criteria set forth in the DSM regarding differential diagnosis (Gadow & DeVincent, 2005). Given that research has suggested there are significant errors in some of the rule-outs for comorbid psychopathology with ASD, this deviation from the DSM may be a positive phenomenon (Gadow & DeVincent, 2005).

A number of comorbid psychopathologies have been associated with ASD. These comorbid diagnoses are widely variable. Identified diagnoses include behavioral disorders, emotional disorders, and mood disorders; there is less information available regarding how these diagnoses were reached (Matson & Nebel-Schwalm, 2007). The key criticism lies in the lack of evidence-based assessment within this population, highlighting the need for research in this area. Prior to the emergence of attention paid to ASD in both the public and professional world, it is

possible many of these diagnoses may be incorrect due to the shared diagnostic criteria between such disorders (e.g., ADHD); these concerns will be discussed in further detail later in the manuscript.

The three most common ASD were the focus of the current study and will be reviewed. This review will be followed by reviews of common comorbid psychopathology within peer-reviewed literature regarding ASD. Examination of comorbid psychopathology is particularly vital and challenging given the paucity of research directly examining these phenomena. A synopsis of assessment instruments for comorbid psychopathology within ASD as well as techniques available to establish cut-off scores will complete this review.

Three Major Diagnoses Included in ASD

Though the DSM-IV-TR acknowledges five subtypes of Pervasive Developmental Disorders, three stand out with prevalence rates markedly higher than the rest. Autistic Disorder, Asperger's Disorder (also called Asperger's Syndrome), and Pervasive Developmental Disorder – Not Otherwise Specified account for almost all documented cases of ASD. Rett's Disorder occurs only in 1 in 10,000 to 1 in 15,000 births (Hegberg, 1989). Childhood Disintegrative Disorder (CDD) is another rare form of ASD which is reported to occur in approximately 1 to 6 per 100,000 births (Burd, Fisher, & Kerbeshian, 1987; Fombonne, 2002). Given their rarity and exclusion from the focus of this manuscript, these two disorders will not be thoroughly examined.

Autistic Disorder/Autism (AD)

In 1943, Leo Kanner observed 11 children with odd patterns of behavior which resembled each other. These behavioral patterns included abnormal development of language, deficits and excesses relating to social skills, and a need for sameness in their environment

(Kanner, 1943). These children also seemed to perceive the world around them differently than other children and evinced language deficits including inflexible and/or literal use of language, often including echolalia and delayed speech development. Verbal language, when exhibited, often included the aforementioned echolalia and included repetitive use of nonfunctional sounds. Kanner noted that social skill difficulties were also common, including poor eye contact and a lack of appropriate reciprocal conversation. These children were described as functioning in a separate world from those around them, preferring to be left alone and ignoring their surroundings (Kanner, 1943). Kanner referred to "insistence on sameness" as a unique feature of these children, who exhibited little spontaneous activities or toy play. Peculiar behaviors were noted, including arranging toys by color, size, or following patterns. Lastly, Kanner observed some of the children exhibited irrational fears which were not age-appropriate. These children did not exhibit particularly unique behaviors; rather the combination of these behaviors seemed to differentiate these children from typically-developing children or children identified with other disorders. The diagnosis of AD was eventually derived from these original observations. AD is commonly referred to as "autism", and these terms will be used interchangeably within this manuscript.

The core symptoms of AD as defined in DSM-IV-TR remain similar to those originally described (Kanner, 1943). However, one noteworthy difference involves the intellectual abilities of children. It has commonly been found that approximately three out of four children with Autistic Disorder also suffer from mental retardation (MR)/intellectual disability (ID), which deviates from Kanner's belief that children with autism were of at least average intelligence (Mágnússon & Sæmundsen, 2001; Rutter, 1983; Wing, 1996). Following his 1943 article, beliefs and understanding of autism evolved and Kanner later refined his definition of autism

with Leon Eisenberg. This revision reduced the essential features of autism to identifying "extreme aloneness" and "insistence on sameness" (Eisenberg & Kanner, 1956). While language difficulties were the most noteworthy omission from this revision, Eisenberg and Kanner's manuscript appears to be the first time an age of onset (before 2 years of age) was included within definitions of autism.

Autism was first popularized in mainstream media by Bruno Bettelheim through his Orthogenic School. This popularization was nowhere near the levels ASD have reached in today's media, but was significant given the era (Bettelheim, 1967). One major critic of Bettelheim's work was Bernard Rimland. Most principles on which Bettelheim's theories were founded were debunked by Rimland before Bettelheim's death in 1992 (Rimland, 1964).

One of the first manuscripts examining autism through a behavioral orientation was published in 1961. This publication viewed autism as a type of schizophrenia, as was a common misconception of the time (Ferster, 1961). Charles Ferster's writings theorized that children with autism learned their behaviors just as any other child learned behaviors. According to Ferster, every child had the opportunity for normal development. Ferster was not alone in his beliefs, as others believed children could develop autistic repertoires based on their learning history (Ferster, 1961; Margolies, 1977). Based on these details, it is obvious that research regarding AD certainly pre-dated its inclusion within the DSM.

Autism first appeared in DSM-III as "infantile autism", which, for the first time, standardized diagnostic criteria for what we call autism (American Psychiatric Association, 1980). At that time, the age of onset was deemed to be prior to 30 months. Diagnostic criteria was later modified to 36 months in DSM-IV (American Psychiatric Association, 1994). The

DSM-III also included "residual autism" as a diagnosis for individuals who previously met criteria for infantile autism, but no longer did.

The DSM has lagged behind what research has suggested regarding autism, and as a result, a number of diagnostic shortcomings tend to be identified before updated versions of the DSM are published. As a result of examination of such research, diagnostic criteria were revamped for DSM-IV. For the first time in the DSM's history, the DSM-IV utilized the term "autism" rather than "infantile autism" (American Psychiatric Association, 1987, 1994). Criteria for autism were expanded, "residual autism" was removed, and diagnostic criteria were modified such that autism could be diagnosed in individuals of any developmental level or age. Unfortunately, these changes reportedly resulted in many false-positive diagnoses of autism (Volkmar, Klin, Siegel, & Szatmari, 1994). These difficulties were attended to and clarified in field trials for DSM-IV.

Currently, the DSM-IV-TR requires qualitative impairments in communication, social interaction, and restricted, repetitive, and stereotyped patterns of behavior, interest, and activities. Communication deficits are manifested by at least one of the following: 1) lack of, or delay in, the development of speech; 2) inability/impairment in initiation or sustainment of conversations; 3) stereotyped or repetitive use of language or lack of imaginative play. Social skill deficits are manifested by at least two of the following: 1) marked impairment in the use of nonverbal communication, such as gaze, eye contact, and facial expressions; and 2) failure to establish developmentally appropriate peer relations, lack of spontaneous seeking to share interests with others, or a lack of social/emotional reciprocity. Within the area of restricted, repetitive, and stereotyped patterns of behaviors, at least one of the following behaviors must be endorsed: 1) preoccupation with one or more stereotyped patterns of interest; 2) inflexible

adherence to specific, nonfunctional routines; 3) stereotyped and repetitive motor behaviors; or 4) preoccupation with parts of objects. As previously mentioned, onset of these problems must be prior to 36 months of age. Additionally, clinicians need to determine if these conditions are not better accounted for by Asperger's Disorder, Pervasive Developmental Disorder – Not Otherwise Specified, Childhood Disintegrative Disorder, or Rett's Disorder, which share many features with autism but have particular distinctions of their own (American Psychiatric Association, 2000).

Asperger's Disorder

Austrian pediatrician Hans Asperger identified four male children who displayed abnormal patterns of behavior, but who also possessed high intellectual abilities and strong language skills shortly after Kanner's identification of autism the year prior (Asperger, 1944). The children described by Asperger exhibited many of the same features as those described by Kanner, including deficits included poor social skills, insistence on sameness, deficits in nonverbal language, stereotypies, and a lack of humor. These children were simply described as socially awkward, even though they had normally developed cognition and personality (Asperger, 1944). Per Asperger, verbal language was often adequate but nonverbal aspects including eye-to-eye gaze, gestures, and facial expressions were often absent. Asperger believed this syndrome to be unique from autism based on multiple features including: age of onset, language delay, intellectual ability, and prognosis (Asperger, 1944).

Asperger's Disorder (AS) first appeared in DSM-IV nearly fifty years after it was first described and followed the addition of Autistic Disorder (American Psychiatric Association, 1994). This disorder received very little attention in English literature until 1981 (Volkmar et al., 1996). A seminal review by Lorna Wing in 1981 outlined the characteristics of "Asperger's

Syndrome" in the English literature (Wing, 1981). Following this article, Asperger's original paper was translated from German to English (Frith, 1991). The terms "Asperger's Disorder" and "Asperger's Syndrome" are often used interchangeably for clinical and research purposes. This diagnosis has continued to be the source of great controversy since its inclusion, as a debate rages whether there is a distinction between AS and high functioning autism (HFA). This debate is beyond the scope of this manuscript, but it is noteworthy that disagreement exists.

Interestingly, Wing, the one often credited with bringing AS to the DSM, has taken the stance that AS should be considered a "less severe form of autism" (Wing, 1981). She determined language deficits were apparent in half the children in her sample. Other researchers described children fitting Kanner and Eisenberg's criteria of early infantile autism as well as fitting criteria outlined by Asperger, while others displayed mixed features of both (Asperger & Frith, 1991; Eisenberg & Kanner, 1956; Wing & Gould, 1979). Wing does not stand alone in her belief, as Rutter also concluded that these disorders are, in fact, similar (Rutter, 1985). In particular, they shared abnormal communication, unusual attachments to objects, and found empathy to be nonexistent (Bowman, 1988; Rutter, 1985). The distinction between these disorders continues to be a highly contended issue.

While many researchers support these disorders being on a continuum of the same disorder, other researchers support Asperger's belief that AS is a unique disorder from autism. Groups of children with autism and children with AS were investigated more closely in order to examine this hypothesis (Szatmari, Archer, Fisman, & Streiner, 1995). Though these groups had no significant differences in nonverbal communication, their adaptive behaviors specifically related to communication and socialization differed. General language skills also were different between groups. Another group of researchers compared a group of children with HFA to a

group with AS and found the HFA group to have higher scores on the CARS (Schopler, et al., 1988) as well as lower verbal IQ scores than the AS group while maintaining similar full-scale IQ scores (S. Ozonoff, Rogers, & Pennington, 1991; Schopler, Reichler, DeVellis, & Daly, 1980). Interestingly, when verbal scores were used as a covariate, many group differences were reduced or eliminated, suggesting the possibility that language ability was the cause of most group differences (S. Ozonoff, Rogers, S. J., Pennington, B. F., 1991).

Methodological flaws and shortcomings are commonplace in the ASD literature, though many had been unavoidable. Definitions of autism and AS have evolved greatly over time; at any single point in time, universal agreement on the definition of either disorder is not likely to be found, nor would one expect current agreement. Further complicating this matter, inclusion criteria for participants vary greatly and operational definitions are rarely consistent across studies (Szatmari, Archer, et al., 1995).

Current DSM criteria require two of the three essential features of autism for AS: 1) qualitative impairments in social interaction; and 2) restricted, repetitive, and stereotyped patterns of behavior, interests, and activities. Unlike a diagnosis of autism, individuals with AS cannot evince significant general delay in language onset, cognitive development, self-help skills, or curiosity about their environment. Lastly, there is no required age of onset for AS as is seen in other ASD (American Psychiatric Association, 2000).

The identification and diagnostic criteria for AS continues to be debated. Beyond Wing and Gould's earlier work, Swedish psychiatrist Christopher Gillberg attempted to better define diagnostic criteria which delineated the differences of AS from autism, including social impairment, unique speech and language, and poor nonverbal communication. Gillberg

continued to support criteria currently identified today including circumscribed interests, repetitive routines, and motor clumsiness (C. Gillberg, 1989).

Epidemiology of AS is as rigorously contested, particularly relating to diagnostic criteria. Variations in diagnostic criteria have led to highly varied statistics regarding this disorder's prevalence. Identified rates have ranged from 3.6 per 1,000 with male-to-female ratios of 4:1 to as low as 1 in 10,000 cases with a male-to-female ratio of 9: 1 (Ehlers & Gillberg, 1993; I. C. Gillberg & Gillberg, 1989). The epidemiological numbers become more skewed as more "possible cases" are included, bringing numbers as high as 7.1 per 1,000 children and male-to-female ratios as low as 2.3 to 1 (Tonge, 2002). Other repercussions regarding the inclusion of AS within ASD include significantly reduced prevalence rates of ID diagnoses within ASD as low as 20% (C. Gillberg, 1992).

PDD-NOS

Specific criteria are laid out for many of the different ASD, but there is an "NOS" category as with many other disorders to help account for cases that do not present typically. The question as to how to handle cases which present with similar and/or related behaviors that do not meet criteria for any particular PDD (or other related disorder) was not handled until the DSM-III (American Psychiatric Association, 1980). The disorder now referred to as Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS) was labeled "atypical PDD" (American Psychiatric Association, 1980). A diagnosis to encompass these individuals is particularly vital given the severity of potential impairment without meeting criteria for autism or AS. All other forms of ASD may require specifications regarding age of onset (which may be unrelated to current behavioral presentations) as well as having specific presentations of deficits.

Children with atypical and/or subclinical presentations of deficits still need, and could benefit from, treatment even without meeting full criteria for another PDD.

Ultimately, PDD-NOS has been defined by what the disorder is not, rather than what it is (Matson, 2007; Matson & Boisjoli, 2007). Researchers seem to suggest these cases tend to be very similar to autism and AS, often describing PDD-NOS as atypical autism or mild symptoms of autism (Clark, Jenson, Miller, Goldstein, & Reynolds, 2005). This debate is not likely to come to any resolution in the near future.

Little research has been conducted defining the boundaries of PDD-NOS. Presumably, the core features are going to be similar to other ASD. Deficits in social interaction, communication, and restricted and/or stereotyped behaviors are likely to be among the defining features of individuals with PDD-NOS. Difficulties with reciprocal social interaction, communication, and stereotypies were suggested to be the most salient deficits in individuals with PDD-NOS, outlining essentially the core symptoms of ASD (Luteijn et al., 2000). Ultimately, reliable diagnostic criteria have not been determined (Matson & Minshawi, 2006). No specific diagnostic criteria for PDD-NOS currently exist in the DSM-IV-TR (American Psychiatric Association, 2000). Until a better understanding of the differentiation of PDD-NOS has been established, clarification of this diagnostic avenue is not likely to be successful. (Leekam, Nieto, Libby, Wing, & Gould, 2007).

Prevalence of ASD

Reported prevalence rates of ASD have varied significantly over the years. More specifically, rates have consistently increased over time. Until the turn of the century, one of the more commonly cited figures estimate that 10-20 children per 10,000 individuals have AD (not including other forms of ASD) (Fombonne, 1999). Earlier estimates were significantly lower

than even Fombonne's estimates of previous rates. One study in the mid-1970s found a rate of 4-5 per 10,000 for autism (Wing, Yeates, Brierley, & Gould, 1976). A later review of studies ranging from 1966-1998 suggested an average prevalence rate of 5.2 per 10,000 for autism (Fombonne, 1999). If estimates are included for all disorders encompassed within ASD, this figure increased significantly, in excess of 60 per 10,000 (Fombonne, 2003; Yeargin-Allsopp et al., 2003). These estimates appear to be more accurate, as other recent studies have suggested figures of 60-70 per 10,000 (Baird et al., 2000; Bertrand et al., 2001). Most recently, prevalence figures have identified rates of 62 to 80 per 10,000 for all types of ASD based on recent CDC criteria (Nicholas, Carpenter, King, Jenner, & Charles, 2009; Nicholas et al., 2008).

While significant differences exist in methodologies across studies, a significant trend exists in the prevalence rates of ASD that is hard to ignore. Diagnosed rates of all ASD have increased over the past decades. Debate continues as to whether actual rates have increased or whether the increase is due to improvements in diagnostic assessments, awareness of the disorders, changes related to funding, or most likely a combination of all these factors. Certainly, there has been an increase in parental motivation for diagnoses for a number of different reasons, including access to special services (community, educational, behavioral modification, etc.), as well as simply having a label for their child's condition. None would argue that a significant increase in media attention has been created around ASD over the past decade. The increase in awareness of the disorders certainly helps build public support for funding both for research and treatment options.

Behaviors Associated with ASD

A number of behaviors have been associated with an ASD diagnosis, but not all are necessarily diagnostic indicators. Some behaviors can be required depending on the diagnosis

within ASD. Some deficits exist which may improve over time, while others tend to linger throughout the lifespan. While language abilities may improve over time (e.g., children with AS learning to request an item rather than to point for it), deficits in social reciprocity have been found to be more resistant to improvement over time (Shattuck, 2006).

Results of a recent study suggested there may be three distinct subtypes of these repetitive behaviors within ASD, supporting a strong structure to these potential subtypes (Lord, et al., 1994). Utilizing the ADI-R, researchers identified repetitive motor behaviors, insistence on sameness, and circumscribed interests within a sample of 316 individuals with autism. Presentation of the latter two appeared to have genetic ties with presentation consistent in families. Not surprisingly, the more types of repetitive behaviors present, the more severe the presentation of autism within their sample (Lam, Bodfish, & Piven, 2008).

Sensory abnormalities are also commonly associated with ASD . A recent study compared children with ASD to a typically-developing control group. Sensory abnormality rates of 33% in the typically-developing group were found compared to 94% in the ASD group (Leekam, et al., 2007). Sensory abnormalities are a good example of an associated feature of autism that is often present but under-diagnosed, as many clinicians simply consider those as associated features of ASD and do not consider treatment specific to these sensory issues.

Physiological and Biological Aspects of ASD

Though a great deal of research has focused on identifying biological correlates in ASD, consistent and significant findings are rarely reported. Certainly, many agree there are strong biological links involved in ASD (Melke, 2008; Zafeiriou, Ververi, & Vargiami, 2007). Accurate identification of specific biological correlates is likely to be a rapidly evolving field; success in this particular area may take years to achieve. Among the greatest challenges facing

these researchers is poor clinical agreement on diagnoses within ASD, highlighting the importance of assessment tools for this particular population. Given the behavioral focus of this manuscript, studies focusing on biology will be briefly reviewed.

Physiological Differences

Physiological abnormalities in individuals with ASD have been researched extensively and these differences have received particular attention in recent years. It appears that a significant increase in utilizing modern imaging technologies has occurred, including MRI, CT, and PET scans. Even with the increased research dedicated to the utilization of imaging, there has been minimal success in identifying abnormalities. One study suggested a thinning of the corpus callosum (i.e., reduced cerebral hemispheric connectivity) had been found in individuals with ASD; this study also identified other studies utilizing Positron Emission Tomography (PET) scanning in an attempt to support these findings (Hughes, 2007). Other studies examining the corpus callosum have similarly not found differences between matched groups of individuals with typically-developing peers (Rice et al., 2005). Magnetic Resonance Imagining (MRI) has been utilized in studying brain volume in children with and without ASD in order to determine whether differences exist between these individuals. In a study examining over 70 individuals with and without ASD, no differences were found in hippocampal volume of the brain (Piven, Bailey, Ranson, & Arndt, 1998). Other research avenues have reported neuron loss in the cerebellum on a consistent basis (Bauman, 1991; Ritvo et al., 1986). Follow-up studies have been built from these results, with one study obtaining evidence of hypoplasia of two cerebellar vermal lobules in 78% of patients with autism (Courchesne, Hesselink, Jernigan, & Yeung-Courchesne, 1987). While these imaging studies are advancing our knowledge with regards to ASD and physiological aspects associated with ASD, more researched is expected to come in

this area. As psychologists are better able to define and identify ASD, imaging studies should have better samples to work with and momentum should continue to build from the medical community.

Head size and its relation to ASD has been discussed in the autism literature for years. Leo Kanner's original study mentioned some subjects having larger than average heads, and many studies have anecdotally noted larger head sizes in participants (Kanner, 1943; Steg & Rapoport, 1975; Walker, 1977). More recently, physiological brain differences have been hypothesized to have involvement in ASD. A recent meta-analysis of brain size focused on controlling for age-related changes and suggested brain sizes were slightly reduced at birth but increased dramatically in the first twelve months of life (Redcay & Courchesne, 2005). This meta-analysis also noted that by adulthood, brain sizes of those with and without autism were found to be mostly in the normal range. As with most studies, more variance was found in younger children and decreased as children reached adulthood. Support for the early-childhood head growth argument was found in a later study focusing on head growth in the first 3 years of life for children comparing groups with ASD, ID, and typically-developing controls. Between 7 and 10 months, the group with ASD reported significantly increased head growth compared to the other groups (Webb et al., 2007). This growth difference was limited to the disorders specifically, as further investigation found no differences when other factors were examined and other variables were controlled for, such as reported regression of skills. Momentum is building supporting the notion that differences in head size development in children with ASD is a consistent phenomenon (Wallace & Treffert, 2004).

While head and brain volume studies suggest minimal differences, other researchers have focused more on how these individuals' brains function from an overall standpoint. Functional

MRI (fMRI) studies have examined brain activation during particular tasks and compared individuals with ASD to those without. Differences were found between the autistic and typically-developing groups when it came to utilizing a sustained visual attention task; within the autistic group the ventral occipital and striate regions were activated rather than the superior parietal, middle temporal, dorsolateral, prefrontal, premotor, and medial frontal cortices (Belmonte & Yurgelun-Todd, 2003). Per Belmonte and Yurgelun-Todd's study, there was increased activation in the autism group when attending to the left visual field compared to the right, though no explanations were offered by the authors. Differences in grey matter were also discovered to exist between individuals with ASD and age and IQ-matched typically-developing peers. Among other differences identified in the ASD group, decreases in grey matter were found in anterior regions of the brain, while increases were noted in posterior regions of the brain (Abell et al., 1999).

Heritability and Biological/Genetic Factors

Though the etiology of ASD is still highly debated, high heritability rates within ASD are generally agreed upon. Genetic heritability rates as high as 90% have been identified (Rutter, Silberg, O'Connor, & Siminoff, 1999; Zafeiriou, et al., 2007). Rates among siblings are generally cited to be 2-10%, which is far greater than the general population (Chakrabarti & Fombonne, 2001; Chudley, Gutierrez, Jocelyn, & Chodirker, 1998; Rutter, et al., 1999). Monozygotic twin studies have reported prevalence rates of over 60% (Bailey, Le Couteur, Gottesman, & Bolton, 1995; Steffenburg, Gillberg, Hellgren, & Andersson, 1989). Together, these figures highlight strong support for the significant genetic contribution to ASD. In many of these studies, traits consistent with ASD were found in the undiagnosed sibling (Bailey, et al., 1995; Le Couteur, Bailey, Goode, & Pickles, 1996). Undiagnosed siblings were also found have

a broader susceptibility to psychopathology, including communication disorders and a number of other anxiety-related disorders (Hollander, King, Delaney, Silverman, & Smith, 2003; Piven, Palmer, Jacobi, & Childress, 1997; Smalley, McCracken, & Tanguay, 1995).

A recent article published in the New England Journal of Medicine garnered intense media attention after identifying microdeletion and microduplication on chromosome 16p11.2 (Weiss et al., 2008). A number of noteworthy factors arose from Weiss' manuscript. While these results are powerful, authors were careful to identify deletions and duplications as "risk factors" rather than "causes". Further, the authors note these abnormalities were identified in only 1% of all cases in the study (Weiss, et al., 2008). Follow-up studies, including some studies from the same authors, state more generally that there is a relationship with features of ASD, in addition to ADHD, anxiety disorders, and mood disorders (Miller et al., 2009). Caution should be given, as a great deal of media attention was paid to an anomaly identified in only 1% of cases with ASD identified.

A multitude of other studies have been completed looking for keys to the role of genetics. Few have had the success of Weiss and colleagues. The role of gene SLC6A4 was examined, as authors theorized variants in this gene played a role in autism (Sakurai et al., 2008). Sakurai and colleagues have suggested no differences in this gene between groups with ASD compared to controls; further, no differences in the expressions of compulsive traits were found based on this gene (Sakurai, et al., 2008). Ultimately, authors of more recent studies suggest the involvement of 10 or more genes in autism, which may be a conservative estimate (Pickles et al., 1995; Risch et al., 1999). Other studies have had limited success identifying chromosomal markers for autism and heritability. A relatively large twin study examining chromosomal links had very limited success even with a large number of analyses. The results left the authors suggesting the

7q22-32 chromosomal region should be further examined while concluding that autism spectrum disorders appear to have very diverse chromosomal linkages (Trikalinos et al., 2006). These sentiments are echoed in similar studies, which find high rates of genetic heritability without identifying specific genetic markers (Ronald et al., 2006). Ultimately, the overwhelming majority of studies examining the role of genetics have had inconsistent and/or inconclusive findings (Bacchelli & Maestrini, 2006).

Other Hypotheses

The strong genetic link to ASD is only part of the equation, as many environmental factors have been identified which may contribute to ASD. These factors often vary from legitimate hypotheses to what amounts to no more than rumors and hearsay with little or no merit. While increased attention from the media is beneficial in some regards, there are also significant drawbacks from this as well. Benefits include increases in funding for research and treatment, increased awareness which may assist families in seeking earlier intervention, and an increased awareness that families are not alone in their struggles. Negative repercussions of this increased awareness include individuals who have attempted to capitalize on the desperation of parents of children with autism promising miracle cures and/or unrealistic treatment gains for therapeutic techniques with no empirical support. In extreme cases, these "treatments" may be dangerous and to a lesser extent, have the potential to be fatal (Atwood, Woeckner, Baratz, & Sampson, 2008). A number of children have been left susceptible to illnesses following fears that vaccines cause ASD (which has been consistently refuted in studies). The article which is most acknowledged as spearheading the movement against vaccines has been retracted and the authors will likely spend their careers attempting to recover from the flaws they failed to highlight in their study. Other children have lacked proper nutrition from a number of diets

popularized without empirical support (gluten-free and casein-free diets in particular). Chelation therapies aimed at removing heavy metals, particularly mercury, have also gained momentum. The chelation therapy theory is also primarily unfounded, as numerous studies overwhelmingly refute the suggestion that mercury from vaccines causes ASD (Doja & Roberts, 2006; Rutter, 2005; Thompson et al., 2007).

As previously mentioned, not all current theories relating to the cause of ASD are without merit. Among those more credible hypotheses (i.e., those with some empirical support), the role of infections involving the frontal lobes of the brain leading to behaviors similar to those exhibited by individuals with ASD appears to have some support in retrospective case-report studies. Mohammad Ghaziuddin and colleagues described two children who developed encephalitis during the neonatal period whose symptoms persisted long after the illness abated; these children were 4 and 11 years of age when identified for the case report (Ghaziuddin, Tsai, Eilers, & Ghaziuddin, 1992). A case-report described an 11-year-old male of Asian descent who developed herpes-encephalitis and suffered from the core symptoms of autism only following his illness; these symptoms were still present after a three-year follow-up (Ghaziuddin, Al-Khouri, & Ghaziuddin, 2002). These cases are just a few of a growing number of such case reports. An additional report described a 14-year-old girl who developed autistic symptoms after a case of encephalitis with persisting symptoms well after the encephalitis subsided (C. Gillberg, 1986). Few cases document symptoms arising with encephalitis and resolving following the illness. Three children from 5 to 11 years of age were documented having developed autistic symptoms after acute episodes of herpes encephalitis whose symptoms improved after their illness abated (DeLong, Bean, & Brown, 1981).

Particular questions remain to be answered regarding these cases of autism arising from encephalitis. Due to the retrospective case-study nature of these descriptions, little overlap exists regarding details of each case and background information available for each individual, including symptoms of ASD. Why would some cases improve after the encephalitic infection was over, while others persisted through life? When available, brain scans generally have indicated permanent changes in the individuals' brains following the infections when symptoms persisted (Ghaziuddin, Al-Khouri, et al., 2002). Further complications exist, including the lack of adequate or consistent pre-infection assessment. Without a true baseline, the actual changes in a child's presentation are based on anecdotal recall which severely limits the conclusions one can draw.

Among these case studies, few reported what measures (if any) were utilized to identify features of ASD. Some utilized acceptable measures in which children met all criteria for autism besides age of onset (Ghaziuddin, Al-Khouri, et al., 2002). One of the most overwhelming challenges in ASD research has to include methodological differences including lack of standardized assessment instruments and lack of consistently applied diagnostic criteria between studies. When assessments are used, significant differences exist between diagnostic criteria used to norm each tool. The CARS and ADI-R, for example, are often utilized in research but are keyed to different versions of the DSM. Drawing conclusions based on these results becomes increasingly difficult, particularly for meta-analyses which weigh results equally when the scientific value of each study have such significant differences in their contribution to the greater literature knowledgebase.

Onset of ASD

The onset of ASD typically begins at an early age; with symptoms apparent by age 3 for autism. Abnormalities are often retrospectively noted in AS and PDD-NOS during early childhood, though many are not severe enough to warrant clinical attention until later in life. A general shift towards earlier diagnosis has been occurring; theories to explain this shift include increased awareness of symptoms for parents and clinicians as well as significant improvements in the assessment of ASD. Early screening for ASD currently has a strong momentum throughout the United States, and progress in this area is being made. A strong push for large-scale screening and diagnosis of ASD in children at a very young age is strongly advised, if not essential, in the eyes of current researchers (Itzchak, Lahat, Burgin, & Zachor, 2008; Matson, Boisjoli, Rojahn, & Hess, 2009). Until recently, the Checklist for Autism in Toddler (CHAT) had been the only tool with acceptable psychometrics for use in toddlers and measured only autism. The Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT) is a recently devised tool geared to assess not only autism, but PDD-NOS as well. Preliminary studies based on an early-intervention program in Louisiana have been promising (Matson, Boisjoli, et al., 2009; Matson, Wilkins, Sevin, et al., 2009). This instrument will be discussed in more depth later in this manuscript.

Stability of ASD Diagnoses

Though great debate continues to exist regarding which diagnosis is appropriate within ASD, the stability of these diagnoses over time has been one significant concern. Utilizing the ADI-R at 20 and 42 months, the tool appeared sensitive to autism, as all children identified at 20 months also met criteria at 42 months. For children with AS, the tool did not appear adequately sensitive at 20 months, as many children ended up being diagnosed with language disorders,

other developmental delays, or considered clinically normal rather than diagnosed with ASD (Cox et al., 1999). Generally speaking, the stability of a diagnosis appears to increase with the severity of deficits based on the ADI-R (Cox, et al., 1999).

Many question the most appropriate time to make diagnoses of ASD. Patterns of earlier diagnoses appear to be the current trend. Presumably, this trend is motivated by the evidence which supports the effectiveness of early intervention. For the most part, ASD diagnoses made at age 2 have been found to be reliable (Lord, Richler, Charman, & Stone, 2006). Those cases diagnosed with autism rather than PDD-NOS were found to be more stable over time, as follow-up was done at 9 years of age. The most likely rationale for this finding would be that symptoms were more severe and/or mapped more clearly on to the ASD diagnostic spectrum, which would make sense considering other diagnoses with the "NOS" caveat. Further, as PDD-NOS is a diagnosis based on exclusionary criteria, the likelihood of children's ASD course deviating from typical autism or AS is more likely to occur than a child's symptoms becoming "more typical". Supporting this notion, many more of the PDD-NOS cases no longer had an ASD diagnosis compared to the autism group in Lord et al.'s study. In fact, these Lord and colleagues suggested there was no benefit in placing these children in discrete groups (autism vs. PDD-NOS); rather it appeared to be simply a difference in severity of impairments that differentiated the groups (Lord, et al., 2006).

Not all aspects of ASD are stable, however. Stereotypies have been found to increase in children with ASD (when compared to typically-developing children) as they increase in age (MacDonald et al., 2007). Though one may suspect the disparity between groups is simply due to the typically-developing group reducing these atypical behaviors as children become more aware of social cues, differences were found to be two-fold. The ASD group's percentage of

time engaging in stereotyped behaviors continued to increase in the two, three, and four-year-old groups, while the opposite was found in the typically-developing group (MacDonald, et al., 2007).

Differential Diagnosis within ASD

Though many core symptoms across ASD are shared, little agreement exists among professionals regarding what exactly constitutes each particular diagnosis. Since the DSM-IV-TR was published in 2000, the ASD diagnoses have strayed far from their diagnostic roots. Clinicians and researchers have modified criteria and improved their understanding of what ASD is (even without significant agreement).

Given the complicated nature of ASD, the difficulties in diagnosis, challenges faced given the core features of ASD, potential comorbid psychopathology, and other difficulties faced by children with ASD, it is distinctly challenging to determine how and where to attribute the plethora of difficulties faced by these children (Leyfer et al., 2006). Assessment instruments developed for use on typically-developing populations have been commonly utilized in an attempt to answer this question, though few have been tested for reliability and validity within ASD (Leyfer, et al., 2006). Assessments for behavioral challenges and comorbid psychiatric issues often include the Child Behavior Checklist (CBCL) (Achenbach, Howell, Quay, & Conners, 1991; Dekker, Koot, van der Ende, & Verhulst, 2002) and the Connors' Rating Scales (Connors, 1973; Fee, Matson, & Benavidez, 1994). Other instruments commonly utilized with individuals with ASD were often designed for individuals with more generalized developmental disabilities, such as the Aberrant Behavior Checklist (Aman, Singh, Stewart, & Field, 1985) and the Behavior Problems Inventory (Rojahn, Matson, Lott, Esbensen, & Smalls, 2001).

As previously noted, the BISCUIT has shown preliminary evidence of success in very young children (Matson, Boisjoli, et al., 2009; Matson, Wilkins, Sevin, et al., 2009). Additional assessment instruments are currently being developed to examine behavior problems within ASD. The Autism Spectrum Disorders – Behavior Problems for Children (ASD-BPC) has been found to be a reliable instrument assessing behavior problems in children with ASD (Matson, González, & Rivet, 2008). Other assessments have been designed to focus specifically on developmental disabilities (including ASD). These include the Psychiatric Instrument for Mentally Retarded Adults (Senatore, Matson, & Kazdin, 1985), the Diagnostic Assessment for the Severely Handicapped (Fombonne, 2002), and its revision the Diagnostic Assessment for the Severely Handicapped – Revised (Matson, 1995) which was specifically utilized within the ASD population (Matson et al., 1996). The normative samples for these instruments have often included some individuals with ASD. However, the use of instruments to specifically diagnose comorbid psychopathology in the ASD population rather than be utilized as screening instruments (as they were designed) is not recommended.

Examples of contradictions in diagnostic practice are abundant. For example, ADHD diagnoses should not be able to coincide with a diagnosis of ASD (APA, 2000). Relatively few clinical studies have supported ADHD as a comorbid diagnosis with ASD, though both are commonly diagnosed clinically (Geurts et al., 2004). Certainly, a number of behavioral similarities exist, but the question remains as to whether multiple diagnoses are actually appropriate. Research in to this question is strongly needed, as very few instruments have been developed to study this phenomenon (Matson & Nebel-Schwalm, 2007).

Other studies have examined objective ways of differentiating between different ASD. Though slightly dated, studies examining this challenge do exist (Ghaziuddin, Tsai, &

Ghaziuddin, 1992b). Furthermore, many agree meaningful clinical distinctions have not yet been made, which makes research examining these groups particularly challenging (Schopler, 1985). Generally speaking, Schopler's report identified intellectual functioning to be higher in the AS group than the autism group (which more current research would likely examine HFA as a distinct group). This also identifies a shift in the disorder across time, as ID is not acceptable as a comorbid diagnosis of AS currently. However, this has not always been the case within the greater body of research literature. When describing his initial patient sample as he outlined the disorder, Frith described some children who had mild to severe learning disabilities (Frith, 1991). These children would not likely be diagnosed with AS today.

Other attempts to "subcategorize" ASD have been conducted. These have tended to focus on taxonomic techniques or cluster analyses (Castelloe & Dawson, 1993; Eaves, Ho, & Eaves, 1994; Sevin et al., 1995; Siegel, 1986; Szatmari, 1992; Waterhouse et al., 1996). Consistent with most ASD research, these are conducted almost exclusively with young children rather than adults (Prior, Perry, & Gajzago, 1975). Results tend to suggest the most powerful discriminating factors within ASD are primarily related to ability levels of these individuals rather than behavioral patterns. One finding of note was that higher-functioning children tended to have more sophisticated routines and preoccupations than lower functioning children (deep knowledge of an Indian tribe rather than a task such as stacking chairs repetitively), which may suggest the content of these preoccupations could have some value in helping discriminate between disorders (Prior & MacMillan, 1973). Other researchers have suggested that the severity of symptoms may be a better factor for clustering groups of patients than behavioral patterns (Prior et al., 1998).

A diagnosis of ASD has a number of associated features (beyond comorbid psychopathology) commonly identified in members of this population. Most important, these features are not diagnostic indicators and do not contribute to a diagnosis of ASD. They are, nevertheless, noteworthy. These features do often contribute to the significant challenges facing caretakers. Two common and severe factors include self-injurious behavior and aggression. Similarly, generalized risks of injury (severe enough to require medical attention) are much higher than typically-developing controls. Rates two to three times higher have been identified in children with ASD than in typically-developing peers, though these were similar to children with ADHD, anxiety, depression, and behavioral/conduct disorders (Lee, 2008).

Comorbid Disorders

As previously discussed, ASD is a risk factor for other forms of psychopathology as evinced by high rates of identified comorbid diagnoses within the ASD population (outlined below). This is not surprising, since individuals with ASD are also at risk for mental retardation (intellectual disability), with previously mentioned comorbidity rates ranging from 1 in 2 to as high as 3 in 4 (Folstein, Rutter, Schopler, & Mesibov, 1987; Koller, Richardson, & Katz, 1992; Ritvo, Freeman, Pingree, & Mason-Brothers, 1989; Rutter, Graham, Chadwick, & Yule, 1976). While the presence of ID is not within the scope of this manuscript, it is noteworthy given the presence of ID has long been acknowledged as a risk factor for comorbid psychopathology (Borthwick-Duffy, 1994; Matson & Barrett, 1982; Reiss, 1988). Further, many forms of psychopathology often identified in ASD are closely linked to common psychopathology found in typically-developing individuals, without specific association to intellectual functioning. Though assessments designed to specifically assess for comorbid psychopathology within ASD are severely lacking, it is generally agreed that high rates of comorbid psychopathology within

ASD exist (Leyfer, et al., 2006). Commonly identified comorbid psychopathology and behavior problems in ASD include aggression, anxiety, bipolar disorder, depression, and psychotic disorders (Bradley, 2004; Gadow & DeVincent, 2005; Ghaziuddin, Ghaziuddin, et al., 2002; Ghaziuddin, Weidmer-Mikhail, & Ghaziuddin, 1998; C. Gillberg & Billstedt, 2000; Kim, Szatmari, Bryson, Streiner, & Wilson, 2000; Morgan, Roy, & Chance, 2003; Muris, Steerneman, Merckelbach, Holdrinet, & Meesters, 1998; Pearson et al., 2006; Sturm, Fernell, & Gillberg, 2004; Tsai, 1996).

Relative to other disorders, comorbidity in ASD has received little attention, particularly outside of examining ASD and ID (Matson & Nebel-Schwalm, 2007). This is not surprising given the high comorbidity rates, as these conditions co-occur frequently in ASD. Other symptoms of autism occur more often as the level of ID becomes more severe; including stereotypies, language delay, and self-injury (Wing & Gould, 1979). The question of whether DSM-IV-TR diagnoses such as self-injury, stereotypies, and conduct disorder warrant a diagnosis in addition to ASD or if they are best described as symptom clusters of ASD is still largely debatable. However, past research has suggested autism is distinguishable from psychosis, while stereotypies and self-injury cannot be differentially diagnosed between autism and ID (Matese, Matson, & Sevin, 1994; Sevin, et al., 1995). Given these challenges, the potential for a cloudy diagnostic picture should appear obvious.

Certainly, one may question whether comorbid psychopathology is appropriate to study. Symptoms may vary from the way in which they present in the general population, but researchers generally agree that these diagnoses are appropriate. However, issues of comorbidity are often poorly understood in this population (Ghaziuddin, Ghaziuddin, et al., 2002; Matson & Barrett, 1982; Matson & Minshawi, 2006).

Not only are these disorders poorly understood in individuals with ASD and other developmental disabilities, they are extremely challenging to diagnose (Matson & Barrett, 1982). Direct communication with patients is nearly always impaired with patients directly in ASD (Lord, 1997). Assessment of comorbid disorders becomes a challenge, which often leads to the need for alternative informants, including parents, teachers, and caregivers given the limited verbal repertoire and other deficits in abilities to self-report (Lord, 1997). This could, in part, explain why much recent research has found correlations and identified risk factors for psychiatric comorbidity to include higher levels of functioning (IQ, social development, communication, etc.) within ASD (Kim, et al., 2000). An alternative answer could simply be the ease at which these disorders are diagnosed given the functioning level of these children when compared to lower functioning children with ASD, such as those who have limited or no verbal communication or additional impairments.

The question of whether or not comorbid disorders present differently based on which ASD diagnosis a child has is also controversial. Very few studies have examined this specific topic and even fewer assessments exist to assist with answering this question (Helverschou, Bakken, & Martinsen, 2009; Leyfer, et al., 2006; Matson, Fodstad, Mahan, & Sevin, 2009; Matson, LoVullo, Rivet, & Boisjoli, 2009). Within anxiety and mood disorders, the limited information available suggests no differences exist between autism and AS (Kim, et al., 2000). However, when pre-school children with autism were compared to those with PDD-NOS, some differences were noted. Compulsions, motor tics, and vocal tics were found to be higher in the group with autism than the PDD-NOS group (Gadow, DeVincent, Pomeroy, & Azizian, 2004). However, this study only applied to pre-school age children and the same results should not be presumed true for older children with ASD. Further, one must be cautious with retrospective

research lacking a non-ASD comparison group, even if results suggest children with autism to be at a particularly high risk for behavioral and emotional problems (Pearson, et al., 2006).

Heterogeneity of symptoms of ASD causes particular difficulty regarding identification of core symptoms of ASD and regarding how one should conceptualize ASD. Some suggest a dimensional scale, while others prefer a categorical approach identifying subtypes similar to the DSM-IV-TR and ICD-10 (Sturmey, Sevin, & Matson, 1994; Szatmari, Volkmar, & Walther, 1995). This topic continues to be debated and the resolution coming with the DSM-V will be anxiously awaited.

As previously noted, behavior problems are common and very problematic in children with ASD. Behavior problems also tend to be chronic in individuals with ASD. A recent study found that symptoms identified during the initial assessment were often present at 12-year follow-up (Murphy et al., 2005). The authors did report many behaviors becoming less prevalent over time. Overall abnormal behavior scores and abnormal responses to visual and auditory stimuli were most improved, while routines/resistance to change and other more general behavior problems (including limited social awareness) did not improve over time. Children with ASD may respond slower than typically-developing peers to social cues, norms, and expectations, which may partially explain these results (Szatmari, Archer, et al., 1995).

Intellectual Disability/Mental Retardation within ASD

Intellectual disability is not being reviewed as are other psychopathology. Even with the existence of improved diagnostic measurements of psychopathology within ASD, it is believed that intellectual ability and adaptive behavior will continue to be assessed as it has been historically. However, given the previous research suggesting the diagnosis of psychopathology within individuals with ID may be unique and more challenging than within the typically-

developing population, a brief review of ID appears warranted. Comorbidity rates of ID and ASD have been reported to be high, though more recent research also suggests these rates may be lower than purported with the increases in diagnoses of AS and PDD-NOS (Fombonne, 2005; Fombonne & Volkmar, 2007). While ID is not specifically studied within this manuscript, the complications involved in differential diagnosis and its implications within other diagnostic instruments deem it noteworthy.

Most studies of ID which have screened for AD have found approximately 70% prevalence rates of AD within populations with ID (Bryson, Clark, & Smith, 1988; Deb & Prasad, 1994; Fombonne, Du Mazaubrun, Cans, & Grandjean, 1997; Fombonne & Volkmar, 2007; Lotter, 1966). One recent study found 28% of adolescents with ID to be identified as having autistic disorder (other forms of ASD were not included in this study) (Bryson, et al., 1988). Prevalence rates did not appear to be linked to severity of ID, though identified rates were in the 2-3:1 male to female ratio rather than the 3-4:1 rate often cited, indicating some differences with the inclusion of ID in the ASD picture. Previously cited rates of 75-80% have been countered by more recent epidemiological studies citing 40-55% comorbidity rates (Chakrabarti & Fombonne, 2005). This lower rate may be due to the increasing prevalence of diagnoses of AS and PDD-NOS. One study found only 15.7% of prevalence claims were able to be traced to empirical data with properly described methodology to assess intelligence in their samples, calling in to question the validity of many previously published prevalence rates (Edelson, 2006). Edelson's critique may be overly critical of existing literature, but does bring up valid concerns and encourages skepticism when evaluating the conclusions of some publications.

Certainly there are challenges in assessing specific intellectual abilities in individuals with autism, particularly those with (suspected) severe and profound ID. Challenges in the assessment of this population have long been recognized, and many of these challenges have been discussed (Koegel, Koegel, & Smith, 1997). Certainly motor skills, motivation, attention, and compliance need to be considered in any type of assessment within this population. These factors' influence on such assessments have been discussed, including why they are not ideal outcome measures of ASD treatment studies (Matson, 2007).

Mood Disorders

Mood disorders will be broken down specifically into depression and bipolar disorders in this manuscript, though these have often been studied concurrently in the literature. Both disorders can significantly impact the lives of those who suffer from them, particularly when compounded with the presence of ASD. Lack of social skills or the enjoyment of socialization will often manifest itself as being withdrawn, which certainly influences the diagnosis of depression. Circumscribed interests may also be confused with components of a manic episode, particularly if plans made revolve around an individuals' area of interest. The perception of the existence of a depression and/or manic episode can influence depression or bipolar disorder diagnoses which may follow an individual the rest of their lives, highlighting the importance of accurate diagnoses. Furthermore, given the previous state of diagnostic abilities within ASD, a number of these mood disorders may have been previously utilized to describe some of the behaviors exhibited by individuals with ASD which may no longer apply as they are better accounted for by ASD or another diagnosis.

Depression has been found to co-occur in children with autism at approximately a 2% rate (Ghaziuddin, Tsai, & Ghaziuddin, 1992a). Within the subgroup of AS, this rate has been

found to be quite high, commonly cited in the 15-30% range (Ghaziuddin, et al., 1998; Tantam & Frith, 1991; Wing, 1981). The reasons for such a high rate are not clear, though some hypothesize increased intelligence and awareness of one's behavioral differences and social ineptitude may play a role. Regardless of the reason, some suggest depression to be the most frequent form of comorbid psychopathology with ASD. These same authors suggested estimates are likely low due to the lack of assessment tools to assess for comorbid disorders within ASD (Ghaziuddin, Tsai, et al., 1992a).

Ghaziuddin and colleagues' sentiments are echoed by other researchers, who also noted the focus on depression in adults and dearth of investigation examining how depression affects children with ASD (Lainhart & Folstein, 1994). Inadequacies in assessment for depression also exist in the area of ID, where depression is found at even higher rates than typically developing populations (Kazdin, Matson, & Senatore, 1983; Matson, Kazdin, & Senatore, 1984). Presentations of depressive symptoms are likely to be consistent with those in the general population within other subsets of the general population. This has been observed in the presentation of depression within individuals with ID (Matson, Barrett, & Helsel, 1988). One caveat of this research includes taking into account how diminished verbal behavior and communication abilities may result in unique symptom profiles. A group of children with autism and AS were compared to a community sample of children and were found to have higher rates of depression than the community sample, while autism and AS did not differ from one another (Kim, et al., 2000). Certainly, the severity of impairments will cloud the diagnostic picture and may mask symptom presentation. These issues in particular warrant further investigation.

At one point in time, there was question as to whether depression impacted individuals with ASD, but studies have been completed supporting that depression does exist in individuals

with ASD (Ghaziuddin, Ghaziuddin, et al., 2002). Does depression impact the course of ASD? Certainly, long-term functioning is affected by depression in individuals without ASD (Beck & Alford, 2009). Therefore, the course of presentation and treatment would likely be impacted within individuals with ASD as well. With depression comes increased risk for suicide, non-compliance, aggression, and oftentimes increased withdrawal (Beck & Alford, 2009). Within the family setting, these problems have been identified as negatively impacting immediate family members, which results in an increase in stress and conflict (Gold, 1993). Thus, recognizing and identifying the causes and implications of these behaviors has important treatment implications.

Bipolar disorder is a serious condition which is challenging to diagnose and treat in many situations. The presentation concurrently with ID and/or ASD further complicates diagnostic pictures (Matson et al., 2006). Presentation of bipolar disorder in the general population has been found to primarily present first as major depression in childhood for approximately 70% of cases (Robertson, Kutcher, Bird, & Grasswick, 2001). In addition, bipolar disorder presents comorbidity with a multitude of other disorders, such as anxiety disorders and ADHD, regardless of the presence of ASD (Carlson, 1998; Masi et al., 2001).

Unfortunately, the literature regarding bipolar disorder within the ASD population is minimal at best. Three individuals with autism who presented with some symptoms of bipolar disorder were described in one manuscript, but expression of symptoms were limited to catatonia (Realmuto & August, 1991). In other studies, some groups identifying depression have also included bipolar disorder in their samples of patients with comorbid depression (Ghaziuddin, et al., 1998). A single case study of bipolar disorder in ASD was reported in a child with AS (C. Gillberg, 1985); though this case should be viewed skeptically as mild ID was also a coexisting diagnosis for this case of AS, which is not generally acceptable by today's classification system

in the DSM-IV-TR. More recently, mood disorders were studied in a group of adolescents and young adults with ASD and IQ scores above 70. Utilizing a clinic setting specializing in ASD, forty-four patients were included in this study. Twelve of thirty-five children meeting criteria for ASD were diagnosed with bipolar disorders (Raja & Azzoni, 2008). These results should again be taken with extreme caution, as no empirically supported assessments were utilized to confirm the diagnoses of bipolar disorder in these individuals.

Identifying these disorders is particularly challenging, and a pair of researchers have suggested the need for extreme caution regarding typical medications used for bipolar disorder and how they may interact with ASD symptoms, as this is often reportedly overlooked in clinical settings (Raja & Azzoni, 2008). It is also noteworthy that existing research in bipolar disorder is focused almost exclusively on adults (Matson et al., 2005). Further, the assessment of bipolar disorder has few instruments with proven reliability and validity (Nassir Ghaemi et al., 2005). As these shortcomings are addressed, questions regarding ASD and bipolar disorder should receive more attention and begin to produce more definitive conclusions.

Behavioral Disorders

Behavioral disorders within ASD are particularly challenging and sometimes controversial given the significant overlap in diagnostic criteria (Gould, Dixon, Najdowski, Smith, & Tarbox, 2011). Given these diagnostic challenges, care needs to be taken when considering these diagnoses given the prevalence at which these are comorbidly diagnosed. Among those primarily diagnosing these types of disorders, the general lack of specialization and training required to accurately make these diagnoses in children with ASD is concerning (Gould, et al., 2011). A number of other explanations exist; including children's challenging behaviors being attributed to a "less severe" behavioral disorder rather than an ASD diagnosis. Similar to

the confounds related to mood disorders, many individuals with ASD are likely to have been previously diagnosed with a behavioral disorder that shares a number of symptoms with ASD which may also carry less "stigma" (de Bruin, Ferdinand, Meester, de Nijs, & Verheij, 2007; Ghaziuddin, et al., 1998; Morgan, et al., 2003). Attention Deficit/Hyperactivity Disorder (ADHD) and anxiety disorders share a number of diagnostic criteria often confused with ASD (American Psychiatric Association, 2000). The similarities between social anxiety disorder and behaviors associated with ASD will be discussed in more detail later. Certainly a number of similarities with Obsessive-Compulsive Disorder (OCD) exist, which are explored later in this manuscript. Significant diagnostic overlap with phobias also will be discussed. Many of the unique and/or challenging behaviors described below are the primary reasons children are referred for assessment and treatment, either by parents, teachers, or medical professionals (Schreck & Mazur, 2008). The recent strides made in assessment should help insure more accurate diagnoses be given to individuals presenting with these unique behavioral profiles.

Though the comorbid diagnosis of Attention-Deficit/Hyperactivity Disorder with ASD is controversial, it is commonly diagnosed in clinical practice (Ghaziuddin, Tsai, & Alessi, 1992). Given the high rate of psychotropic medication prescription to aid in treatment of ADHD, the question of how well this medication treats ADHD symptoms or otherwise influences children with ASD is vital (Morgan, et al., 2003). Further, the emphasis that these medications are utilized to treat ADHD symptoms rather than ASD symptoms could not be strong enough. Many of the commonly prescribed medications include methylphenidate (Ritalin) and dexamphetamine (Focalin) (Barkley, 1990; Morgan, et al., 2003). A number of small studies have examined this question and generally have found that children with ADHD and ASD do respond well to stimulant medication in the treatment of their ADHD (Quintana, Birmaher, Stedge, & Lennon,

1996). This phenomenon was investigated in a larger study, which also supported these previous findings (Santosh, Baird, Pityaratstian, Tavare, & Gringras, 2006). In this larger study, subjects in the combined group did not show significant changes in repetitive behaviors or tics, as many worried would occur. In fact, symptom improvements in target areas (hyperactivity, impulsivity, inattention, oppositional behavior, and aggression) showed similar improvements in the ADHD only and ADHD+ASD groups (Quintana, et al., 1996).

Verbal behavior has been examined as one potential factor to diagnose comorbid ADHD in children with ASD (Lovaas, Koegel, Simmons, & Long, 1973). There has been some empirical support that children with ASD (HFA in particular) differentiated from children with ADHD as well as typically-developing controls in their use of pragmatic language (Bishop, 1998). Utilizing the Children's Communication Checklist (Bishop, 1998), researchers found children with ASD, ADHD, and typically-developing controls all had unique profiles on their use of pragmatic language when assessed by parents and teachers (Geurts, et al., 2004). These researchers suggested there may be diagnostic utility to their findings, though no follow-up research was identified.

Anxiety Disorders

Anxiety and anxiety-related symptoms are very commonly found in ASD (Davis et al., 2011). In fact, the DSM specifically lists these as an "associated feature" of autism (American Psychiatric Association, 2000). A number of studies exist which have highlighted children with ASD experiencing these types of symptoms at home, at school, and in other social situations (Coupland, 2001; Groden et al., 1994; Kim, et al., 2000; Muris, et al., 1998; Tonge, Brereton, Gray, & Einfeld, 1999). Many children in these studies met full criteria for one or more anxiety

disorders in addition to their ASD; other studies have found nearly half their sample meeting clinically significant criteria for anxiety disorders (A. Gillott, Furniss, F., & Walter, A., 2001).

Few argue that children with ASD experience less anxiety than typically-developing peers; rather, the opposite appears true (A. Gillott, Furniss, & Walter, 2001; Kuusikko et al., 2008; MacNeil, Lopes, & Minnes, 2009; White, Oswald, Ollendick, & Scahill). Research supports the higher levels of anxiety in the ASD population than the typically-developing population, which is not surprising given the similarities in diagnostic criteria of the disorders (Achenbach, Tuma, & Maser, 1985; Benjamin, Costello, & Warren, 1990; Bird, 1996; Chalfant, Rapee, & Carroll, 2007; A. Gillott, Furniss, F., & Walter, A., 2001; Matson & Love, 1990).

The aforementioned findings should not be surprising, given that anxiety is commonly cited as a feature of individuals with ASD (Attwood, 1998; Tantam, 2000). One study found 14% of children with ASD had clinically elevated (2 standard deviations above the mean) scores on parent-report measures of generalized anxiety as well as internalized measures of anxiety including separation anxiety and depression (Kim, et al., 2000). Anxiety disorder levels based on ICD-9 (World Health Organization, 1979) criteria found Anxiety Disorder levels to reach clinical significance in 7% of cases of adults with AS (Tantam & Frith, 1991).

Anxiety disorders have be treated with comorbid ASD with some success. A controlled trial (utilizing a wait-list control group) of twelve weekly sessions (of treatment similar to non-ASD anxiety patients) was found to be superior to the wait-list control (Chalfant, et al., 2007). Following treatment, 71.4% of participants no longer met criteria for an anxiety disorder. Participants in this group all were considered to have “High Functioning Autism Spectrum Disorder”, which included AS and autism with IQ’s greater than 70 (Chalfant, et al., 2007).

Social anxiety disorder (SAD) is another anxiety disorder which has been identified in individuals with ASD. This is not surprising, as a number of social impairments associated with ASD are shared with a diagnosis of SAD (American Psychiatric Association, 2000). One case-study found traditional cognitive behavioral therapy (CBT) to be an effective therapy treating symptoms of SAD in an adult with AS (Cardaciotto & Herbert, 2004). Both immediately following treatment and at a two-month follow-up, the individual no longer met criteria for SAD. Others studying SAD in children with AS/HFA have found elevated levels of behavioral avoidance and evaluative social anxiety on the Social Phobia and Anxiety Inventory for Children, the Social Anxiety Scale for Children – Revised, and the CBCL (Kuusikko, et al., 2008). This group differed from controls in another way; as age increased, scores tended to increase on all scales while the opposite was found in typically-developing controls.

As many of the diagnostic criteria are shared between ASD and other anxiety disorders, controversy exists as to whether or not they should be separated (Bejerot, 2007). The above illustrations highlight many examples of why the controversy exists. Some argue that obsessions are an integral part of ASD, while others notice peculiarities in the object of such obsessions (Toichi, 2006). The debate regarding OCD is likely the most controversial debate. One theory is that people with ASD seem interested in how things, rather than people, work (Baron-Cohen & Wheelwright, 1999). Individuals with OCD tend to engage in repetitive acts with the goal of reducing anxiety and this would appear to hold true for the repetitive behaviors found in ASD (Russell, Mataix-Cols, Anson, & Murphy, 2005). One extreme view may suggest individuals would need to engage in acts typical of OCD, be responsive to OCD treatments and interventions, and exhibit a core set of OCD symptoms which would have to extend far beyond typical OCD-like symptoms seen in ASD in order to warrant a diagnosis. However, studies of

this nature have not been completed and this stance is not being supported. The general consensus is that these disorders do co-occur (Leyfer, et al., 2006; Thomsen, 1994; Toichi, 2006).

Arguments have been made that broad distinctions do exist which can aid clinicians and researchers in differentially diagnosing AS from OCD, which is the most likely ASD to be confused with OCD (Ghaziuddin, 2002). One noted distinction is that social and/or communicative deficits do not exist in OCD as they do in AS. A second distinction includes sensory abnormalities, which are often seen in AS but not OCD. Similarly, deficits in coordination are often seen in ASD but not OCD. Furthermore, fixations and idiosyncratic interests do not seem accompanied by inner distress in AS as well as in OCD; rather these interests may be pleasurable to an individual with ASD (Ghaziuddin, 2002). These conditions can occur together in situations where increases in compulsive behaviors occur when accompanied by distress and a desire to decrease anxiety through rituals, which may include handwashing, counting, or other behaviors associated with OCD (Ghaziuddin, 2002). Others suggest autism to be distinguishable from OCD on the basis of qualitative impairments in social interaction being present in autism but not OCD, as more restricted patterns of interest and activities would help identify autism from OCD in these cases (C. Gillberg, 1989; Khouzam, El-Gabalawi, Pirwani, & Priest, 2004).

Some strides have been made to operationally define particular terms. Obsessions have been defined in the ASD literature as continuous verbal requests across settings (Charlop-Christy & Haymes, 1996). This study also noted the use of DSM-IV criteria, but was vague in describing how these criteria were applied. Many repetitive behaviors identified in this study were described as stereotypic behaviors, which does represent a step in the direction of

identifying obsessive behavior as part of an ASD rather than another comorbid disorder. However, there is a great deal more information needed in this area. Given the relative dearth of studies examining these disorders together, limited information is available regarding these disorders from a comorbidity standpoint. Even with the lack of information in the literature, some researchers have suggested ASD be a subtype of OCD (Bejerot, 2007). Currently, there is little support for this change.

A long-term follow-up study of forty-seven individuals who were treated for OCD in childhood identified two males later diagnosed with AS in Denmark (Thomsen, 1994). Unfortunately, it is unclear whether these individuals met criteria for the disorder at the initial treatment time given the lack of research foresight on these individuals when originally treated. A more recent study compared individuals with a diagnosis of ASD to those with OCD utilizing the Yale-Brown Obsessive-Compulsive Scale and Symptom Checklist. Overall levels of symptoms were similar between the groups, though somatic obsessions and ritualistic behaviors were more common in the OCD group. Results of the study did not suggest the two groups to be able to be differentiated based on their scores; rather, the authors suggested these data support the argument that individuals with ASD suffer significant levels of distress, as do individuals with OCD (Russell, et al., 2005).

Very few studies have examined the comorbidity of Generalized Anxiety Disorder (GAD) and ASD. One of the few published reports includes a case study with only a quasi-experimental ABAB design focusing on the efficacy of dextromethorphan (Woodard, Groden, Goodwin, Shanower, & Bianco, 2005). An adolescent male diagnosed with GAD and ASD was prescribed this medication to treat a medical condition. Following this medication, lowered levels of tantrums, elopement from high-anxiety situations, and general levels of anxiety were

observed (Woodard, et al., 2005). It is noteworthy that the manuscript did not specify whether any of the reporters were blind to the medication phases.

The diagnosis of tic disorders, including Tourette's syndrome, has been identified within the population with ASD (Baron-Cohen, Scahill, Izaguirre, Hornsey, & Robertson, 1999; Kerbeshian & Burd, 1986; Marriage, Miles, Stokes, & Davey, 1993). Prevalence rates of Tourette's within ASD appear very low, which leads to the implications of these as comorbid disorders yet to be well understood, as they have not been studied in-depth. Studies involving both of these disorders tend to focus on identifying study participants with these diagnoses not as a focus of their research. Rather, the inclusion of this information appears to be a by-product of research focusing in other areas.

In a study focusing on Tourette's syndrome, three children were also identified with varying forms of ASD (Kerbeshian & Burd, 1986). Another study focusing primarily on Tourette's syndrome including a large sample (over 400) also identified a number of children with ASD and estimated a prevalence rate of 0.10 – 0.67% for comorbid ASD and Tourette's syndrome (Kadesjo & Gillberg, 2000). Information regarding the relationship between these disorders is currently lacking, as most research identifying these cases were found retrospectively by identifying these disorders in their samples rather than investigating these phenomenon proactively. As assessment instruments improve, the ability to properly study the association between these disorders should improve.

The literature is remarkably sparse concerning fears and phobias in children with ASD. Traditional behavioral treatments have shown efficacy in some cases (Luiselli, 1978). Treatment of an autistic child's fear of riding the school bus was successfully conducted over nine days. Utilizing exposure and reinforcement in a seven-year-old boy with autism with the boy's mother

involved in reinforcement, treatment gains were maintained at one-year follow-up (Love, Matson, & West, 1990). Parent training has been applied to treating fears in children with ASD. Modeling was used in successfully training mothers of children with ASD to assist their children to deal with fears of going outside as well as fears of bathroom showers with treatment gains maintained at five months and one year follow-up.

Phobias in ASD appear to present uniquely in children with ASD compared to typically-developing peers. Children with autism typically feared thunderstorms, dark places, large crowds, and closed places, which showed little overlap with the phobias of the typically-developing group (Love, et al., 1990). One recent study matched children with ASD, Down syndrome, and a typically-developing group matched for mental age. Results of this study suggest the children with ASD have a unique profile of fears when compared to the other groups (Evans, Canavera, Kleinpeter, Maccubbin, & Taga, 2005) .

Utilizing a classical conditioning procedure, desensitization was used to treat fear of dental procedures in three children with autism (Luscre & Center, 1996). Participants in this study successfully completed the steps required for a dental visit in an analog setting and also resulted in clinically significant improvements in vivo. The treatment for anxiety in an adolescent girl with autism who feared and avoided swimming pools was also described recently (Rapp, Vollmer, & Hovanetz, 2005). Researchers utilized blocking procedures for both flopping and elopement behaviors while utilizing reinforcement in the form of access to edibles for movements towards a swimming pool, the adolescent was eventually able to sustain exposure to a swimming pool without edible reinforcement.

Though many fears exist for the ID population, they are not always similar to those with ASD. A number of specific phobias were identified in a group of children with ASD when

compared to a typically-developing control group (Love, et al., 1990; Matson & Love, 1990). Among those, thunderstorms, paternal punishment, dark places, being in crowds, going to bed in a dark room, closed places, and going to the dentist were all identified as top-ten fears in the ASD group while none of these were identified in the typically-developing group's top fears (Matson & Love, 1990). Ultimately, strategies to treat these fears exist and are effective, even if the fears may differ from typically-developing children.

Psychotic Disorders

Autism and childhood schizophrenia have been viewed as overlapping conditions, have been confused, and have been used interchangeably over the years (Eisenberg & Kanner, 1956; Prior, et al., 1975). Today these disorders are viewed to be quite unique, with ASD referred to as developmental disorders and childhood schizophrenia not considered as such. Symptom presentation is quite different in these two disorders. ASD symptoms are relatively stable once a diagnosis can be accurately made, which is currently believed to be approximately three years of age (Moore & Goodson, 2003; Sigman & Ruskin, 1999). However, psychosis in most individuals is characterized by acute episodes of psychotic behaviors with other times having little to no psychotic behavior. One should be able to differentiate between behaviors observed over time if serial measurements are taken. Stable behaviors may be likened to ASD, while those more volatile behaviors could be attributed to psychosis. Age of onset is likely to be much older with psychotic disorders than symptom presentation within ASD (American Psychiatric Association, 2000).

Regardless of one's position on the matter, support for either position has not been verified by a plethora of studies. Rather, very little research to empirically distinguish between these disorders exists. In order to examine differences in a number of variables in children with

ASD, researchers utilized a personality inventory for children and found children with ASD to have higher scores than do typically-developing children for psychosis, but no changes in intelligence, adaptive, or maladaptive behaviors (McEachin, Smith, & Lovaas, 1993). This was not consistent with later research, which found differences for language, social skills, and adaptation to change between the two groups (Matese, et al., 1994). Interestingly, 20% of the childhood schizophrenia group had previously been diagnosed with PDD-NOS, which supports the difficulty in differential diagnosing these disorders. These disorders are still found to coexist. A study found a 9% prevalence rate of AS with psychosis (with mania noted), while only 3.5% were found to have AS and schizophrenia specifically (Tantam & Frith, 1991).

Ultimately, the presentation of comorbid schizophrenia does not appear to be common in ASD (Leyfer, et al., 2006). Only 1 of 200 cases reported by early research by Asperger ever developed schizophrenia (Asperger, 1944). However, many believe this condition to be misdiagnosed as children present with odd and peculiar behaviors during adolescence, particularly to medical professionals untrained in dealing with mental health disorders. In particular, people with AS may have intense preoccupations or odd ideas which superficially may resemble delusions or other thought disorders (Ghaziuddin, 2002). Particular attention should be paid to developmental histories in cases where these diagnostic questions may appear. As a result, caution is suggested in comorbidly diagnosing psychotic disorders with ASD.

Once thought to be extremely rare, evidence is beginning to support the notion that catatonia within ASD may be more common than previously believed. Catatonia has been described as a distinct disorder characterized by abnormalities of motor function and disturbances of behavior. Catatonia is most often associated with schizophrenia, but is also seen in mood disorders and general medical conditions (Fink & Taylor, 2001). One noteworthy

presentation of comorbid catatonia appears to be depression, which is often observed with ASD. These disorders share some diagnostic criteria, but can be identified by the emergence of new symptoms or a change in the type and/or pattern of presenting symptoms shared by the disorders, including stereotypies, posturing, and changes in activity levels.

Another study identified 12% of a population showing neurological regression during adolescence, including regressed language skills, inertia, and intellectual decline (Lockyer & Rutter, 1970). These regressions were also often accompanied by seizures. More recently, researchers identified 6% of adults referred for autism evaluations to also meet criteria for catatonia and another 1.6% to evince some symptoms of catatonia (Wing & Shah, 2000). Another manuscript identified and described three cases of autism with catatonia, further supporting some evidence of cases of comorbidity of ASD and catatonia (Realmuto & August, 1991). Further case studies identified catatonia within ASD, as a 14-year-old male with both autism and catatonia was described a decade ago (Zaw, Bates, Murali, & Bentham, 1999). Onset appears to be most common from 15 to 19 years of age (Wing & Shah, 2000).

Schizophrenia and other psychotic disorders tend to develop in early adulthood, rather than during childhood. These disorders are rarely diagnosed comorbidly and are often misdiagnosed in adults (Clarke, Littlejohns, Corbett, & Joseph, 1989). Care needs to be taken when symptoms are seen and both disorders are being considered. This is particularly important given the potent antipsychotic medications often prescribed to individuals with psychotic disorders. A thorough review of patient history should be conducted to determine the onset of questionable behaviors, as this information is diagnostically vital and easily overlooked. One study identified four individuals who were diagnosed with ASD and later developed psychotic illnesses as adults, while another was misdiagnosed with schizophrenia and treated with

antipsychotic medications for a number of years before being correctly identified as having AS (Clarke, et al., 1989).

Eating Disorders

Feeding issues have been widely reported as an associated feature of ASD, particularly food refusal (Kodak & Piazza, 2008). Pica is also commonly identified in individuals with ASD (Piazza et al., 1998). Many suggestions have been offered to explain feeding problems in individuals with ASD, including perseveration, impulsivity, fears, sensory impairments, and compliance issues associated with ASD (Cumine, Leach, & Stevenson, 2000; Ledford & Gast, 2006). Protocols to specifically treat these disorders in individuals with ASD are not commonly available, though applied behavior analysis is often used with great success. A number of challenges to the treatment in children with ASD and feeding difficulties exist, particularly within school settings (Twachtman-Reilly, Amaral, & Zebrowski, 2008). Most issues specific to individuals with ASD center around selectivity and refusal rather than presenting as more common eating disorders (Fodstad & Matson, 2008). By extension, though rarely identified in the literature, is the link between these feeding challenges and ASD to children identified with Failure to Thrive (FTT) (Hutchinson, 1999; Keen, 2008).

However, more traditional eating disorders such as Anorexia nervosa (anorexia) and Bulimia nervosa (bulimia) have been cited in the literature as well, though generally these disorders have been seen in HFA and AS (Zucker et al., 2007). Anorexia has been reported rarely in individuals with ASD; while some argue this occurrence is merely chance, there is sufficient evidence suggesting there may be more to this phenomenon. A recent study found twenty-three percent of a group of patients with anorexia were reported to meet criteria for ASD (Zucker, et al., 2007). However, no assessments specific to ASD were utilized in this study and

the results should be considered with this limitation in mind. Overall, very little research has been conducted specifically in this area.

Sleep Disorders

Often overlooked, sleep disorders appear to be far more prevalent than once believed in ASD (Krakowiak, Goodlin-Jones, Hertz-Picciotto, Croen, & Hansen, 2008). Groups of AD, AS, and typically-developing children's sleep patterns were recently investigated (Polimeni, Richdale, & Francis, 2005). Though both ASD groups had more problems than the typically-developing group, the two groups were not distinguishable from one another. Another study has found children with AS to be more sluggish and disoriented than typically-developing peers after waking (Schreck, Mulick, & Rojahn, 2003). Multiple forms of insomnia (sleep initiation and daytime sleepiness) were identified as significantly more abundant in a group of HFA/AS children compared to typically-developing peers (Allik, Larsson, & Smedje, 2006). These results have been supported in a follow-up study which compared a group with ASD to a group of typically-developing peers (Allik, Larsson, & Smedje, 2008). The ASD group was found to have longer sleep latency during the week, while sleep on the weekends was typically earlier onset and earlier waking typically-developing peers. At three-year follow-up, the ASD group had longer sleep wakings, later sleep onset, and a generally less efficient sleep cycle than typically-developing matched peers.

Difficulties with sleep onset and night waking have been found in other studies of sleep problems for children with ASD (Krakowiak, et al., 2008). These findings are echoed in more general sleep disturbance studies; 66.7% of children with ASD were found to have sleep disturbance problems compared to 45.9% of typically-developing children (Souders, 2008). Sleep problems extend to daytime sleeping problems, not unlike typically-developing children.

A simple combination of environmental engineering (removing soft mats a child was identified sleeping on frequently from the room), response prevention/interruption (moving the child to a highly stimulating area contingent on putting his head down), and differential reinforcement of alternative behavior (pats on back and verbal praise for any desirable behavior) were very effective in reducing daytime sleep of a child diagnosed with autism (Friedman & Luiselli, 2008).

An additional factor to consider with sleep problems is the stress these challenges put on families. Sleep problems in children with ASD has been found to be a significant factor in marital stress (Hoffman et al., 2008). These problems have also led to sleep problems for families. It makes sense that parents being required to attend to their children's nighttime problems have their own sleep schedules disrupted, therefore leading to their own sleep challenges. Support for this phenomenon was identified by matching parents of children with ASD to parents of typically-developing children; parents were found to have greater sleep problems in the ASD group (Lopez-Wagner, Hoffman, Sweeney, Hodge, & Gilliam, 2008). Support for these findings was also found utilizing validated sleep measures with similar findings (Meltzer, 2008).

Receptive Language Disorders

Challenges exist in the differential diagnosis of ASD from receptive language disorder. In particular, it has been noted that children with these disorders share many behavioral challenges (Mildenberger, Sitter, Noterdaeme, & Amorosa, 2001). Interestingly, it appears that pre-school behaviors as assessed by the ADI-R were more accurate in determining later diagnostic groups than current behaviors; regardless it appears there is some support for differentially diagnosing these disorders with accepted assessment protocols such as the ADI-R.

General Psychopathology Assessment

A multitude of assessment instruments for psychopathology in children exist. As previously discussed, scales to assess for psychopathology within ASD have limited empirical support, highlighting the need to develop assessments in this area. The overwhelming majority of current assessments have not been properly normed within ASD, limiting the conclusions one should draw based on assessment results. The lack of proper psychopathology assessments for use in the children with ASD highlights the pressing need for assessment tools in this area.

Comorbid Disorder Assessment within ASD

As was noteworthy in the review of identified comorbid psychopathology within ASD, there were very few studies that utilized empirically supported assessments specific to ASD, and very few studies to date identify individuals utilizing such assessments outside of reliability and validity studies for said instruments (Helverschou & Martinsen, 2010; Worley & Matson, 2011).

The Autism Spectrum Disorder – Comorbidity - Child Version (ASD-CC) utilized in this manuscript is a part of a larger battery of assessments called the Autism Spectrum Disorder – Child Version. The ASD-CC was developed alongside its companion assessments. The diagnostic (for autism spectrum disorders) assessment is called the Autism Spectrum Disorders – Diagnostic for Children (ASD-DC) (Matson, González, & Wilkins, 2009). The companion assessment for behavioral problems associated with autism spectrum disorders is called the Autism Spectrum Disorders –Problem Behaviors for Children (ASD-PBC) (Matson, González, & Rivet, 2008).

The ASD-CC is designed to measure symptoms of other emotional difficulties commonly found to occur within ASD. There are 39 items on the ASD-CC in which parents or other caregivers rate each item as to the extent there is a problem or impairment based on a 0, 1, or 2

(Likert-type) scoring system. Scores vary between not a problem or impairment, a mild problem or impairment, or a severe problem or impairment.

The ASD-CC has strong research supporting its psychometric properties. Both reliability and validity of this manuscript have been established for children with ASD (Hegberg, 1989; Matson, LoVullo, et al., 2009). For all items retained in the final version of the ASD-CC, inter-rater and test-retest reliability was at least fair with kappa coefficients over 0.30, with moderately good inter-rater (k = .46) and test-retest reliability (k = .51) while internal consistency was acceptable (Hegberg, 1989). Validity was established with a seven-factor solution for the ASD-CC as measured against the ASD subpopulation of the Behavioral Assessment System for Children – Revised (BASC-2) (Matson, LoVullo, et al., 2009). The ASD-CC was designed with the hope of assessing symptoms of disorders including depression, conduct disorder, ADHD, tics disorder, OCD, specific phobia, and eating difficulties (Matson, LoVullo, et al., 2009).

BISCUIT. While designed for a narrow age range, the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT) has shown promising preliminary results (Matson, Boisjoli, et al., 2009; Matson, Fodstad, Mahan, et al., 2009; Matson, Wilkins, Sevin, et al., 2009; Matson, Wilkins, Sharp, et al., 2009). The BISCUIT was designed to assess traits of ASD in babies and infants ages 17-37 months in a similar fashion to the ASD-CC assessment. Scoring and administration of the BISCUIT is similar to the ASD-CC, with a 3-point Likert scale comparing the child in question to typically-developing children (or the extent to which particular problem behaviors have been a problem). Initial impressions of the BISCUIT suggest this to be a high quality instrument to assess ASD in babies and infants. The BISUIT is a three-part diagnostic assessment is designed similarly to the ASD-Child battery, with a diagnostic assessment, a comorbidity assessment, and a problem behavior assessment. Interestingly, the

BISCUIT-Part 2 has been normed for both children with ASD as well as children with ID (Matson, Fodstad, & Mahan, 2009; Matson, Fodstad, Mahan, et al., 2009). Benefits of the BISCUIT are similar to the ASD-Child and Adult batteries, including brief, simple administration rather than a lengthy administration.

Psychopathology in Autism Checklist (PAC). The PAC is a 30-item caregiver/informant-based measure designed to measure psychopathology on four dimensions in adults with autism and ID (Helverschou, et al., 2009). The PAC was developed by the National Autism Unit in Norway. The PAC is designed to evaluate symptoms of psychosis, depression, anxiety, and OCD that are, by the authors' report, not related to autism. While this assessment is not designed for use in children, it represents one of very few identified psychopathological comorbidity assessment published outside of the ASD-Child, ASD-Adult and BISCUIT assessment batteries for adults or children. The PAC is scored on a 4-point Likert scale, with a score of one being indicative of no problem while a score of 4 indicates severe problems. The PAC's preliminary psychometric properties are described as acceptable but requiring further investigation. Like other instruments described, the PAC is designed to be a screening instrument. It was noteworthy that relatively low subscale scores were identified utilizing this assessment, which was unexpected given the higher range of scores available in this assessment. To date, there has been a single identified study utilizing this assessment (Helverschou & Martinsen, 2010).

Autism Co-morbidity Interview – Present and Lifetime (ACI-PL) is a modified version of the Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS) (Chambers, 1985; Leyfer, et al., 2006). The ACI-PL is designed to be utilized with children, which is unique to this instrument and the ASD-CC being studied in this manuscript. The ACI-PL covers all psychiatric disorders of the KSADS (Chambers, 1985). In many instances, questions were added

to the generic KSADS battery to more specifically address differences in how psychopathology presents in children with ASD compared to the general population (Lainhart & Folstein, 1994). This semi-structured interview utilizes only a parent as an informant. Unlike the previous measures, the ACI-PL is not a screening instrument. The ACI-PL is a complex semi-structured interview. Due to this tailored design, it does have many positives, including follow-up questions tailored more to individuals' abilities and response repertoires. Additionally, the ACI-PL does allow for diagnoses of ADHD, social phobia, generalized anxiety disorder, and separation anxiety disorders, unlike the DSM-IV-TR (American Psychiatric Association, 2000). Reliability and validity of this instrument were only able to be substantiated for major depressive disorder, OCD, and ADHD (Leyfer, et al., 2006). The ACI-PL is quite time-consuming, taking two or more hours to complete, which is its most significant drawback. Single assessments with a two or more hour assessment time are not likely to be utilized by clinicians outside of university hospitals or training facilities.

Styles of Assessment for Psychopathology

Self-report measures are often utilized and studied in psychological assessment. There is support that children are able to provide valuable information on anxiety and depression symptoms under controlled circumstances at pre-school ages (Luby, Belden, Sullivan, & Spitznagel, 2007). The controlled circumstances that allow for this to be possible in young children are not present in children with ASD, which is the primary reason this method is cautioned within ASD (Mazefsky, Kao, & Oswald, 2010). As discussed previously, the high comorbid rate of ID often found in ASD present unique problems. First and foremost would be the limited ability to provide information based on intellectual functioning as well as other skill deficits associated with ID (Wilkins & Matson, 2009). Further complicating matters, many of

the fundamental aspects of autism suggest restraint in self-report measures within ASD (Mazefsky, et al., 2010). Disagreement between self-report and parent-report measures have been noted on multiple occasions (Solomon, Goodlin-Jones, & Anders, 2004; White, Ollendick, Scahill, Oswald, & Albano, 2009). Contrary to this, there is at least one study where self-report and parent-report measures supported the efficacy of treatment for anxiety symptoms in children with ASD and anxiety (Chalfant, et al., 2007). Studies have supported that differences in self-reports of responses to physiological stimuli exist, even when the physiological response was measured to be identical (Shalom et al., 2006). Support for this finding was also found in a study examining how adults with ASD understand their emotions (Berthoz & Hill, 2005). One study noted that self-report and parent-report scores on the BASC-2 were "not associated" in a sample of children with AS (Meyer, Mundy, van Hecke, & Durocher, 2006). The most in-depth study examining this phenomenon within ASD utilizing a number of self-report instruments including the Child Depression Inventory, Revised Children's Manifest Anxiety Scale, Conners-Wells Adolescent Self-Report Scale –Short Edition, and the Short Leyton Obsessional Inventory – Child Version. Psychometric properties as measured within their sample of each assessment were far inferior to all published figures of each assessment (Mazefsky, et al., 2010).

Informant-based rating scales are commonly utilized in psychological assessment. The need for this type of assessment stems from a variety of different reasons. First, when diagnostic criteria require deficits to be present in multiple settings (e.g., ADHD), informant-based measures are often utilized (Achenbach & Rescorla, 2006; Reynolds & Kamphaus, 2004). A second obvious reason to utilize informants for assessment is necessity; situations arise in which an individual is not able to provide accurate information. Informant-based assessment has often been utilized in situations where individuals suffer from ID (Matson & Barrett, 1982). Similarly,

individuals with ASD may have language and/or communication deficits which limit their ability to self-report (Matson & Nebel-Schwalm, 2007; Mazefsky, et al., 2010). A significant drawback to this method is the need to consider informants' motivations, as reports may be inaccurate or manipulative without direct observation (Achenbach, 2011). This issue underscores one of many reasons to utilize multisource assessment in making clinical judgments.

Direct Observation has been utilized and is well-accepted in both clinical assessment and research (Himle et al., 2006). Among the most commonly utilized avenues of direct observation is applied behavior analysis (ABA) (Iwata & Dozier, 2008). ABA was popularized and described by Iwata and colleagues (Iwata, 1982; Iwata, Dorsey, Slifer, & Bauman, 1994). Direct observation has been utilized to assess the relationship between behaviors and the variables that maintain behaviors. Within ABA, observers are trained to observe and record behaviors while modifying environmental factors to examine what can be modified to increase or decrease frequency and/or severity of behaviors (Iwata, et al., 1994). Reliability of this type of data collection is easily attained and often reported in the literature at rates above 90% (Kelly, 1977).

Establishment of Cut-off Scores in Assessment

While a number of determinants are taken into consideration with diagnostic assessment design, two of the most important factors include sensitivity and specificity (Altman & Bland, 1994). The highest sensitivity and specificity are preferred, but there are no specific requirements of values of either of these (Bland & Altman, 2002). Depending on the goal of the measure, a trade-off between one and the other is necessary to fit the assessment. Related to, but unique to sensitivity and specificity are positive predictive value (PPV) and negative predictive value (NPV). Ultimately, the proper balance of all factors is guided and determined by the goals of the assessment in question.

Sensitivity

Sensitivity (in the realm of assessment) is defined as the probability an assessment will be positive among a group of individuals with the measured disorder (Altman & Bland, 1994). Ultimately, sensitivity of a measure identifies how well it can identify true positives. Sensitivity is calculated by dividing the number of true positives by the sum of true positives plus the true false negatives. An assessment with high sensitivity would be useful as a screening device in the hopes of ruling out disorders. Sensitivity can range theoretically from 0.0 to 1.0; it cannot be negative. Sensitivity also is not realistically likely to be 1.0 (perfectly sensitive) at final cut-off scores for assessments, but is able to approach it in certain situations, particularly when trade-offs in sensitivity are made (sensitivity will be further discussed shortly). A measure with sensitivity of 1.0 and specificity (discussed later in this text) of 1.0 would be a perfectly designed assessment. Tests with high sensitivity will have a low type II error rate, rarely misidentifying true positives; making high sensitivity a priority for screening instruments (Altman & Bland, 1994). Within the realm of psychological assessment, sensitivity can be more desired than in the medical field given that psychological tests are rarely physically invasive; psychological invasiveness is strongly limited by institutional review boards, etc. following historically invasive experiments (Milgram, 1963). Modern psychological assessments can be invasive in the sense of requiring time of the patient or families/respondents, but generally does not prove to be so invasive that it would be contraindicated. Invasiveness of assessment tends to become problematic far more often in the medical field where assessment can involve blood draws, sensors being physically attached to a person, etc. (Callaghan, Gray, Caldamone, & Ellsworth, 2008). Ultimately, increased sensitivity comes at the expense of specificity due to the lowering of thresholds for positive cases. More intrusive and/or time-consuming measures may value

specificity more, as would be expected if screening measures suggested the presence of psychopathology but the correct diagnosis was not clear with other data available.

Specificity

The specificity of a diagnostic assessment is the probability the assessment will be negative among individuals without the disorder; it is the assessment's ability to identify true negatives (Altman & Bland, 1994). Specificity, therefore, is assessed by examining the positive assessment results within a group of subjects who are not supposed to have the disorder (the control group). According to Orne (1962), it is important that the subjects in the experimental and control groups have as similar of expectations of the experiment (demand characteristics) as possible. This is primarily because there is no statistical tool to protect against these types of confounds (Youden, 1950). This is the primary reason a "normal" sample is sought for assessment tools, as it minimizes possible confounds. Demand characteristics are considered one possible confounding variable, particularly in psychological assessment (Orne, 1962).

An assessment with high specificity will find that those it identifies without a disorder do not have the disorder. Specificity is calculated by dividing the number of true negatives by the sum of the true negatives plus the false positives. An assessment with high specificity will have a low type I error rate, which means it identifies true negatives (i.e., the assessment identifies all with the comorbid disorder as having it). An assessment with extremely high specificity would be useful in confirming negative diagnoses, rather than using it as a screening device. In instances where assessments are particularly cumbersome, time consuming, or otherwise highly invasive, specificity becomes more important. Specificity is vital in instances where ruling out a diagnosis of the utmost importance.

Positive Predictive Value

PPV is defined as the proportion of individuals who are correctly identified (with a disorder, in this case) utilizing an assessment (Akobeng, 2007). Positive predictive value is vital, as it represents the probability that a positive result reflects an individual as having the actual disorder being identified. The positive predictive value is calculated by dividing the true positive value by all (true and false) positives identified by an assessment. Within the realm of assessment, a high positive predictive value is preferred. Assessments with high rates of false-positives will tend to have lower PPV, as the true-positive cases are divided by the true and false-positive cases. Similarly, a low true-positive rate will decrease PPV.

Negative Predictive Value

NPV is defined as the proportion of individuals who are correctly identified (as not having a disorder, in this case) utilizing an assessment (Akobeng, 2007). Negative predictive value is calculated by dividing the true negative subjects by all negatively identified subjects. Negative predictive value is highly important, as it represents the probability that negative assessment results reflect an individual does not have an actual disorder. The negative predictive value is calculated by dividing the number of true negatives by the total (true and false) negatives. As with positive predictive values, higher values are preferred.

Total Correct Classification

Total Correct Classification (TCC) is defined as the proportion of individuals who are correctly identified as having or not having a condition utilizing an assessment (i.e., the true positive and true negatives divided by the number of individuals administered the assessment) (Akobeng, 2007). As with PPV and NPV, higher values are preferred and are indicative of a better assessment. TCC can be somewhat misleading in judging an assessment, as extreme high-

incidence and low-incidence disorders can skew rates when there are still issues with sensitivity and specificity.

Reference Standard

A reference standard is an alternative method to identify what the assessment is trying to measure. Reference standards need to be independent of the assessment being developed or evaluated in order to be useful for assessment validation. Reference standards are generally the "gold standards" in assessment of whatever disorder is in question. In validating the ASD-DC, the ADI-R and CARS were utilized as reference standards (Matson, Hess, Mahan, & Fodstad, 2010; Matson, Mahan, Hess, Fodstad, & Neal, 2010). The BASC-2 was utilized in validating the ASD-CC (Matson, LoVullo, et al., 2009). In situations where a gold-standard is not available or not reasonable to be utilized, a population with confirmed diagnoses can also be utilized as a reference standard (Helverschou, et al., 2009; Matson, Gardner, Coe, & Sovner, 1991; J. Moss, Magiati, Charman, & Howlin, 2008).

Common Statistical Methods in Assessment

A number of methods involved in the determination of cut-off scores are discussed. The majority of the options discussed revolve around psychological assessment. However, other commonly utilized methods are also briefly discussed in regards to how they relate to this study and whether or not they were utilized.

Receiver Operator Characteristics (ROC) Analysis

Receiver operator characteristics provide a very powerful method to analyze the balance between sensitivity and specificity in classifying subjects in one of two categories (with or without a disorder, for example). With ROC analysis, the goal of an assessment is to maximize the area under the curve (AUC) for a set of cutoff scores. Sensitivity and specificity scores range

from 0 to 1, with 0.5 being the indicative of positive or negative results being equal to chance; a score closest to 1.0 is most desirable. This method provides flexibility in balancing sensitivity and specificity as desired for the scale by providing detailed properties of an assessment at any number of potential cut-off points (Fawcett, 2006). ROC analysis demonstrates how severe the trade-off is between an assessment's sensitivity and specificity (Bültmann et al., 2000). This method does contain significant drawbacks, which are a necessary cost given the statistical advantages inherent in this method. Drawbacks are primarily centered on the requirements for a relatively large sample. A significant number of both known positive and negative cases are required; hence this is not ideal for identifying disorders with low incidence rates. It is generally accepted that at least 50 positive cases be utilized for each analysis in an ideal environment, which severely limits the utility of this method (Fawcett, 2006).

Standard Deviation from Central Tendency Method

Clinical significance is commonly accepted for assessment scales as two standard deviations from the central tendency of the "normal" population (N. S. Jacobson & Traux, 1991). The standard deviation method of determining cutoff scores has been utilized commonly in the psychological assessment literature (Matson, Fodstad, & Mahan, 2009; Matson, Fodstad, Mahan, et al., 2009; Matson, Kozlowski, Neal, Worley, & Fodstad, 2011; Rojahn et al., 2009). This method most often adheres to a 95% confidence interval of a mean to identify the cutoff score. With a reasonable sample size including known positive cases, both the mean and standard deviation of the sample can be calculated. An interval is obtained by adding/subtracting twice the standard deviation from the mean. With the 95% confidence interval, there is a 5% chance that the values of a test will fall outside of this interval. One benefit of this technique includes its ability to be utilized on a sample with many known negative cases and it provides significant

utility in samples with low incidence rates. Oftentimes, the standard deviation technique is the only option available given requirements of acceptable levels of statistical power in samples and due to how well it lends itself to psychological assessment.

Angoff Method

The Angoff method of standard-setting is frequently used and most known within academic standard-setting and high-stakes realms (Angoff, 1971). This method attempts to create cut-off scores with empirical data by utilizing subject-matter experts to agree upon correct scores given their particular expertise in an area. The Angoff method is far more applicable in academic testing, where minimal passing scores for tests are identified based on what a panel would consider minimally qualified individuals to attain (Impara & Plake, 1998; Tiratira, 2009). In psychological assessment, this method is not as applicable when compared to alternative methods available. It may be theoretically possible that each factor of a psychological assessment be viewed as a separate "test" in the academic sense, where the expert panel would come up with an average score (a predicted difficulty value, in academic terms). Scores can be refined after investigating how other experts scored the assessment. The average of the experts' scores would be the score determined by the Angoff method (Angoff, 1971). Within the Angoff method, it is common to utilize aspects of other procedures (including ROC analysis and the standard deviation from central tendency method) as a part of the decision-making process among the expert panel.

Item Response Theory Method

Item Response Theory (IRT) is one option used to design and evaluate assessments. IRT is also known as Rasch model, latent trait theory, characteristic curve theory, and modern mental test theory. One criticism of IRT includes all items and raters discriminate equally (Thomas,

2002). IRT has been utilized in the design of a number of high-stakes assessments, such as the graduate record examination. IRT is based on the belief each item has a portion of relevance to ability; this is not a technique that is easily applicable to psychological assessment. While this method is commonly utilized in academic settings, this technique is not as useful in the realm of diagnostic psychological testing, given the seven factor make-up of the ASD-CC. Difficulties in utilizing IRT in psychological assessment have been discussed (Vincent, 2004).

Discriminant Function Analysis

Discriminant function analysis (DFA) does not actually establish cut-off scores, but is actually often used in establishing the factor structures of assessments where these cut-off scores are calculated. In psychological assessment, DFA utilizes a sample of known positive and negative cases for a given disorder and works to discriminate between groups of either having or not having a disorder. For example, DFA observes test values to classify cases as having or not having this disorder based on the test values' ability to predict group membership (the factors of an assessment, for example). One of the major advantages of DFA is that it can be used in instances when diagnoses are to be made based on multiple diagnostic assessments where no clear gold-standard is available or highly similar criteria are grouped together from other assessments. Sample size is one drawback to this method, as a minimum of 20 cases in the smallest group is recommended to be able to utilize this technique (Tabachnick & Fidell, 2001). This method was utilized in the determination of the factor structure of the ASD-CC (Matson, LoVullo, et al., 2009).

Purpose

As previously outlined, a dearth of assessments specifically designed for people with ASD and comorbid ASD exists. Given the increasing rates of ASD and the severe impact it has on the lives of those afflicted with these disorders (and their families), improved assessment is of vital importance. High rates of comorbid psychopathology are suspected within ASD, but confirming these diagnoses proves to be particularly daunting. The most serious challenge in confirming these diagnoses is that these disorders have not been diagnosed with assessments utilizing a proper normative sample. The need for such instruments is not to be underestimated. Scale development, such as the project outlined in this manuscript, is vital to properly investigate differential diagnosis of comorbid psychopathology within ASD.

The purpose of this study was to establish cut-off scores for a new measure of comorbid psychopathology in children with ASD with the Autism Spectrum Disorders – Comorbid for Children (ASD-CC). The ASD-CC shares one particular similarity with other measures used in children with ASD; the ASD-CC is informant-based, as many individuals with ASD lack the expressive communicative abilities to accurately self-report. For a more thorough discussion of this issue, readers are referred to Lainhart and Folstein (1994). A relatively restricted number of highly reported incidence Axis I psychopathology factors are identified for the ASD-CC; this allows for an increased number of symptoms to be evaluated and increased diagnostic utility. The diagnostic similarities of ASD and other Axis I psychopathology create a significant challenge for establishing norms for this population. This challenge highlights the necessity of establishing such norms, as this relationship is currently poorly understood and the only other assessment for comorbid psychopathology in children is not reasonable for screening purposes due to length of administration.

Method

Participants and Settings

Participants for this study were recruited from a variety of clinic, community, and school settings throughout the United States and Canada. There were disproportionately higher numbers of participants from Louisiana, Minnesota, Iowa, and Nebraska as a result of proximity to researchers involved in this and related studies. Recruitment was based on self, personal, and/or professional referrals to participate in this study. A number of groups involving children with ASD were contacted as a part of the recruitment process for this study, including social skills groups, parent support groups, residential treatment centers, as well as psychology and social service conferences. A number of typically-developing children were recruited for this study in addition to children with various developmental disabilities (including ASD) as a part of the normative sample. This project was described to participants and their families as a study aimed to develop measures to assess ASD as well as co-occurring problems in children with ASD. IRB approval from Louisiana State University was obtained and informed consent was obtained from parents and/or guardians.

A previously existing sample consisting of approximately 250 children was increased to 638 children with the addition of 388 children ranging in age from 2 to 17 years. Participants included in this study reported a variety of ethnic and cultural backgrounds (see Table 1 for specifics regarding demographic data). Both males and females were recruited for this study, though males accounted for 70.2% of the participants, which closely approximates the generally accepted prevalence rates of 3 to 4 males per 1 female in ASD populations (Fombonne, 2005). Information was gathered regarding verbal ability; functionally verbal was defined by the ability

to convey needs or wants to others using words. Intellectual disability was defined by the presence of a diagnosis of mild, moderate, severe, profound, or unspecified mental retardation.

Demographic characteristics of participants are presented in Table 1 below. All Axis I and Axis II diagnoses were based on DSM-IV-TR and ICD-10 criteria. Participants presented with a variety of Axis I disorders for both the ASD group and the non-ASD Psychopathology control group. Axis I disorders are displayed in Table 2 below.

Table 1
Demographic Characteristics of Participants (N = 638)

Characteristic	n	%
Age (in Years)		
2	12	1.9
3	33	5.2
4	40	6.4
5	57	9.0
6	75	11.8
7	72	12.2
8	55	8.8
9	51	8.1
10	35	5.6
11	42	6.7
12	29	4.6
13	33	5.2
14	21	3.3
15	15	2.4
16	13	2.0
17	7	1.1
Unspecified	6	1.0

(Table 1 Continues)

(Table 1 Continued)

Characteristic	n	%
Group		
ASD	372	59.1
Psychopathology	77	12.1
Control	180	28.2
Incomplete Information	9	1.4
Gender		
Male	448	70.2
Female	180	28.2
Unspecified	10	1.6
Verbal Ability		
Functionally Verbal	458	71.8
Not Functionally Verbal	42	6.6
Unspecified	138	21.6
Intellectual Disability (ID)		
No Presence of ID	425	66.6
Presence of ID	58	9.1
Unspecified	155	24.3
Race		
White	422	66.1
Black	57	8.9
Hispanic	16	2.5
Other	21	3.3
Unspecified	122	19.1

Table 2
Psychopathology Present in Sample

Axis I Diagnosed Disorders	ASD Group (n=372)	%	Psychopathology Group (n=77)	%
ADHD/Behavioral Disorders	54	33.97	45	44.55
Anxiety	42	26.42	26	25.74
Depression	3	1.89	3	2.97
Learning Disorders	4	2.52	7	6.93
Elimination Disorders	4	2.52	4	3.96
Mood Disorder (Not Depression)	9	5.67	2	1.98
ODD/CD	22	13.84	6	5.94
Psychotic Disorders	4	2.52	1	0.99
Sensory Disorders	12	7.54	0	0.00
Sexual Disorders/Deviance	2	1.26	0	0.00
Sleep Disorders	3	1.89	1	0.99
Other	0	0.00	6	5.94

Note: A number of individuals in each group had multiple Axis I diagnoses, accounting for higher individual disorder numbers than the total number of individuals with Axis I Psychopathology.

Receiver Operator Characteristic (ROC) Analysis

ROC analysis is widely considered the ideal statistical analytic tool to utilize in developing cut-off scores in psychological assessment due to its flexibility and utility in evaluation cut-off scores (Schisterman, Perkins, Liu, & Bondell, 2005). ROC analysis, as previously discussed in this manuscript, provides sensitivity and specificity levels for each potential cut-off point. The benefit of this analysis is the ability to accurately cater cut-off scores based on the desired functionality of the assessment (screening instrument versus highly specific diagnostic instrument). ROC analysis was utilized for the following ASD-CC factors: Tantrum Behavior, Repetitive Behavior, Worry/Depressed, Avoidant Behavior, and Conduct, which were chosen to be examined with this approach due to being the best available option given the sample.

Standard Deviation from Central Tendency Method

When confronted with insufficient statistical power or assumptions of normalcy required to utilize a ROC analysis method, the standard deviation from central tendency method is often utilized (Matson, Fodstad, & Mahan, 2009; Matson, Fodstad, Mahan, et al., 2009; Matson, et al., 2011). This approach was utilized in order to determine cut-off points for the two eating factors of the ASD-CC. While the sample is not a normally distributed sample, it is representative of children with ASD, which is the target sample for this assessment. Means and standard deviations were computed for all factors of the ASD-CC. To determine means and standard deviations, results were rounded to two decimal points. Results (i.e., potential scores) were rounded to the nearest whole number, as the ASD-CC only allows for whole numbers to be used in scoring. For this analysis, standard deviations were calculated for all individuals in the sample at the recommended 2.0 standard deviations as well as at 1.5 and 1.0 standard deviations for comparison on each factor.

Materials and Measures

Autism Spectrum Disorders – Comorbid for Children

The ASD-CC is a 49-item, informant-based rating scale designed to assess symptoms of psychopathology and emotional difficulties which commonly occur with ASD. Items are included to address conditions such as ADHD, depression, conduct disorder, eating disorders/difficulties, OCD, specific phobias, and tic disorders. Caregivers rate each item to the extent it has been a recent problem as either 0 = "not a problem or impairment; not at all", 1="mild problem or impairment", 2 = "severe problem or impairment", or X = "does not apply or don't know". Inter-rater and test-retest reliability for the ASD-CC has been found to be moderately good (k = *.46* and k = .51, respectively) with very good internal consistency (α = .91)

reported (Matson & Dempsey, 2008). Factor analysis yielded seven subscales for the ASD-CC: 1) Tantrum Behavior, 2) Repetitive Behavior, 3) Worry/Depressed, 4), Avoidant Behavior, 5) Under-Eating, 6) Conduct, and 7) Over-Eating. Construct validity was established for Tantrum Behavior, Worry/Depressed, Repetitive Behavior, Conduct, and Over-Eating factors. The Under-Eating subscale's validity was not as strong as other factors and the Avoidant Behavior subscale's validity was unable to be established (Matson, González, et al., 2009).

DSM/ICD Checklist

Standardization of ASD diagnoses and inclusion criteria are of vital importance. To this end, a composite symptom checklist from the DSM-IV-TR (American Psychiatric Association, 2000) and International Classification of Diseases, Tenth Edition (ICD-10) (World Health Organization, 1992) was designed and described in a previous study (Matson, González, Wilkins, & Rivet, 2008). This DSM-IV-TR/ICD-10 checklist (DSM/ICD checklist) has been found to have excellent inter-rater and test-retest reliability, as well as excellent internal consistency ($r=.89$; $r=.98$; $\alpha=.95$, respectively) for a subset of this sample (Matson, González, Wilkins, et al., 2008). Utilizing clinical diagnoses as well as this a secondary checklist such as the DSM/ICD Checklist is consistent with current recommendations in ASD research (Matson, Nebel-Schwalm, & Matson, 2007). To be included in the ASD group, two deficits in social interactions and one in an additional area of functioning were required (e.g. repetitive behaviors/interests or communication) for this study based on the DSM/ICD checklist.

Administration of Materials

Parents or caregivers completed the ASD-CC and the DSM-IV-TR/ICD-10 checklist independently. Directions for these instruments were printed at the top of each questionnaire.

Doctoral students in clinical psychology familiar with the instrument were available to help resolve any questions parents and caretakers had while completing these measures.

A diagnosis by a licensed doctoral level clinical psychologist (Ph.D. or Psy.D.) and/or a board certified Psychiatrist was also required for inclusion in any non-typically-developing group in this study. Clients with previously identified psychiatric disorders were examined for comparative purposes of this study, as this is an accepted method for validating psychometric instruments (Helverschou, et al., 2009; Matson, et al., 1991; S. Moss, Patel, Prosser, & Goldberg, 1993).

Procedure

Parents and/or guardians served as informants for the assessments in this study. Given the largely understudied nature of comorbid psychopathology in ASD, a number of methods were considered in order to determine the best cut-off scores for each factor. Separate cut-off scores were established for the seven factors identified previously for the ASD-CC: Tantrum Behavior, Repetitive Behavior, Worry/Depressed, Avoidant Behavior, Under-Eating, Over-Eating, and Conduct (Matson, González, et al., 2009). Given the statistical rigor desired, the particular analysis for each factor varied based on the intent to utilize the best available method for each factor. The Tantrum Behavior, Repetitive Behavior, Worry/Depressed, Avoidant Behavior, and Conduct factors were analyzed utilizing a ROC Analysis procedure while the two eating factors (Under-Eating and Over-Eating) were analyzed utilizing a standard deviation procedure. Standard deviation scores were calculated for all factors for the readers to be able to compare scores from the two methods.

Results

ROC analysis was conducted on five of the seven factors of the ASD-CC. Since two of the factors had only one participant meeting criteria for their respective disorders, ROC analysis could not be conducted for those two factors. Instead, the standard deviation from central tendency method was utilized for these two factors. For the five applicable factors, analyses were performed using SPSS ROC CURVE ANALYSIS to determine the sensitivity and specificity of potential cut-off scores for each factor. Potential cut-off scores were entered individually as predictor variables for the presence of all seven factors in order to identify PPV and NPV values for each cut-off score.

Results of the ROC analysis on the Tantrum Behavior factor allowed multiple cut-off points to be explored in order to maximize sensitivity and specificity while considering PPV and NPV. The sensitivity, specificity, PPV, NPV, Total Correct Classification (TCC), and AUC are listed in Table 3. The ROC analysis curve is displayed in Figure 1. Results of the analysis indicated a cut-off score of 3 or 4 to be better than other potential scores, with the highest AUC of any potential cut-off scores within preferable levels of sensitivity. While the sensitivity at the cut-off score of 4 is slightly lower than that at a cut-off score of 3, the .06 increase in specificity and an 11% improvement in TCC appear to be worthwhile trade-offs for the .07 decrease in sensitivity. Given these results, a cut-off score of 4 was the best score for the Tantrum Behavior factor given the goals of this assessment. For comparison purposes, cut-off scores at 1.0, 1.5, and 2.0 standard deviations are also displayed in Table 3. The mean value of the Tantrum Behavior factor was 5.56 with a standard deviation of 4.24. The cut-off score for one standard deviation above the mean was 9.8, which was rounded to 10. The cut-off score for 1.5 standard deviations above the mean was 11.92, which was rounded to 12. The cut-off score for two standard deviations above the mean was 14.04, which was rounded to 14.

Table 3
Sensitivity, Specificity, PPV, NPV, TCC, and AUC for ROC Analysis based on Factor 1 (Tantrum Behavior) Cut-Off Scores

Score	Sensitivity	Specificity	PPV	NPV	TCC	AUC
1	.97	.14	11.5%	95.5%	29.0%	.56
2	.92	.25	12.1%	95.1%	35.9%	.59
3	.92	.32	13.5%	96.1%	43.3%	.62
4	.85	.38	14.5%	94.6%	54.0%	.62
5	.78	.44	13.9%	92.7%	59.7%	.61
6	.62	.55	14.7%	92.4%	66.0%	.59
7	.53	.64	13.5%	91.2%	70.5%	.59
8	.38	.72	14.8%	91.3%	75.1%	.55
Standard Deviation Model						
1.0 SD						
10	.30	.84	22.5%	91.8%	84.6%	.57
1.5 SD						
12	.28	.91	30.2%	91.4%	87.3%	.60
2.0 SD						
14	.17	.95	26.3%	90.5%	88.6%	.56

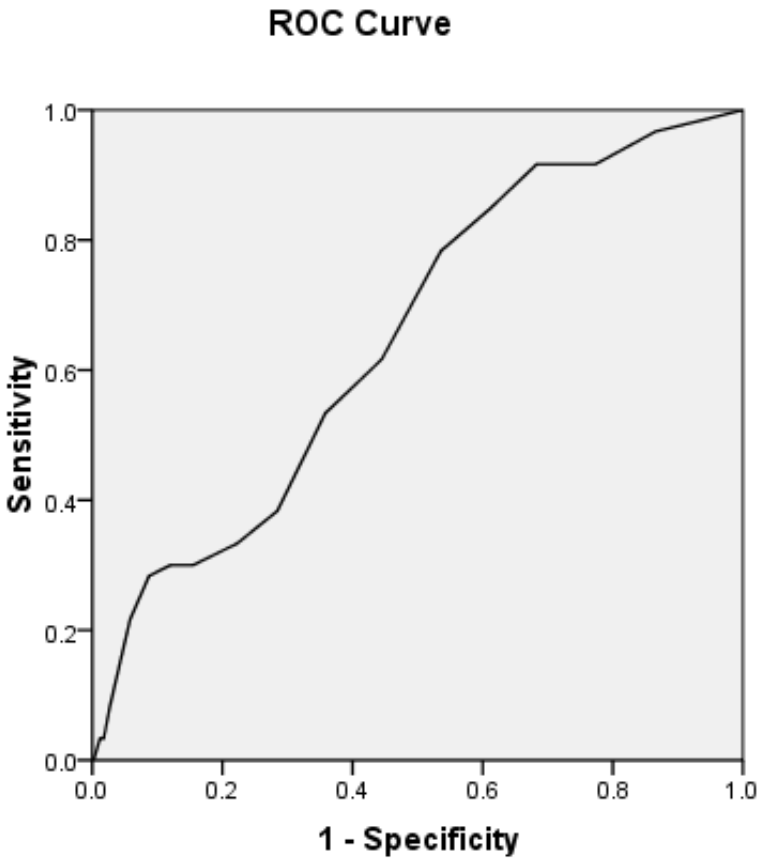

Figure 1: ROC Analysis Curve for the Tantrum Behavior Factor

The ROC analysis of each remaining factor followed the same format as used with Tantrum Behavior factor. Potential cut-off scores for the second factor, Repetitive Behavior, were entered individually as predictor variables for the presence of repetitive behaviors in order to identify PPV and NPV values for each cut-off score. Results of the ROC analysis allowed all potential cut-off points to be explored in order to maximize sensitivity and specificity while considering PPV and NPV. The results from the ROC analysis for the Repetitive factor are listed in Table 4 and the ROC analysis curve is displayed in Figure 2. Results of the analysis indicated a cut-off score of 4 to be better than other potential scores. The increase in specificity with no trade-off in sensitivity between 3 and 4 supports a score of 4, while the sensitivity level at a cut-off score of 5 is much lower (.11) for a marginal increase in specificity (.07). See Table 4 for a comparison of other potential cut-off scores. For comparison purposes, cut-off scores at 1.0, 1.5, and 2.0 standard deviations are also displayed in Table 4. The mean value of the Repetitive Behavior factor was 3.82 with a standard deviation of 3.79. The cut-off score for one standard deviation above the mean was 7.8, which was rounded to 8. The cut-off score for 1.5 standard deviations above the mean was 9.51, which was rounded to 10. The cut-off score for two standard deviations above the mean was 11.4, which was rounded to 11.

As with the previous analysis, for the third factor, Worry/Depressed, potential cut-off scores were entered individually as predictor variables for the presence of Worry/Depressed behaviors in order to identify PPV and NPV values for each cut-off score. Results of the ROC analysis allowed multiple cut-off points to be explored in order to maximize the sensitivity and specificity while considering PPV and NPV. The results from the ROC analysis for the Worry/Depressed factor are listed in Table 5 and the ROC analysis curve is displayed in Figure 3.

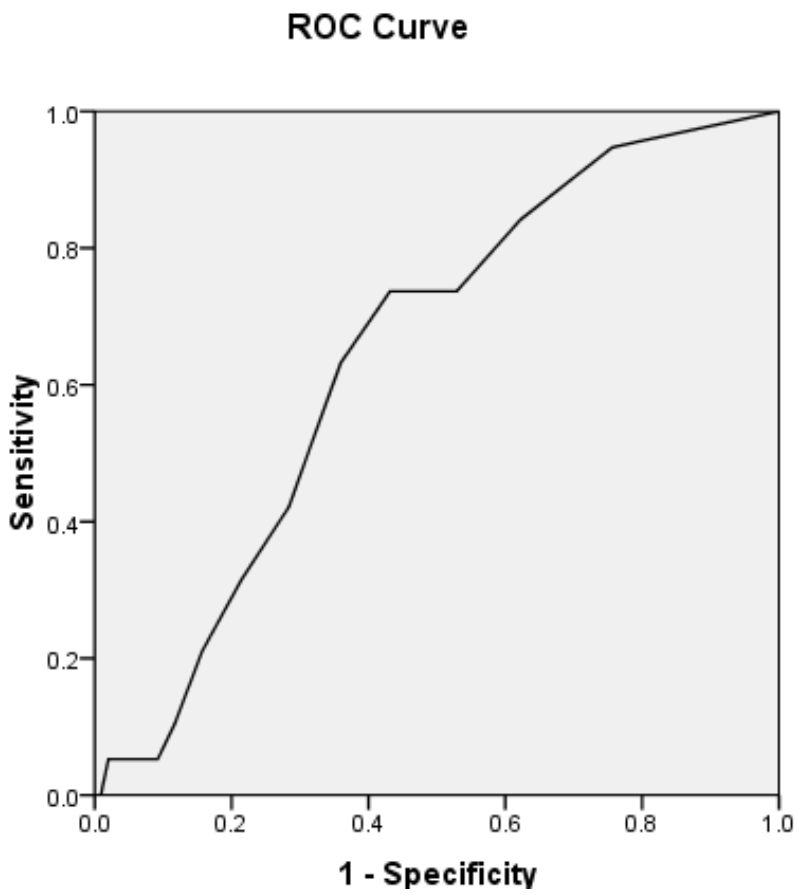

Figure 2: ROC Analysis Curve for the Repetitive Behavior Factor

Table 4
Sensitivity, Specificity, PPV, NPV, TCC, and AUC based on ROC Analysis for Factor 2 (Repetitive Behavior) Cut-Off Scores

Score	Sensitivity	Specificity	PPV	NPV	TCC	AUC
1	.95	.24	4.1%	98.5%	33.9%	.60
2	.84	.38	4.4%	98.2%	45.1%	.61
3	.74	.47	4.6%	97.9%	53.0%	.61
4	.74	.57	5.7%	97.9%	67.4%	.66
5	.63	.64	4.8%	97.3%	73.4%	.64
6	.42	.72	4.8%	97.1%	79.0%	.57
7	.32	.79	4.4%	96.9%	83.7%	.56
8	.21	.84	3.0%	96.7%	86.8%	.53
1.0 SD						
8	.21	.84	3.0%	96.7%	86.8%	.53
1.5 SD						
10	.05	.91	5.0%	96.7%	90.9%	.48
2.0 SD						
11	.05	.93	5.0%	96.8%	93.9%	.49

For comparison purposes, cut-off scores at 1.0, 1.5, and 2.0 standard deviations are also displayed in Table 5. Results of this analysis indicate a cut-off score of 2 or 3 to be better than other potential scores as these two cut-off scores maximize the AUC. Given the scoring protocol for the assessment (a single item could potentially be scored as 2 points), it was determined that a score of 3 was the best cut-off score for this factor so that a single item did not have the ability to move a child beyond the cut-off threshold for the factor. Moving the cut-off score from 2 to 3 increased specificity by 0.12, which is a trade-off for the same decrease in sensitivity (0.12) while considering the above single-item threshold consideration. See Table 5 for a comparison of potential cut-off scores with more details. For comparison purposes, cut-off scores at 1.0, 1.5, and 2.0 standard deviations are also displayed in Table 5. The mean value of the Worry/Depressed factor was 2.31 with a standard deviation of 2.69. The cut-off score for one standard deviation above the mean was 5.00. The cut-off score for 1.5 standard deviations above the mean was 6.35, which was rounded to 6. The cut-off score for two standard deviations above the mean was 7.7, which was rounded to 8.

Table 5
Sensitivity, Specificity, PPV, NPV, TCC, and AUC for ROC Analysis for Factor 3 (Worry/Depressed) Cut-Off Scores

Score	Sensitivity	Specificity	PPV	NPV	TCC	AUC
1	.93	.35	10.8%	96.9%	49.5%	.64
2	.85	.55	14.0%	97.0%	64.4%	.70
3	.73	.67	16.1%	96.2%	72.9%	.70
4	.54	.78	17.0%	94.3%	82.9%	.66
5	.39	.84	20.9%	94.2%	86.5%	.62
6	.34	.89	15.2%	93.2%	87.6%	.62
7	.17	.98	11.8%	92.9%	88.6%	.58
8	.10	.99	8.7%	92.7%	89.7%	.55
1.0 SD						
5	.39	.84	20.9%	94.2%	86.5%	.62
1.5 SD						
6	.34	.89	15.2%	93.2%	87.6%	.62
2.0 SD						
8	.10	.99	8.7%	92.7%	89.7%	.55

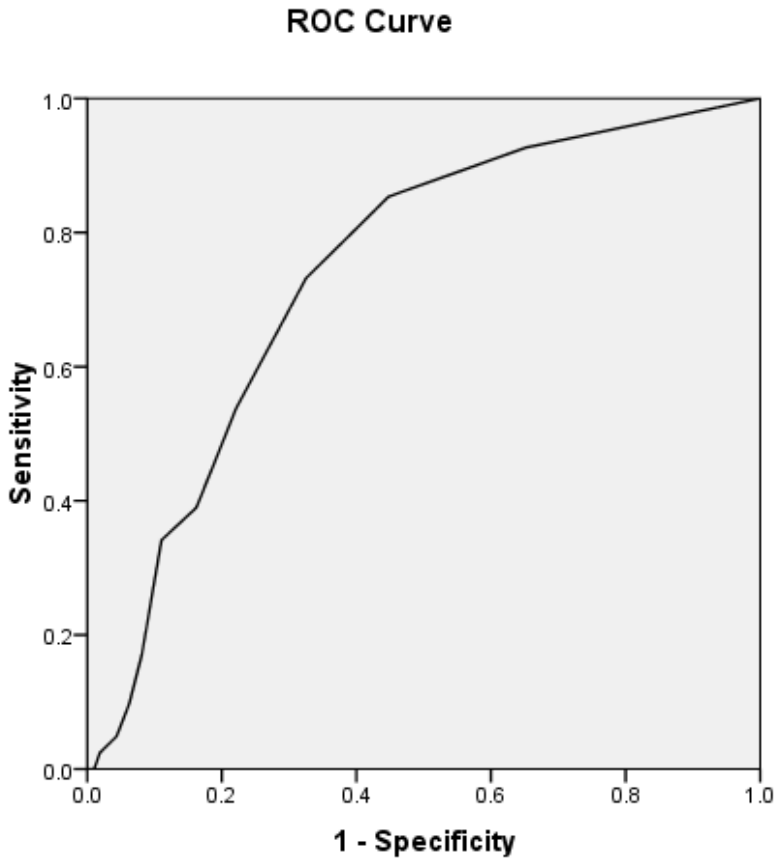

Figure 3: ROC Analysis Curve for the Worried/Depressed Factor

As with the previous factors, potential cut-off scores for the fourth factor, Avoidant Behavior, were entered individually as predictor variables for the presence of avoidant behaviors in order to identify PPV and NPV values for each cut-off score. Multiple cut-off points were allowed the ability to be examined through ROC analysis in order to maximize sensitivity and specificity while still considering PPV and NPV. The results from the ROC analysis for the Avoidant Behavior factor are listed in Table 6 and the ROC analysis curve is displayed in Figure 4. For comparison purposes, cut-off scores at 1.0, 1.5, and 2.0 standard deviations are also displayed in Table 6. Results of the analysis indicate a cut-off score of 2 or 3 to be better than other potential scores given they maximize the AUC at .62. Because of the scoring protocol for the assessment (a single item could potentially be scored as 2 points), it was determined that a

score of 3 was the best cut-off score for the Avoidant Behavior factor. The increase in specificity still allowed sufficient sensitivity for the assessment's goal, ultimately making a worthwhile trade-off while also keeping a single item from being able to move a factor score beyond its established cut-off score. See Table 6 for a comparison of the other potential cut-off scores. For comparison purposes, cut-off scores at 1.0, 1.5, and 2.0 standard deviations are also displayed in Table 6. The mean value of the Avoidant Behavior factor was 3.31 with a standard deviation of 3.08. The cut-off score for one standard deviation above the mean was 6.39, which was rounded to 6. The cut-off score for 1.5 standard deviations above the mean was 7.93, which was rounded to 8. The cut-off score for two standard deviations above the mean was 9.47, which was rounded to 9.

Table 6
Sensitivity, Specificity, PPV, NPV, TCC, and AUC for ROC Analysis for Factor 4 (Avoidant Behavior) Cut-Off Scores

Score	Sensitivity	Specificity	PPV	NPV	TCC	AUC
1	.97	.24	6.6%	99.0%	35.6%	.61
2	.87	.36	7.0%	98.1%	39.0%	.62
3	.73	.50	7.6%	97.4%	56.6%	.62
4	.57	.61	7.1%	96.0%	72.1%	.59
5	.40	.70	7.8%	95.9%	78.1%	.55
6	.33	.78	6.9%	95.5%	92.0%	.56
7	.20	.85	8.1%	95.5%	87.0%	.53
8	.17	.89	11.6%	95.6%	90.0%	.53
1.0 SD						
6	.33	.78	6.9%	95.5%	92.0%	.56
1.5 SD						
8	.17	.89	11.6%	95.6%	90.0%	.53
2.0 SD						
9	.17	.93	12.9%	95.6%	91.5%	.55

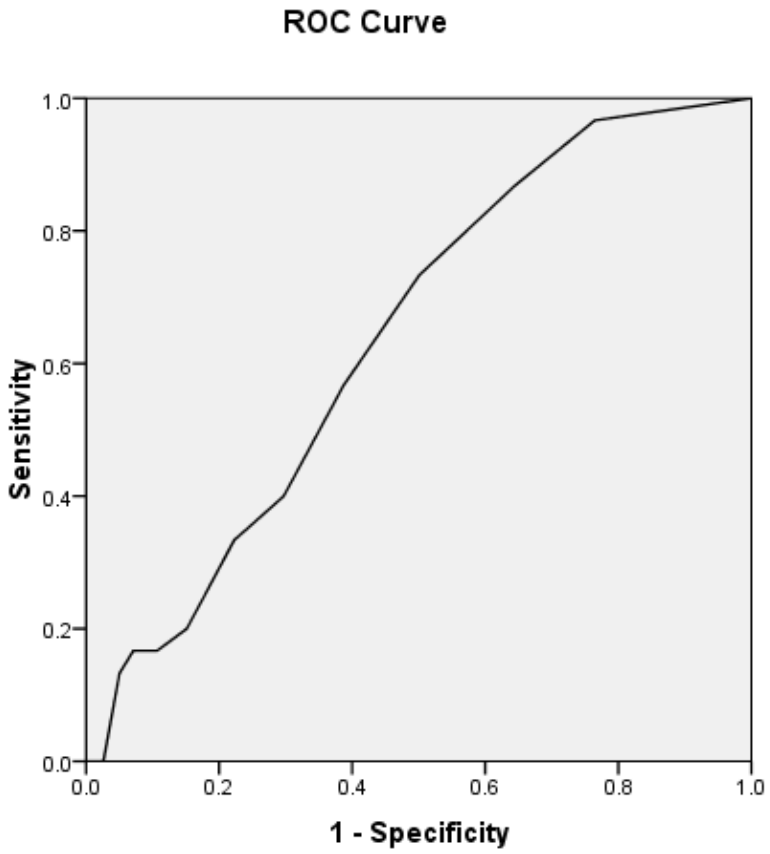

Figure 4: ROC Analysis Curve for the Avoidant Behavior Factor

For the fifth factor, Under-Eating, potential cut-off scores were entered individually as predictor variables for the presence of Under-Eating behaviors in order to identify PPV and NPV values for each cut-off score. ROC Analysis was not feasible given the low number of known positives in the sample size. Given this limitation, the standard deviation from central tendency model was utilized for the Under-Eating factor. As previously discussed, clinical significance has been defined as two or more standard deviations above and below the mean of the normal population (N. S. Jacobson & Traux, 1991; Reynolds & Kamphaus, 2004). Cut-off scores were calculated for all individuals for the Under-Eating factor. The mean value of the sum of scores on the Under-Eating factor was 0.71 with a standard deviation of 1.42. Following the standard deviation method, a cut-off score of 3.55 was identified, which was then rounded up to 4 given

the assessment only allows for the use of whole numbers. See Table 7 for a comparison of all potential cut-off scores as a reference point. The single positive case in the sample scored a "1" on this assessment. As a result, sensitivity was "0" for all but a score of 1; this finding is reflected in Table 7 below.

Table 7
Sensitivity, Specificity, PPV, NPV and TCC for Factor 5 (Under-Eating) Cut-Off Scores

Score	Sensitivity	Specificity	PPV	NPV	TCC
All Potential Cut-Off Scores					
1	1.0	.74	0.6%	100%	73.8%
2	0.0	.81	0.8%	100%	80.6%
3	0.0	.91	0.0%	99.8%	90.1%
4	0.0	.97	0.0%	99.8%	97.5%
5	0.0	.98	0.0%	99.8%	98.3%
6	0.0	.99	0.0%	99.8%	99.3%
Standard Deviation Model					
1.0 SD					
2	0.0	.81	0.8%	100%	80.6%
1.5 SD					
3	0.0	.91	0.0%	99.8%	90.1%
2.0 SD					
4	0.0	.97	0.0%	99.8%	97.5%

For the sixth factor, Conduct Behavior, potential cut-off scores were again entered individually as predictor variables for the presence of repetitive behaviors in order to identify PPV and NPV values for each cut-off score. Results from the ROC analysis for the Conduct Behavior factor are listed in Table 8 and the ROC analysis curve is displayed in Figure 5. For comparison purposes, cut-off scores at 1.0, 1.5, and 2.0 standard deviations are also displayed in Table 8. Results of the analysis indicate a cut-off score of 2 or 3 to be better than other potential scores. It is reasonable to consider a cut-off score of 2, given both sensitivity and specificity would be above .7, but the drawback of having a single item able to reach the factor threshold outweighs the advantage over a cut-off score of 3. The PPV of the assessment was 1.0% higher

at 3 while the NPV decreased 2.8%, which was still quite acceptable. Given the scoring protocol of an assessment (a single item could potentially be scored 2 points), it was determined that a score of 3 was the best cut-off score for this factor. See Table 8 for a comparison of other potential cut-off scores. For comparison purposes, cut-off scores at 1.0, 1.5, and 2.0 standard deviations are also displayed in Table 8. The mean value of the Conduct factor was 1.31 with a standard deviation of 1.73. The cut-off score for one standard deviation above the mean was 3.04, which was rounded to 3. The cut-off score for 1.5 standard deviations above the mean was 3.91, which was rounded to 4. The cut-off score for two standard deviations above the mean was 4.77, which was rounded to 5.

Table 8
Sensitivity, Specificity, PPV, NPV, TCC, and AUC for ROC Analysis from Factor 6 (Conduct) Cut-Off Scores

Score	Sensitivity	Specificity	PPV	NPV	TCC	AUC
1	.82	.50	16.6%	95.3%	58.9%	.66
2	.70	.71	22.7%	94.9%	74.0%	.71
3	.55	.83	28.9%	93.9%	88.3%	.69
4	.30	.92	35.5%	91.1%	88.4%	.61
5	.18	.96	40.0%	90.8%	89.2%	.57
6	.18	.98	66.7%	90.6%	90.3%	.58
7	.10	.99	40.0%	89.3%	89.7%	.55
8	.10	.99	0.0%	89.8%	89.7%	.55
1.0 SD						
3	.55	.83	28.9%	93.9%	88.3%	.69
1.5 SD						
4	.30	.92	35.5%	91.1%	88.4%	.61
2.0 SD						
5	.18	.96	40.0%	90.8%	89.2%	.57

For the seventh, and final, factor, Over-Eating, potential cut-off scores were entered individually as predictor variables for the presence of repetitive behaviors in order to identify PPV and NPV values for each cut-off score. Similar to the Under-Eating factor, ROC Analysis

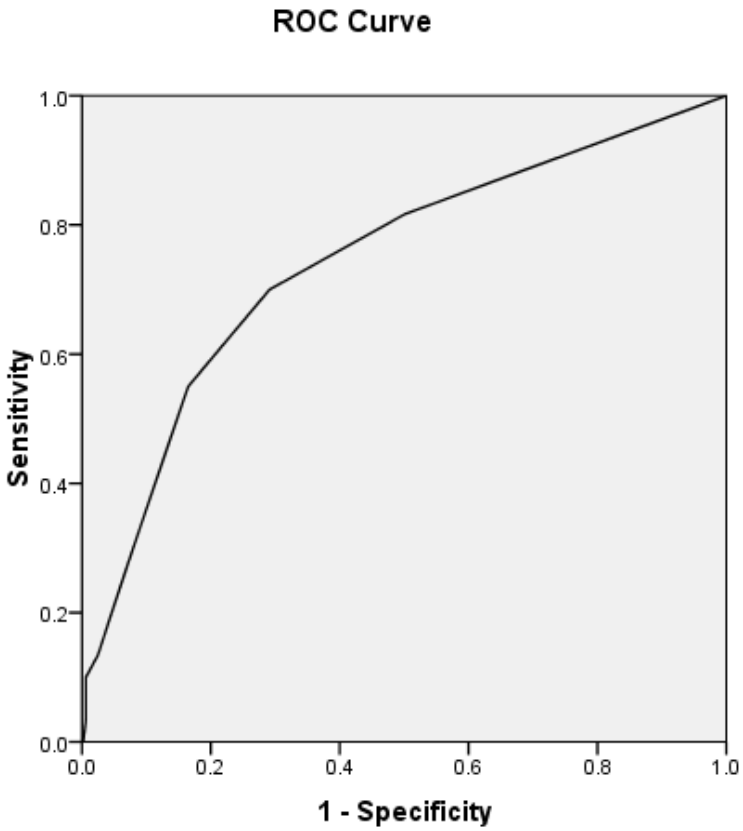

Figure 5: ROC Analysis Curve for the Conduct Factor

was not feasible given the low number of known positives in the sample. Therefore, the standard deviation from central tendency method was utilized with this factor. Cut-off scores were calculated for all individuals with diagnosed ASD in the Over-Eating factor. The mean value of the sum of scores on the Under-Eating factor was 1.00 with a standard deviation of 1.58. Per the standard deviation from central tendency method of analysis, a cut-off score of 4.16 was identified, which was rounded to 4 given the assessment only allows for the use of whole numbers. The sensitivity, specificity, PPV, NPV, and TCC are listed in Table 9 for all potential cut-off scores, including the identified ideal cut-off score of 5.

Table 9
Sensitivity, Specificity, PPV, NPV, and TCC for Factor 7 (Over-Eating) Potential Cut-Off Scores

Score	Sensitivity	Specificity	PPV	NPV	TCC
All Potential Cut-Off Scores					
1	1.0	.63	0.4%	100%	62.5%
2	0.0	.77	0.0%	99.8%	75.3%
3	0.0	.85	0.0%	99.8%	85.3%
4	0.0	.95	0.0%	99.8%	95.0%
5	0.0	.98	0.0%	99.8%	97.3%
6	0.0	.99	0.0%	99.8%	99.7%
Standard Deviation Model					
1.0 SD					
2	0.0	.77	0.0%	99.8%	75.3%
1.5 SD					
3	0.0	.85	0.0%	99.8%	85.3%
2.0 SD					
4	0.0	.95	0.0%	99.8%	95.0%

Discussion

The goal of this study was to identify ideal cut-off scores to identify the presence or absence of comorbid psychopathology within a subset of children with ASD utilizing the ASD-CC. This tool was normed within the ASD-Child battery of assessments, which is designed to allow for an evaluation of ASD, comorbid psychopathology, and behavior problems in a timely fashion that is not otherwise available (Matson, González, & Rivet, 2008; Matson, González, et al., 2009; Matson, LoVullo, et al., 2009). The creation of a tool (ASD-DC) designed to diagnose between different ASD rather than having to utilize multiple tools for diagnostic purposes was a significant step within the realm of ASD (Matson, González, et al., 2009). The ability to do so in a timely and cost-effective fashion is another significant benefit. Utilizing the ASD-Child battery should provide for ideal diagnosis of ASD in addition to determining if and when any additional diagnoses should be considered. Certainly, the need for an assessment tool such as the ASD-CC is clear given the significant diagnostic overlap between various ASD and other forms of psychopathology (de Bruin, et al., 2007; Gadow, et al., 2004; Ghaziuddin, 2002; Ghaziuddin, et al., 1998; Morgan, et al., 2003). The ASD-CC fills a void in assessment for comorbid psychopathology within the ASD population, as only one other assessment tool exists to work with the exception of toddlers or adults (Helverschou, et al., 2009; Leyfer, et al., 2006; Matson, Fodstad, Mahan, et al., 2009).

Accurate diagnoses are vital for proper treatment and should be particularly important given the increasing prevalence of the utilization of psychotropic medications for children (McCracken et al., 2002; Staudenmeier & Jacoby, 1998; Woodard, et al., 2005). Accurately diagnosed comorbid conditions could significantly assist medical doctors in providing the best possible medication regiments for children while minimizing the side effect profile as much as

possible. Given the shortage of mental health professionals prescribing medications (and subsequent increase in general practitioners such as Pediatricians and Family Medicine medical doctors prescribing to children), the simplification and clarification of a diagnostic picture is vital (Staudenmeier & Jacoby, 1998).

Sensitivity of the ASD-CC was held in higher regard than specificity given this assessment is to be used as a screening tool. Maintaining reasonable sensitivity and specificity levels was challenging, presumably due to the significant difficulty in accurately diagnosing comorbid psychopathology within the ASD population. The cut-off scores identified in the assessment came with significant concessions in specificity, as these were needed to maintain reasonable levels of sensitivity in the ASD-CC. The results of this experiment support the difficulty in assessing psychopathology within a population with ASD (de Bruin, et al., 2007; Ghaziuddin, et al., 1998; C. Gillberg & Billstedt, 2000; Leyfer, et al., 2006).

Another unexpected noteworthy finding includes the low cut-off thresholds identified within each factor. On the surface, this is very concerning, as this assessment generates a high number of false positives. Given this knowledge, clinical judgment will be an important step in utilizing this assessment, as level of impairment needs to be considered in assessing the need for additional diagnoses with ASD. As such, clinical elevations indicate the need to consider a diagnosis, not to make the diagnosis when utilizing a screening assessment. Determining when to make diagnoses continues to be a challenge for clinicians.

Differences exist between the ASD group and the other psychopathology group. Examination of mean scores between groups yielded statistically significant differences between the ASD group and the general psychopathology group on the Tantrum Behavior factor ($p<.05$), the Repetitive Behavior factor ($p<.05$), and the Avoidant Behavior factor ($p<.05$) utilizing a

Bonferroni post-hoc procedure following an ANOVA to analyze the mean summed scores of each factor. In all three scales where means were different between the ASD and psychopathology group, means were higher for the ASD group, which supports the notion of increased challenges faced by children with ASD.

The PPV of the ASD-CC was adversely affected by the high rates of false positives. PPV scores were low, which is not surprising with the low cut-off scores of the assessment. Given the nature of the assessment (a brief, simple, noninvasive questionnaire), this is not as serious of an issue as it otherwise could have been. The NPV of this instrument was much better; which gives a clinician strong reason to feel comfortable ruling out any sort of comorbid diagnosis. NPV scores in this assessment were very good, with scores above the 90th percentile for all determined cut-off scores. In particular, NPV values were very strong in both of the eating factors that were otherwise statistically weak, which is not surprising given the low prevalence rate of eating troubles in the sample (Akobeng, 2007; Shang-Ying & Constantine, 2008).

The Tantrum Behavior factor had PPV and NPV values which were higher than some of the other factors of the ASD-CC. For the determined cut-off value of 4, the PPV of the Tantrum Behavior factor was 14.5%. This score is indicative of a high number of false positives, which is acceptable given the screening instrument nature of this assessment. NPV for the Tantrum Behavior factor was much vastly better than PPV, with a value of 94.6%. For the Repetitive Behavior factor, PPV was not as strong as the NPV values. At the determined cut-off score of 4, the PPV was only 5.7%, indicative of very high levels of false positives. However, the NPV at this level was far better, with a value of 97.9%. For the Worry/Depressed factor, the determined cut-off score was 3. The PPV of this factor was 16.1% and the NPV was 96.2%. These values are very similar to that of the Tantrum Behavior factor and these factors share both positive and

negative characteristics. The Avoidant Behavior factor had a PPV and NPV which were more similar to the Repetitive Behavior factor than others. Given the cut-off score of 3, PPV and NPV were 7.6% and 97.4% respectively. Again, there are elevated numbers of false positives but the assessment is fairly efficient in identifying negative cases. The Under-Eating factor's determined cut-off score of 4 did not identify the single positive case in the sample, so the PPV for this factor was 0.0%. The NPV was more promising, with a 99.8% rate, which is excellent. Given the low rate of the eating difficulties in the sample, this finding is not too surprising. Similar to the Under-Eating factor, the Over-Eating factor's cut-off score was too high to accurately diagnose the positive case. The PPV of this factor was therefore 0.0%; the NPV was far better at 99.8%. The issues related to these two eating factors will be further discussed later in the discussion. Lastly, the Conduct factor's cut-off score was determined to be 3. The PPV was the best of all factors, at 28.9% and the NPV was also very good at 93.9%. Noting the previous discussion regarding the sensitivity and specificity values making a value of "2" as a possibility, it is noted the PPV was 1.0% higher at 3 and the NPV was only 2.8% lower, which lends support to utilizing a score of 3 rather than 2 for this factor given the hope to increase PPV given the already high NPV. Ultimately, if a single item did not have the ability to reach the threshold for the factor, a score of 2 would have been recommended.

As noted with all of the factors, PPV values were decidedly low. In a screening assessment, the need for clinical judgment is important to rule out the false positives which were identified. Clinicians need to be aware of the properties of the assessment when utilizing it in clinical practice. However, the NPV scores of this assessment were much better. Higher NPVs are important factors to consider in an assessment of this nature, as it would be highly beneficial to pass these results on to medical professionals who determine whether children need

psychotropic medications (Lavigne et al., 1998). High NPV scores provide reassurance if the child does not score high enough; these children are not likely to have a comorbid disorder and therefore these children would not likely need or benefit from treatment for these disorders. Those who are above the threshold for a factor would ideally be referred to a psychologist who specializes in ASD. Again, this is particularly important in situations where medications might be utilized (Staudenmeier & Jacoby, 1998).

Low prevalence rates of many of some disorders were certainly a weakness of this study. The overall sample size was large, but pre-existing psychopathology was sparsely diagnosed within the sample with ASD. Given the poor understanding of comorbidity in ASD, this is not surprising (Ghaziuddin, 2005; Matson & Nebel-Schwalm, 2007). This was highlighted most strongly in the two factors which involved problems with eating. Within the realm of under-eating, food selectivity is not a current diagnosis and very few children are diagnosed with failure to thrive, anorexia, etc. While the exact reason the low rate of identified eating issues reported in this sample remains unclear, it is hypothesized that a number of family members minimize the pathology of eating problems. It is also feasible that there could be a level of burn out and/or frustration in families of children with eating problems. These factors could potentially explain how so few children with these disorders participated in this study. It is also possible that eating issues existed in the sample, but had gone otherwise undiagnosed previously, given the knowledge of the prevalence of eating issues in ASD (Kodak & Piazza, 2008; Ledford & Gast, 2006; Schreck, Williams, & Smith, 2004). Another potential explanation to consider which might help explain the low rates of some of the disorders in this sample must include low base rates of these disorders when taking in to consideration both the need for ASD and an eating disorder (Ledford & Gast, 2006). Eating disorders, as previously discussed, are rarely

diagnosed but believed to be a far more significant problem than statistics currently report (Kodak & Piazza, 2008). As Kodak and Piazza discussed, many feeding problems are considered "associated features" of autism spectrum disorders. The feeding problems are often somewhat localized to particular age ranges (Ledford & Gast, 2006). Failure to thrive often is identified early in childhood by pediatricians. These are treated most often with highly intrusive feeding tubes, but alternatively (and quite successfully), feeding challenges are treated with behavioral therapy (Kodak & Piazza, 2008). Most clinically relevant feeding disorders do not often arise again until adolescence, with 13 as an early-identified general age of onset (Herzog et al., 1999; Merikangas et al., 2010). Anorexia Nervosa, for example, has a mean age of onset of 17 years old (American Psychiatric Association, 2000). Given the sample for this study, this may help explain the struggles in identifying eating disorders within the sample. The current sample included thirty-three 13-year-olds, twenty-one 14-year-olds, fifteen 15-year-olds, thirteen 16-year-olds, and seven 17-year-olds. Furthermore, a disproportionate number of teenagers suffering from eating disorders are female (Herzog, et al., 1999), which is opposite of what is observed within male to female ratios in ASD. Furthermore, very few people who suffer from eating disorders seek treatment or even diagnosis, which complicates matters significantly (Zucker, et al., 2007). A recent study found only one third of people with anorexia living in the community seek mental health care; only 6% of those with bulimia receive mental health care (Hoek & van Hoeken, 2003).

Ultimately, it may not prove as useful to pursue diagnosing eating disorders that arise in adolescence within the ASD population with the ASD-CC, but further study is needed to make this determination. At a minimum, the utility of the assessment in identifying disorders may be marginal outside of the ages of younger children or those who have reached adolescents.

Eating disorders are likely going to be diagnosed based on the significant health risks associated with the disorders. The greater utility of the ASD-CC appears to be in the realm of issues that present far more often with ASD, such as food selectivity related to tactile and olfactory senses. The under-eating factor will likely be utilized with diagnoses of FTT based on under-eating, particularly if it were utilized as a screening instrument, perhaps in well-child checkups. The ASD-Child battery could certainly be utilized in conjunction with pediatrician visits, which is discussed later in the manuscript. In order to further examine the utility of the ASD-CC for eating problems, it would be highly beneficial to specifically target populations with these challenges for study.

This study has highlighted a number of issues. A significant issue that has affected both the typically-developing population in addition to the ASD population would be problems with eating (over-eating, under-eating, and diagnosable eating disorders) (Hoek & van Hoeken, 2003; Zucker, et al., 2007). Given what we know of ASD, it is common that children suffer from food selectivity (Kodak & Piazza, 2008; Ledford & Gast, 2006). Given the rate of children with ASD who suffer from FTT and who are treated with ABA and other techniques, it was quite surprising to find so few individuals in this study with any diagnosis to support this issue. The reason for this discrepancy is intriguing. Could these disorders simply be overlooked as not being "legitimate" with parents not seeking help for existing issues? It is possible these behaviors are not reported by parents when giving histories or during interviews. It is also possible that frustrations with the global assessment process mounts in these individuals and they choose not to participate in these types of studies at the same rates as others with ASD. Certainly, this matter would benefit from further investigation.

Treatment implications also warrant discussion, as a diagnosis of FTT has multiple treatment options available beyond the previously discussed ABA. In particular, intrusive and expensive treatments exist in which insurance companies and/or medical assistance programs are more likely to approve (Brandon et al., 2009; Romanow, 2010). Insurance companies' preferred treatment methods include utilizing highly intrusive feeding tubes and expensive nutritional supplements which sustain life but do not fix the underlying problem (Brandon, et al., 2009). Behavioral modification programs tend to be highly successful and permanent fixes, but have the drawbacks of being time consuming and expensive in regards to human intervention hours (Kodak & Piazza, 2008). However, it would be noted that with ABA, there is generally a single licensed psychologist overseeing numerous cases which are ongoing. Each case generally has a treatment team of 2-3 bachelors-degree level behavioral technicians directly working with the child receiving supervision from the licensed psychologist, which greatly reduces the hourly cost of these procedures and provides long-term cost savings compared to alternative methods (J. W. Jacobson, Mulick, & Green, 1998; Kodak & Piazza, 2008; Sturmey, 2006). This phenomenon certainly warrants continued study.

The ASD-CC is likely to be used as part of an assessment battery as a portion of a psychological assessment, but may also be utilized in a stand-alone fashion as a screening instrument. Clinicians may also utilize the entire ASD-Child battery independently to specifically answer questions regarding ASD. The factors on the scale do not relate to a singular DSM-IV-TR or ICD-10 diagnosis, so a level of clinical judgment is necessary with this tool, particularly given the psychometric properties of the scale. It could be utilized as a pre-screening tool which clinicians could send out prior to their formal clinical interview/assessment. There is

great utility in utilizing the results of this type of assessment to guide clinical interview questions and observations in formal assessment.

The ASD-Child battery relies on a caregiver's input. In the current age of technology, a great deal of information is available to individuals regarding diagnosis. Without any sort of a "lie" scale, one must be conscious of the potential for respondents to answer less than truthfully. The ASD-Child battery is, as are almost all assessments of this nature, susceptible to respondent manipulation. This again highlights the importance of clinical judgment in the diagnosis of psychopathology.

The previously discussed shortage of trained mental health professionals is a significant driving factor highlighting the importance of proper diagnostic measures. Relatively brief screening measures allow clinicians to perform proper diagnostic assessment in a timely manner. Expanding on this, the ASD-CC should allow for significant improvements in diagnosis within ASD, as no other brief assessments of comorbid psychopathology currently exist that have been specifically normed on a population with ASD (Leyfer, et al., 2006). It is highly likely that the benefits from this scale will lead to improved diagnosis of psychopathology within ASD.

While many questions may be answered, this is likely to introduce a number of new questions. When is a comorbid diagnosis proper? When do symptoms warrant treatment? What treatments are appropriate for an individual given their diagnosis? Extensions from these questions could also arise. How will individuals with ASD respond to treatments for comorbid psychopathology? Do treatment modalities which benefit the general population also show benefit in a population with ASD? If so, are they more or less effective than the general population? Modifications to existing treatment modalities may be needed and a more serious

question would be identifying what modifications may prove to be beneficial with children with ASD.

A dramatic increase in research on ASD has been conducted in recent years. There are a number of potential explanations for this increase. The media has significantly increased its reporting on ASD, partially due to the disorders personally affecting individuals of influence. This increase of awareness has often times led to subsequent increases in research, creating somewhat of a snowball effect (in a positive way). This research has led to a number of realizations for science. Diagnosed rates of ASD have increased dramatically (Merikangas, et al., 2010; Nicholas, et al., 2008; Ritvo, et al., 1989; Wing & Potter, 2002). Motivation for such an increase could be attributed to the improvements made in assessment. There are also significant advantages in the areas of services made available for children with ASD, which provides motivation for parents to seek diagnoses for their child(ren) (Nicholas, et al., 2009). Ultimately, it has been accepted that assessment has improved significantly, which assists psychologists to accurately diagnose the issues children present with clinically.

A large prevalence of externalizing disorders was noted (compared to internalizing disorders) in the sample. The rationale behind this appears straightforward. Particularly in situations where verbal behavior and/or socialization is limited, parents, as well as clinicians, are inclined to observe the behaviors associated with externalizing disorders and seek treatment for these disorders. Externalized disorders are also more likely to cause distress within the family and as such, provide enough motivation for parents to seek professional help for the problems their child(ren) face. Simply put, a child with behavior problems causes more distress for a family than a child suffering from depression. Some of the most observed comorbid disorders in our sample included ADHD, Conduct Disorder, Oppositional Defiant Disorder, Anxiety

Disorder-NOS, and other mood disorders. Given the currently identified rates of mental health disorders from the National Institute of Mental Health, it is not surprising that our sample included high rates of ADHD and conduct disorders; though a slightly higher rate of depression was expected.

This study appears to have made strides towards developing more appropriate measures to accurately diagnose Axis I psychopathology within the ASD population. As previously discussed, there are significant concerns regarding the repercussions of the high rates of psychotropic medication utilization that is not always appropriate and oftentimes unnecessary (Matson, et al., 1984). The development of the ASD-CC should contribute to the knowledge base of how comorbid disorders present within children with ASD. Certainly, it represents a tool that can assist in the further investigation of comorbid psychopathology in children with ASD. As previously discussed, the psychometrics of this assessment supports its use as a screening tool. The ASD-CC is simple, takes very little time to administer, score, and ultimately interpret. Such a screen would be ideal to be utilized with pediatricians and/or family medicine doctors who do not have the training to accurately diagnose psychopathology in children, particularly in children with ASD (Meadows, Valleley, Haack, Thorson, & Evans, 2011). In the event that elevated results are present on the assessment, referrals should be made to experienced psychologists and/or psychiatrists. In clinical practice, these experts should be relied upon to determine appropriate diagnoses for these individuals. Experts should coordinate treatment with medical professionals to determine the ideal course of treatment in these situations (Meadows, et al., 2011). While the ASD-CC has not been utilized in such a manner yet, its design also lends itself well to monitoring the course of symptoms over time. This would be particularly useful in monitoring treatment efficacy; the three point scoring system allows for improvements to be

noted without completely removing symptoms of psychopathology. Lastly, replication of the factor structure and potential cut-off scores may be beneficial in the future.

References

Abell, F., Krams, M., Ashburner, J., Passingham, R., Friston, K., Frackowiak, R., et al. (1999). The neuroanatomy of autism: a voxel-based whole brain analysis of structural scans. *Neuroreport, 10*(8), 1647-1651.

Achenbach, T. M. (2011). Commentary: Definitely more than measurement error: But how should we understand and deal with informant discrepancies? *Journal of Clinical Child and Adolescent Psychology, 40*(1), 80-86.

Achenbach, T. M., Howell, C. T., Quay, H. C., & Conners, C. K. (1991). National survey of problems and competencies among four- to sixteen-year-olds: Parents' reports for normative and clinical samples. *Monographs of the Society for Research in Child Development, 56*(3), v-120.

Achenbach, T. M., & Rescorla, L. A. (2006). The Achenbach System of Empirically Based Assessment. In R. P. Archer (Ed.), *Forensic uses of clinical assessment instruments.* (pp. 229-262). Mahwah, NJ US: Lawrence Erlbaum Associates Publishers.

Achenbach, T. M., Tuma, A. H., & Maser, J. D. (1985). Assessment of anxiety in children. *Anxiety and the anxiety disorders.* (pp. 707-734). Hillsdale, NJ England: Lawrence Erlbaum Associates, Inc.

Akobeng, A. K. (2007). Understanding diagnostic tests 1: sensitivity, specificity and predictive values. [Article]. *Acta Paediatrica, 96*(3), 338-341.

Allik, H., Larsson, J. O., & Smedje, H. (2006). Sleep patterns of school-age children with Asperger Syndrome or High-Functioning Autism. *Journal of Autism and Developmental Disorders, 36*(5), 585-595.

Allik, H., Larsson, J. O., & Smedje, H. (2008). Sleep patterns in school-age children with Asperger Syndrome or High-Functioning Autism: A follow-up study. *Journal of Autism and Developmental Disorders, 38*(9), 1625-1633.

Altman, D. G., & Bland, J. M. (1994). Diagnostic tests 1: sensitivity and specificity. [Article]. *BMJ: British Medical Journal, 308*(6943), 1552.

Aman, M. G., Singh, N. N., Stewart, A. W., & Field, C. J. (1985). The aberrant behavior checklist: A behavior rating scale for the assessment of treatment effects. *American Journal of Mental Deficiency, 89*(5), 485-491.

American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, D.C: Author.

American Psychiatric Association. (1987). *Diagnostic and statistical manual of mental disorders* (3rd, revised ed.). Washington, D.C: Author.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th, text rev ed.). Washington, DC: Author.

Angoff, W. H. (1971). *The College Board Admissions Testing Program: A technical report on research and development activities relating to the Scholastic Aptitude Test and Achievement Tests*. New York, NY US: College Entrance Examination Board.

Asperger, H. (1944). Die "autistichen Psychopathen" im Kindersalter. *Archive fur Psychiatrie und Nervenkrankheiten, 117,* 76-136.

Asperger, H., & Frith, U. (1991). *'Autistic psychopathy' in childhood*. New York, NY, US: Cambridge University Press.

Attwood, T. (1998). *Asperger's syndrome: A guide for parents and profesisonals*. Philadelphia: Kingsley.

Atwood, K. C., Woeckner, E., Baratz, R. S., & Sampson, W. I. (2008). Why the NIH Trial to Assess Chelation Therapy (TACT) should be abandoned. *Medscape Journal of Medicine, 10*(5), 115-115.

Bacchelli, E., & Maestrini, E. (2006). Autism spectrum disorders: molecular genetic advances. *American Journal Of Medical Genetics. Part C, Seminars In Medical Genetics, 142C*(1), 13-23.

Bailey, A., Le Couteur, A., Gottesman, I., & Bolton, P. (1995). Autism as a strongly genetic disorder: Evidence from a British twin study. *Psychological Medicine, 25*(1), 63-77.

Baird, G., Charman, T., Baron-Cohen, S., Cox, A., Swettenham, J., Wheelwright, S., et al. (2000). A screening instrument for autism at 18 months of age: A 6-year follow-up study. *Journal of the American Academy of Child & Adolescent Psychiatry, 39*(6), 694-702.

Barkley, R. A., McMurray, M. B., Edelbrock, C. S., & Robbins , K. (1990). Side effects of methylphenidate in children with attention deficit hyperactivity disorder: a systematic placebo-controlled evaluation. *Pediatrics, 86*, 184-192.

Baron-Cohen, S., Scahill, V. L., Izaguirre, J., Hornsey, H., & Robertson, M. M. (1999). The prevalence of Gilles de la Tourette syndrome in children and adolescents with autism: A large scale study. *Psychological Medicine, 29*(5), 1151-1159.

Baron-Cohen, S., & Wheelwright, S. (1999). 'Obsessions' in children with autism or Asperger syndrome: Content analysis in terms of core domains of cognition. *British Journal of Psychiatry, 175*, 484-490.

Bauman, M. L. (1991). Microscopic neuroanatomic abnormalities in autism. *Pediatrics, 87*(5), 791-796.

Beck, A. T., & Alford, B. A. (2009). *Depression: Causes and treatment (2nd ed.)*. Baltimore, MD US: University of Pennsylvania Press.

Bejerot, S. (2007). An autistic dimension: A proposed subtype of obsessive-compulsive disorder. *Autism, 11*(2), 101-110.

Belmonte, M. K., & Yurgelun-Todd, D. A. (2003). Functional anatomy of impaired selective attention and compensatory processing in autism. *Cognitive Brain Research, 17*(3), 651-664.

Benjamin, R. S., Costello, E. J., & Warren, M. (1990). Anxiety disorders in a pediatric sample. *Journal of Anxiety Disorders, 4*(4), 293-316.

Berthoz, S., & Hill, E. L. (2005). The validity of using self-reports to assess emotion regulation abilities in adults with autism spectrum disorder. *European Psychiatry, 20*(3), 291-298.

Bertrand, J., Mars, A., Boyle, C., Bove, F., Yeargin-Allsopp, M., & Decoufle, P. (2001). Prevalence of autism in a United States population: the Brick Township, New Jersey, investigation. *Pediatrics, 108*(5), 1155-1161.

Bettelheim, B. (1967). *The empty fortress: infantile autism and the birth of the self*. Oxford England: Free Press of Glencoe.

Bird, H. R. (1996). Epidemiology of childhood disorders in a cross-cultural context. *Journal of Child Psychology and Psychiatry, 37*(1), 35-49.

Bishop, D. V. M. (1998). Development of the Children's Communication Checklist (CCC): A method for assessing qualitative aspects of communicative impairment in children. *Journal of Child Psychology and Psychiatry, 39*(6), 879-891.

Bland, J. M., & Altman, D. G. (2002). Validating scales and indexes. [Article]. *BMJ: British Medical Journal, 324*(7337), 606.

Borthwick-Duffy, S. A. (1994). Epidemiology and prevalence of psychopathology in people with mental retardation. *Journal of Consulting and Clinical Psychology, 62*(1), 17-27.

Bowman, E. P. (1988). Asperger's syndrome and autism: The case for a connection. *British Journal of Psychiatry, 152*, 377-382.

Bradley, E. A., Summer, J. A., Wood, H. L., & Bryson, S. E. (2004). Comparing rates of psychiatric and behavior disorders in adolescents and young adults with severe intellectual disability with and without autism. *Journal of Autism and Developmental Disorders, 34*, 151-161.

Brandon, G. D., Adeniyi-Jones, S., Kirkby, S., Webb, D., Culhane, J. F., & Greenspan, J. S. (2009). Are Outcomes and Care Processes for Preterm Neonates Influenced by Health Insurance Status? [Article]. *Pediatrics, 124*(1), 122-127.

Bryson, S. E., Clark, B. S., & Smith, I. M. (1988). First report of a Canadian epidemiological study of autistic syndromes. *Journal of Child Psychology and Psychiatry, 29*(4), 433-445.

Bültmann, U., de Vries, M., Beurskens, A. J. H. M., Bleijenberg, G., Vercoulen, J. H. M. M., & Kant, I. (2000). Measurement of prolonged fatigue in the working population: Determination of a cutoff point for the Checklist Individual Strength. *Journal of Occupational Health Psychology, 5*(4), 411-416.

Burd, L., Fisher, W., & Kerbeshian, J. (1987). A prevalence study of pervasive developmental disorders in North Dakota. *Journal of the American Academy of Child & Adolescent Psychiatry, 26*(5), 700-703.

Callaghan, K., Gray, E., Caldamone, A., & Ellsworth, P. (2008). Factors Involved in Parental Decision Making for Surgical Correction of Vesicoureteral Reflux. *The Journal of Urology, 180*(2), 701-706.

Cardaciotto, L., & Herbert, J. D. (2004). Cognitive behavior therapy for social anxiety disorder in the context of Asperger's syndrome: A single-subject report. *Cognitive and Behavioral Practice, 11*(1), 75-81.

Carlson, G. A. (1998). Mania and ADHD: Comorbidity or confusion. *Journal of Affective Disorders, 51*(2), 177-187.

Castelloe, P., & Dawson, G. (1993). Subclassification of children with autism and pervasive developmental disorders: A questionnaire based on Wing's subgrouping scheme. *Journal of Autism and Developmental Disorders, 23*, 229-241.

Chakrabarti, S., & Fombonne, E. (2001). Pervasive developmental disorders in preschool children. *Journal of the American Medical Association, 285*(24), 3093-3099.

Chakrabarti, S., & Fombonne, E. (2005). Pervasive developmental disorders in preschool children: Confirmation of high prevalence. *American Journal of Psychiatry, 162*(6), 1133-1141.

Chalfant, A. M., Rapee, R., & Carroll, L. (2007). Treating anxiety disorders in children with high functioning autism spectrum disorders: A controlled trial. *Journal of Autism and Developmental Disorders, 37*(10), 1842-1857.

Chambers, W. J. (1985). The assessment of affective disorders in children and adolescents by semistructured interview: Test–retest reliability of the Schedule for Affective Disorders and Schizophrenia for School-Age Children, Present Episode Version. *Archives of General Psychiatry, 42*(7), 696-702.

Charlop-Christy, M. H., & Haymes, L. K. (1996). Using obsessions as reinforcers with and without mild reductive procedures to decrease inappropriate behaviors of children with autism. *Journal of Autism and Developmental Disorders, 26*(5), 527-546.

Chudley, A. E., Gutierrez, E., Jocelyn, L. J., & Chodirker, B. N. (1998). Outcomes of genetic evaluation in children with pervasive developmental disorder. *Journal of Developmental & Behavioral Pediatrics, 19*(5), 321-325.

Clark, E., Jenson, W. R., Miller, J. N., Goldstein, S., & Reynolds, C. R. (2005). Autistic Spectrum Disorders *Handbook of neurodevelopmental and genetic disorders in adults.* (pp. 225-242). New York, NY US: Guilford Press.

Clarke, D. J., Littlejohns, C. S., Corbett, J. A., & Joseph, S. (1989). Pervasive developmental disorders and psychoses in adult life. *British Journal of Psychiatry, 155*, 692-699.

Connors, C. K. (1973). Rating scales for use in drug studies. *Psychopharmacology Bulletin, 9*, 24-29.

Coupland, N. J. (2001). Social phobia: Etiology, neurobiology, and treatment. *Journal of Clinical Psychiatry, 62*, 25-35.

Courchesne, E., Hesselink, J. R., Jernigan, T. L., & Yeung-Courchesne, R. (1987). Abnormal neuroanatomy in a nonretarded person with autism. Unusual findings with magnetic resonance imaging. *Archives Of Neurology, 44*(3), 335-341.

Cox, A., Klein, K., Charman, T., Baird, G., Baron-Cohen, S., Swettenham, J., et al. (1999). Autism spectrum disorders at 20 and 42 months of age: Stability of clinical and ADI-R diagnosis. *Journal of Child Psychology and Psychiatry, 40*(5), 719-732.

Cumine, V., Leach, J., & Stevenson, G. (2000). *Autism in the early years*. London: David Fulton.

Davis, T. E., III, Moree, B. N., Dempsey, T., Reuther, E. T., Fodstad, J. C., Hess, J. A., et al. (2011). The relationship between autism spectrum disorders and anxiety: The moderating effect of communication. *Research in Autism Spectrum Disorders, 5*(1), 324-329.

de Bruin, E. I., Ferdinand, R. F., Meester, S., de Nijs, P. F. A., & Verheij, F. (2007). High rates of psychiatric co-morbidity in PDD-NOS. *Journal Of Autism And Developmental Disorders, 37*(5), 877-886.

Deb, S., & Prasad, K. B. G. (1994). The prevalence of autistic disorder among children with a learning disability. *British Journal of Psychiatry, 165*(3), 395-399.

Dekker, M. C., Koot, H. M., van der Ende, J., & Verhulst, F. C. (2002). Emotional and behavioral problems in children and adolescents with and without intellectual disability. *Journal of Child Psychology and Psychiatry, 43*(8), 1087-1098.

DeLong, G. R., Bean, S. C., & Brown, F. R., 3rd. (1981). Acquired reversible autistic syndrome in acute encephalopathic illness in children. *Archives of Neurology, 38*(3), 191-194.

Doja, A., & Roberts, W. (2006). Immunizations and autism: a review of the literature. *The Canadian Journal of Neurological Sciences., 33*(4), 341-346.

Eaves, L. C., Ho, H. H., & Eaves, D. M. (1994). Subtypes of autism by cluster analysis. *Journal of Autism and Developmental Disorders, 24*(1), 3-22.

Edelson, M. G. (2006). Are the Majority of Children With Autism Mentally Retarded? A Systematic Evaluation of the Data. *Focus on Autism and Other Developmental Disabilities, 21*(2), 66-83.

Ehlers, S., & Gillberg, C. (1993). The epidemiology of Asperger syndrome: A total population study. *Journal of Child Psychology and Psychiatry, 34*(8), 1327-1350.

Eisenberg, L., & Kanner, L. (1956). Early infantile autism, 1943-55. *American Journal of Orthopsychiatry, 26*, 556-566.

Evans, D. W., Canavera, K., Kleinpeter, F. L., Maccubbin, E., & Taga, K. (2005). The fears, phobias and anxieties of children with Autism Spectrum Disorders and Down Syndrome: Comparisons with developmentally and chronologically age matched children. *Child Psychiatry and Human Development, 36*(1), 3-26.

Fawcett, T. (2006). An introduction to ROC analysis. [Article]. *Pattern Recognition Letters, 27*(8), 861-874.

Fee, V. E., Matson, J. L., & Benavidez, D. A. (1994). Attention deficit-hyperactivity disorder among mentally retarded children. *Research in Developmental Disabilities, 15*(1), 67-79.

Ferster, C. B. (1961). Positive reinforcement and behavioral deficits of young children. *Child Development, 32*, 437-456.

Fink, M., & Taylor, M. A. (2001). The many varieties of catatonia. *European Archives of Psychiatry and Clinical Neuroscience, 251*(7), I8-i13.

Fodstad, J. C., & Matson, J. L. (2008). A comparison of feeding and mealtime problems in adults with intellectual disabilities with and without autism. *Journal of Developmental and Physical Disabilities, 20*(6), 541-550.

Folstein, S. E., Rutter, M., Schopler, E., & Mesibov, G. B. (1987). Familial aggregation and genetic implications. *Neurobiological issues in autism.* (pp. 83-105). New York, NY, US: Plenum Press.

Fombonne, E. (1999). The epidemiology of autism: A review. *Psychological Medicine, 29*(4), 769-786.

Fombonne, E. (2002). Prevalence of childhood disintegrative disorder. *Autism, 6*(2), 149-157.

Fombonne, E. (2003). The prevalence of autism. *Journal of the American Medical Association, 289*(1), 87-89.

Fombonne, E. (2005). The changing epidemiology of autism. *Journal of Applied Research in Intellectual Disabilities, 18*(4), 281-294.

Fombonne, E., Du Mazaubrun, C., Cans, C., & Grandjean, H. (1997). Autism and associated medical disorders in a French epidemiological survey. *Journal of the American Academy of Child & Adolescent Psychiatry, 36*(11), 1561-1569.

Fombonne, E., & Volkmar, F. R. (2007). Epidemiological surveys of pervasive developmental disorders *Autism and pervasive developmental disorders (2nd ed.).* (pp. 33-68). New York, NY US: Cambridge University Press.

Friedman, A., & Luiselli, J. K. (2008). Excessive daytime sleep: Behavioral assessment and intervention in a child with autism. *Behavior Modification, 32*(4), 548-555.

Frith, U. (1991). *Autism and Asperger syndrome.* New York, NY, US: Cambridge University Press.

Gadow, K. D., & DeVincent, C. J. (2005). Clinical Significance of Tics and Attention-Deficit Hyperactivity Disorder (ADHD) in Children With Pervasive Developmental Disorder. *Journal of Child Neurology, 20*(6), 481-488.

Gadow, K. D., DeVincent, C. J., Pomeroy, J., & Azizian, A. (2004). Psychiatric Symptoms in Preschool Children with PDD and Clinic and Comparison Samples. *Journal of Autism and Developmental Disorders, 34*(4), 379-393.

Geurts, H. M., Verte, S., Oosterlaan, J., Roeyers, H., Hartman, C. A., Mulder, E. J., et al. (2004). Can the Children's Communication Checklist differentiate between children with autism, children with ADHD, and normal controls? *Journal of Child Psychology and Psychiatry, 45*(8), 1437-1453.

Ghaziuddin, M. (2002). Asperger syndrome: Associated psychiatric and medical conditions. *Focus on Autism and Other Developmental Disabilities, 17*(3), 138-144.

Ghaziuddin, M. (2005). *Mental health aspects of autism and Asperger syndrome*. London, England: Jessica Kingsley Publishers.

Ghaziuddin, M., Al-Khouri, I., & Ghaziuddin, N. (2002). Autistic symptoms following herpes encephalitis. *European Child & Adolescent Psychiatry, 11*(3), 142-146.

Ghaziuddin, M., Ghaziuddin, N., & Greden, J. (2002). Depression in persons with autism: Implications for research and clinical care. *Journal of Autism and Developmental Disorders, 32*(4), 299-306.

Ghaziuddin, M., Tsai, L. Y., & Alessi, N. (1992). ADHD and PDD. *Journal of the American Academy of Child & Adolescent Psychiatry, 31*(3), 567-567.

Ghaziuddin, M., Tsai, L. Y., Eilers, L., & Ghaziuddin, N. (1992). Brief report: Autism and herpes simplex encephalitis. *Journal of Autism and Developmental Disorders, 22*(1), 107-113.

Ghaziuddin, M., Tsai, L. Y., & Ghaziuddin, N. (1992a). Autism in Down's syndrome: Presentation and diagnosis. *Journal of Intellectual Disability Research, 36*(5), 449-456.

Ghaziuddin, M., Tsai, L. Y., & Ghaziuddin, N. (1992b). Brief report: A comparison of the diagnostic criteria for Asperger syndrome. *Journal of Autism and Developmental Disorders, 22*(4), 643-649.

Ghaziuddin, M., Weidmer-Mikhail, E., & Ghaziuddin, N. (1998). Comorbidity of Asperger syndrome: A preliminary report. *Journal of Intellectual Disability Research, 42*(4), 279-283.

Gillberg, C. (1985). Asperger's syndrome and recurrent psychosis: A case study. *Journal of Autism and Developmental Disorders, 15*(4), 389-397.

Gillberg, C. (1986). Brief report: Onset at age 14 of a typical autistic syndrome: A case report of a girl with herpes simplex encephalitis. *Journal of Autism and Developmental Disorders, 16*(3), 369-375.

Gillberg, C. (1989). Asperger syndrome in 23 Swedish children. *Developmental Medicine & Child Neurology, 31*(4), 520-531.

Gillberg, C. (1992). The Emanuel Miller Memorial Lecture 1991: Autism and autistic-like conditions: Subclasses among disorders of empathy. *Journal of Child Psychology and Psychiatry, 33*(5), 813-842.

Gillberg, C., & Billstedt, E. (2000). Autism and Asperger syndrome: Coexistence with other clinical disorders. *Acta Psychiatrica Scandinavica, 102*(5), 321-330.

Gillberg, I. C., & Gillberg, C. (1989). Asperger syndrome: Some epidemiological considerations: A research note. *Journal of Child Psychology and Psychiatry, 30*(4), 631-638.

Gilliam, J. E. (1995). *Gilliam Autism Rating Scale*. Austin, TX: Pro-Ed.

Gilliam, J. E. (2001). *Gilliam Asperger's Disorder Scale*. Austin, TX: Pro-Ed.

Gillott, A., Furniss, F., & Walter, A. (2001). Anxiety in high-functioning children with autism. *Autism, 5*(3), 277-286.

Gillott, A., Furniss, F., & Walter, A. (2001). Anxiety in high-functioning chidlren with autism. *Autism, 5*, 277-286.

Gold, N. (1993). Depression and social adjustment in siblings of boys with autism. *Journal of Autism and Developmental Disorders, 23*(1), 147-163.

Gould, E., Dixon, D. R., Najdowski, A. C., Smith, M. N., & Tarbox, J. (2011). A review of assessments for determining the content of early intensive behavioral intervention programs for autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*(3), 990-1002.

Groden, J., Cautela, J., Prince, S., Berryman, J., Schopler, E., & Mesibov, G. B. (1994). The impact of stress and anxiety on individuals with autism and developmental disabilities. *Behavioral Issues in Autism.* (pp. 177-194). New York, NY US: Plenum Press.

Hegberg, B. (1989). Rett syndrome: Clinical peculiarities, diagnostic approach, and possible cause. *Pediatric Neurology, 5*, 75-83.

Helverschou, S. B., Bakken, T. L., & Martinsen, H. (2009). The Psychopathology in Autism Checklist (PAC): A pilot study. *Research in Autism Spectrum Disorders, 3*(1), 179-195.

Helverschou, S. B., & Martinsen, H. (2010). Anxiety in people diagnosed with autism and intellectual disability: Recognition and phenomenology. *Research in Autism Spectrum Disorders, 5*(1), 377-387.

Herzog, D. B., Dorer, D. J., Keel, P. K., Selwyn, S. E., Ekeblad, E. R., Flores, A. T., et al. (1999). Recovery and relapse in anorexia and bulimia nervosa: A 7.5-year follow-up

study. *Journal of the American Academy of Child & Adolescent Psychiatry, 38*(7), 829-837.

Himle, M. B., Chang, S., Woods, D. W., Pearlman, A., Buzzella, B., Bunaciu, L., et al. (2006). Establishing the feasibility of direct observation in the assessment of tics in children with chronic tic disorders. *Journal of Applied Behavior Analysis, 39*(4), 429-440.

Hoek, H. W., & van Hoeken, D. (2003). Review of the prevalence and incidence of eating disorders. *International Journal of Eating Disorders, 34*(4), 383-396.

Hoffman, C. D., Sweeney, D. P., Lopez-Wagner, M. C., Hodge, D., Nam, C. Y., & Botts, B. H. (2008). Children with autism: Sleep problems and mothers' stress. *Focus on Autism and Other Developmental Disabilities, 23*(3), 155-165.

Hollander, E., King, A., Delaney, K., Silverman, J. M., & Smith, C. J. (2003). Obsessive-compulsive behaviors in parents of multiplex autism families. *Psychiatry Research, 117*(1), 11-16.

Hughes, J. R. (2007). Autism: The first firm finding = underconnectivity? *Epilepsy & Behavior, 11*(1), 20-24.

Hutchinson, H. (1999). Feeding problems in young children: Report of three cases and review of the literature. *Journal of Human Nutrition and Dietetics, 12*, 337-343.

Impara, J. C., & Plake, B. S. (1998). Teachers' ability to estimate item difficulty: A test of the assumptions in the Angoff standard setting method. *Journal of Educational Measurement, 35*(1), 69-81.

Itzchak, E. B., Lahat, E., Burgin, R., & Zachor, A. D. (2008). Cognitive, behavior and intervention outcome in young children with autism. *Research in Developmental Disabilities, 29*(5), 447-458.

Iwata, B. A. (1982). Toward a functional analysis of self-injury. *Analysis & Intervention in Developmental Disabilities, 2*(1), 3-20.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., & Bauman, K. E. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*(2), 197-209.

Iwata, B. A., & Dozier, C. L. (2008). Clinical application of functional analysis methodology. *Behavior Analysis in Practice, 1*(1), 3-9.

Jacobson, J. W., Mulick, J. A., & Green, G. (1998). Cost–benefit estimates for early intensive behavioral intervention for young children with autism—general model and single state case. [Article]. *Behavioral Interventions, 13*(4), 201-226.

Jacobson, N. S., & Traux, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology, 59,* 12-19.

Kadesjo, B., & Gillberg, C. (2000). Tourette's disorder: Epidemiology and comorbidity in primary school children. *Journal of the American Academy of Child & Adolescent Psychiatry, 39*(5), 548-555.

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child, 2,* 217-250.

Kazdin, A. E., Matson, J. L., & Senatore, V. (1983). Assessment of depression in mentally retarded adults. *American Journal of Psychiatry, 140*(8), 1040-1043.

Keen, D. V. (2008). Childhood autism, feeding problems and failure to thrive in early infancy: Seven case studies. *European Child & Adolescent Psychiatry, 17*(4), 209-216.

Kelly, M. B. (1977). A review of the observational data-collection and reliability procedures reported in the Journal of Applied Behavior Analysis. *Journal of Applied Behavior Analysis, 10*(1), 97-101.

Kerbeshian, J., & Burd, L. (1986). Asperger's syndrome and Tourette syndrome: The case of the pinball wizard. *British Journal of Psychiatry, 148,* 731-736.

Khouzam, H. R., El-Gabalawi, F., Pirwani, N., & Priest, F. (2004). Asperger's Disorder: A Review of its Diagnosis and Treatment. *Comprehensive Psychiatry, 45*(3), 184-191.

Kim, J. A., Szatmari, P., Bryson, S. E., Streiner, D. L., & Wilson, F. J. (2000). The prevalence of anxiety and mood problems among children with autism and Asperger syndrome. *Autism, 4*(2), 117-132.

Kodak, T., & Piazza, C. C. (2008). Assessment and behavioral treatment of feeding and sleeping disorders in children with autism spectrum disorders. *Child and Adolescent Psychiatric Clinics of North America, 17*(4), 887-905.

Koegel, L. K., Koegel, R. L., & Smith, A. (1997). Variables related to differences in standardized test outcomes for children with autism. *Journal of Autism and Developmental Disorders, 27*(3), 233-243.

Koller, H., Richardson, S. A., & Katz, M. (1992). Families of children with mental retardation: Comprehensive view from an epidemiologic perspective. *American Journal on Mental Retardation, 97*(3), 315-332.

Krakowiak, P., Goodlin-Jones, B., Hertz-Picciotto, I., Croen, L. A., & Hansen, R. L. (2008). Sleep problems in children with autism spectrum disorders, developmental delays, and

typical development: A population-based study. *Journal of Sleep Research, 17*(2), 197-206.

Krug, D. A. (2003). *Krug Asperger's Disorder Index*. Austin, TX: Pro-Ed.

Kuusikko, S., Pollock-Wurman, R., Jussila, K., Carter, A. S., Mattila, M. L., Ebeling, H., et al. (2008). Social anxiety in high-functioning children and adolescents with autism and Asperger syndrome. *Journal of Autism and Developmental Disorders, 38*(9), 1697-1709.

Lainhart, J. E., & Folstein, S. E. (1994). Affective disorders in people with autism: A review of published cases. *Journal of Autism and Developmental Disorders, 24*(5), 587-601.

Lam, K. S. L., Bodfish, J. W., & Piven, J. (2008). Evidence for three subtypes of repetitive behavior in autism that differ in familiality and association with other symptoms. *Journal of Child Psychology and Psychiatry, 49*(11), 1193-1200.

Lavigne, J. V., Binns, H. J., Arend, R., Rosenbaum, D., Christoffel, K. K., Hayford, J. R., et al. (1998). Psychopathology and health care use among preschool children: A retrospective analysis. *Journal of the American Academy of Child & Adolescent Psychiatry, 37*(3), 262-270.

Le Couteur, A., Bailey, A., Goode, S., & Pickles, A. (1996). A broader phenotype of autism: The clinical spectrum in twins. *Journal of Child Psychology and Psychiatry, 37*(7), 785-801.

Ledford, J. R., & Gast, D. L. (2006). Feeding Problems in Children with Autism Spectrum Disorders: A Review. *Focus on Autism and Other Developmental Disabilities, 21*(3), 153-166.

Lee, L., Harrington, R.A., Chang, J.J., Connors, S.L. (2008). Increased risk of injury in children with developmental disabilities. *Research in Developmental Disabilities, 29*, 247-255.

Leekam, S. R., Nieto, C., Libby, S. J., Wing, L., & Gould, J. (2007). Describing the sensory abnormalities of children and adults with autism. *Journal of Autism and Developmental Disorders, 37*(5), 894-910.

Leyfer, O. T., Folstein, S. E., Bacalman, S., Davis, N. O., Dinh, E., Morgan, J., et al. (2006). Comorbid Psychiatric Disorders in Children with Autism: Interview Development and Rates of Disorders. *Journal of Autism and Developmental Disorders, 36*(7), 849-861.

Lockyer, L., & Rutter, M. (1970). A five to fifteen year follow-up study of infantile psychosis. *British Journal of Social and Clinical Psychology, 31*, 152-163.

Lopez-Wagner, M. C., Hoffman, C. D., Sweeney, D. P., Hodge, D., & Gilliam, J. E. (2008). Sleep problems of parents of typically developing children and parents of children with autism. *Journal of Genetic Psychology, 169*(3), 245-259.

Lord, C. (1997). Diagnostic instruments in autism spectrum disorders. In D. J. Cohen & F. R. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders (2nd ed.)* (pp. 460-483). Hoboken, NJ, US: John Wiley & Sons Inc.

Lord, C., Richler, J., Charman, T., & Stone, W. (2006). Early diagnosis of children with autism spectrum disorders. *Social & communication development in autism spectrum disorders: Early identification, diagnosis, & intervention.* (pp. 35-59). New York, NY, US: Guilford Press.

Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism Diagnostic Interview--Revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 24*(5), 659-685.

Lord, C., Rutter, M. L., Goode, S., & Heemsbergen, J. (1989). Autism Diagnostic Observation Schedule: A standardized observation of communicative and social behavior. *Journal of Autism and Developmental Disorders, 19*(2), 185-212.

Lotter, V. (1966). Epidemiology of autistic conditions in young children: Prevalence. *Social Psychiatry, 1*, 124-127.

Lovaas, O. I., Koegel, R., Simmons, J. Q., & Long, J. S. (1973). Some generalization and follow-up measures on autistic children in behavior therapy. *Journal of Applied Behavior Analysis, 6*(1), 131-166.

Love, S. R., Matson, J. L., & West, D. (1990). Mothers as effective therapists for autistic children's phobias. *Journal of Applied Behavior Analysis, 23*(3), 379-385.

Luby, J. L., Belden, A., Sullivan, J., & Spitznagel, E. (2007). Preschoolers' contribution to their diagnosis of depression and anxiety: Uses and limitations of young child self-report of symptoms. *Child Psychiatry and Human Development, 38*(4), 321-338.

Luiselli, J. K. (1978). Treatment of an autistic child's fear of riding a school bus through exposure and reinforcement. *Journal of Behavior Therapy and Experimental Psychiatry, 9*(2), 169-172.

Luscre, D. M., & Center, D. B. (1996). Procedures for reducing dental fear in children with autism. *Journal of Autism and Developmental Disorders, 26*(5), 547-556.

Luteijn, E. F., Serra, M., Jackson, S., Steenhuis, M. P., Althaus, M., Volkmar, F., et al. (2000). How unspecified are disorders of children with a pervasive developmental disorder not otherwise specified? A study of social problems in children with PDD-NOS and ADHD. *European Child & Adolescent Psychiatry, 9*(3), 168-179.

MacDonald, R., Green, G., Mansfield, R., Geckeler, A., Gardenier, N., Anderson, J., et al. (2007). Stereotypy in young children with autism and typically developing children. *Research in Developmental Disabilities, 28*(3), 266-277.

MacNeil, B. M., Lopes, V. A., & Minnes, P. M. (2009). Anxiety in children and adolescents with Autism Spectrum Disorders. *Research in Autism Spectrum Disorders, 3*(1), 1-21.

Mágnússon, P., & Sæmundsen, E. (2001). Prevalence of autism in Iceland. *Journal of Autism and Developmental Disorders, 31*(2), 153-163.

Marriage, K. J., Miles, T., Stokes, D., & Davey, M. (1993). Clinical and research implications of the co-occurrence of Asperger's and Tourette syndromes. *Australian and New Zealand Journal of Psychiatry, 27*(4), 666-672.

Masi, G., Toni, C., Perugi, G., Mucci, M., Millepiedi, S., & Akiskal, H. S. (2001). Anxiety disorders in children and adolescents with bipolar disorder: A neglected comorbidity. *The Canadian Journal of Psychiatry / La Revue canadienne de psychiatrie, 46*(9), 797-802.

Matese, M., Matson, J. L., & Sevin, J. (1994). Comparison of psychotic and autistic children using behavioral observation. *Journal of Autism and Developmental Disorders, 24*(1), 83-94.

Matson, J. L. (1995). The Diagnostic Assessment of the Severely Handicapped-Revised (DASH-II). Baton Rouge, LA: Disability Consultants, LLC.

Matson, J. L. (2007). Determining treatment outcome in early intervention programs for autism spectrum disorders: A critical analysis of measurement issues in learning based interventions. *Research in Developmental Disabilities, 28*(2), 207-218.

Matson, J. L., Baglio, C. S., Smiroldo, B. B., Hamilton, M., Packlowskyj, T., Williams, D., et al. (1996). Characteristics of autism as assessed by the Diagnostic Assessment for the Severely Handicapped-II (DASH-II). *Research in Developmental Disabilities, 17*(2), 135-143.

Matson, J. L., & Barrett, R. P. (1982). *Psychopathology in the mentally retarded*. Philadelphia, PA US: Grune & Stratton/W B Saunders Co.

Matson, J. L., Barrett, R. P., & Helsel, W. J. (1988). Depression in mentally retarded children. *Research in Developmental Disabilities, 9*(1), 39-46.

Matson, J. L., Boisjoli, J., Rojahn, J., & Hess, J. (2009). A factor analysis of challenging behaviors assessed with the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT-Part 3). *Research in Autism Spectrum Disorders*.

Matson, J. L., & Boisjoli, J. A. (2007). Autism spectrum disorders in adults with intellectual disability and comorbid psychopathology: Scale development and reliability of the ASD-CA. *Research in Autism Spectrum Disorders*.

Matson, J. L., & Dempsey, T. (2008). Stereotypy in adults with autism spectrum disorders: Relationship and diagnostic fidelity. *Journal of Developmental and Physical Disabilities, 20*(2), 155-165.

Matson, J. L., Fodstad, J. C., & Mahan, S. (2009). Cutoffs, norms, and patterns of comorbid difficulties in children with developmental disabilities on the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT-Part 2). *Research in Developmental Disabilities, 30*(6), 1221-1228.

Matson, J. L., Fodstad, J. C., Mahan, S., & Sevin, J. A. (2009). Cutoffs, norms, and patterns of comorbid difficulties in children with an ASD on the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT-Part 2). *Research in Autism Spectrum Disorders, 3*(4), 977-988.

Matson, J. L., Gardner, W. I., Coe, D. A., & Sovner, R. (1991). A scale for evaluating emotional disorders in severely and profoundly mentally retarded persons: Development of the Diagnostic Assessment for the Severely Handicapped (DASH) scale. *British Journal of Psychiatry, 159*, 404-409.

Matson, J. L., González, M., & Rivet, T. T. (2008). Reliability of the Autism Spectrum Disorder-Behavior Problems for Children (ASD-BPC). *Research in Autism Spectrum Disorders, 2*(4), 696-706.

Matson, J. L., González, M., & Wilkins, J. (2009). Validity study of the Autism Spectrum Disorders-Diagnostic for Children (ASD-DC). *Research in Autism Spectrum Disorders, 3*(1), 196-206.

Matson, J. L., González, M., Wilkins, J., & Rivet, T. T. (2008). Reliability of the Autism Spectrum Disorder-Diagnostic For Children (ASD-DC). *Research in Autism Spectrum Disorders, 2*(3), 533-545.

Matson, J. L., González, M. L., Smith, K. R., Terlonge, C., Thorson, R. T., & Dixon, D. R. (2005). Assessing side effects of pharmacotherapy treatment of bipolar disorder: A 20-year review of the literature. *Research in Developmental Disabilities, 27*(5), 467-500.

Matson, J. L., González, M. L., Smith, K. R., Terlonge, C., Thorson, R. T., & Dixon, D. R. (2006). Assessing side effects of pharmacotherapy treatment of bipolar disorder: A 20-year review of the literature. *Research in Developmental Disabilities, 27*(5), 467-500.

Matson, J. L., Hess, J. A., Mahan, S., & Fodstad, J. C. (2010). Convergent validity of the Autism Spectrum Disorder-Diagnostic for Children (ASD-DC) and Autism Diagnostic Interview-Revised (ADI-R). *Research in Autism Spectrum Disorders, 4*(4), 741-745.

Matson, J. L., Kazdin, A. E., & Senatore, V. (1984). Psychometric properties of the psychopathology instrument for mentally retarded adults. *Applied Research in Mental Retardation, 5*(1), 81-89.

Matson, J. L., Kozlowski, A. M., Neal, D., Worley, J. A., & Fodstad, J. (2011). Cutoffs for the Matson Evaluation of Social Skills with Youngsters-II (MESSY-II) for typically developing children and for children diagnosed with autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*(2), 798-802.

Matson, J. L., & Love, S. R. (1990). A comparison of parent-reported fear for autistic and nonhandicapped age-matched children and youth. *Australia & New Zealand Journal of Developmental Disabilities, 16*(4), 349-357.

Matson, J. L., LoVullo, S. V., Rivet, T. T., & Boisjoli, J. A. (2009). Validity of the Autism Spectrum Disorder-Comorbid for Children (ASD-CC). *Research in Autism Spectrum Disorders, 3*(2), 345-357.

Matson, J. L., Mahan, S., Hess, J. A., Fodstad, J. C., & Neal, D. (2010). Convergent validity of the Autism Spectrum Disorder-Diagnostic for Children (ASD-DC) and Childhood Autism Rating Scales (CARS). *Research in Autism Spectrum Disorders, 4*(4), 633-638.

Matson, J. L., & Minshawi, N. F. (2006). *Early Intervention for Autism Spectrum Disorders, Volume 1: A Critical Analysis*. Amsterdam, the Netherlands: Elsevier Science.

Matson, J. L., Nebel-Schwalm, M., & Matson, M. L. (2007). A review of methodological issues in the differential diagnosis of autism spectrum disorders in children. *Research in Autism Spectrum Disorders, 1*(1), 38-54.

Matson, J. L., & Nebel-Schwalm, M. S. (2007). Comorbid psychopathology with autism spectrum disorder in children: An overview. *Research in Developmental Disabilities, 28*(4), 341-352.

Matson, J. L., Terlonge, C., & González, M. (2006). *Autism Spectrum Disorders-Diagnosis (ASD-D)*. Baton Rouge, LA: Disability Consultants, LLC.

Matson, J. L., Wilkins, J., Sevin, J. A., Knight, C., Boisjoli, J. A., & Sharp, B. (2009). Reliability and item content of the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT): Parts 1-3. *Research in Autism Spectrum Disorders, 3*(2), 336-344.

Matson, J. L., Wilkins, J., Sharp, B., Knight, C., Sevin, J. A., & Boisjoli, J. A. (2009). Sensitivity and specificity of the Baby and Infant Screen for Children with aUtIsm Traits

(BISCUIT): Validity and cutoff scores for autism and PDD-NOS in toddlers. *Research in Autism Spectrum Disorders, 3*(4), 924-930.

Mazefsky, C. A., Kao, J., & Oswald, D. P. (2010). Preliminary evidence suggesting caution in the use of psychiatric self-report measures with adolescents with high-functioning autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*(1), 164-174.

McCracken, J. T., McGough, J., Shah, B., Cronin, P., Hong, D., Aman, M. G., et al. (2002). Risperidone in children with autism and serious behavioral problems. *The New England Journal Of Medicine, 347*(5), 314-321.

McEachin, J. J., Smith, T., & Lovaas, O. I. (1993). Long-term outcome for children with autism who received early intensive behavioral treatment. *American Journal on Mental Retardation, 97*(4), 359-372.

Meadows, T., Valleley, R., Haack, M. K., Thorson, R., & Evans, J. (2011). Physician "Costs" in Providing Behavioral Health in Primary Care. [Article]. *Clinical Pediatrics, 50*(5), 447-455.

Melke, J. (2008). Autism: Which genes are involved? *Clinical Neuropsychiatry: Journal of Treatment Evaluation, 5*(1), 62-69.

Meltzer, L. J. (2008). Brief report: Sleep in parents of children with autism spectrum disorders. *Journal of Pediatric Psychology, 33*(4), 380-386.

Merikangas, K. R., He, J.-p., Burstein, M., Swanson, S. A., Avenevoli, S., Cui, L., et al. (2010). Lifetime Prevalence of Mental Disorders in U.S. Adolescents: Results from the National Comorbidity Survey Replication-Adolescent Supplement (NCS-A). *Journal of the American Academy of Child & Adolescent Psychiatry, 49*(10), 980-989.

Meyer, J. A., Mundy, P. C., van Hecke, A. V., & Durocher, J. S. (2006). Social attribution processes and comorbid psychiatric symptoms in children with Asperger syndrome. *Autism, 10*(4), 383-402.

Mildenberger, K., Sitter, S., Noterdaeme, M., & Amorosa, H. (2001). The use of the ADI-R as a diagnostic tool in the differential diagnosis of children with infantile autism and children with a receptive language disorder. *European Child & Adolescent Psychiatry, 10*(4), 248-255.

Milgram, S. (1963). Behavioral Study of obedience. *The Journal of Abnormal and Social Psychology, 67*(4), 371-378.

Miller, D. T., Shen, Y., Weiss, L. A., Korn, J., Anselm, I., Bridgemohan, C., et al. (2009). Microdeletion/duplication at 15q13.2q13.3 among individuals with features of autism and other neuropsychiatric disorders. *Journal Of Medical Genetics, 46*(4), 242-248.

Moore, V., & Goodson, S. (2003). How well does early diagnosis of autism stand the test of time? Follow-up study of children assessed for autism at age 2 and development of an early diagnostic service. *Autism, 7*(1), 47-63.

Morgan, C. N., Roy, M., & Chance, P. (2003). Psychiatric comorbidity and medication use in autism: A community survey. *Psychiatric Bulletin, 27*(10), 378-381.

Moss, J., Magiati, I., Charman, T., & Howlin, P. (2008). Stability of the Autism Diagnostic Interview-Revised from pre-school to elementary school age in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 38*(6), 1081-1091.

Moss, S., Patel, P., Prosser, H., & Goldberg, D. (1993). Psychiatric morbidity in older people with moderate and severe learning disability: I. Development and reliability of the patient interview (PAS-ADD). *British Journal of Psychiatry, 163*, 471-480.

Muris, P., Steerneman, P., Merckelbach, H., Holdrinet, I., & Meesters, C. (1998). Comorbid anxiety symptoms in children with pervasive developmental disorders. *Journal of Anxiety Disorders, 12*(4), 387-393.

Murphy, G. H., Beadle-Brown, J., Wing, L., Gould, J., Shah, A., & Holmes, N. (2005). Chronicity of Challenging Behaviours in People with Severe Intellectual Disabilities and/or Autism: A Total Population Sample. *Journal of Autism and Developmental Disorders, 35*(4), 405-418.

Nassir Ghaemi, S., Miller, C. J., Berv, D. A., Klugman, J., Rosenquist, K. J., & Pies, R. W. (2005). Sensitivity and specificity of a new bipolar spectrum diagnostic scale. *Journal of Affective Disorders, 84*(2-3), 273-277.

Nicholas, J. S., Carpenter, L. A., King, L. B., Jenner, W., & Charles, J. M. (2009). Autism Spectrum Disorders in Preschool-Aged Children: Prevalence and Comparison to a School-Aged Population. *Annals of Epidemiology, 19*(11), 808-814.

Nicholas, J. S., Charles, J. M., Carpenter, L. A., King, L. B., Jenner, W., & Spratt, E. G. (2008). Prevalence and Characteristics of Children With Autism-Spectrum Disorders. *Annals of Epidemiology, 18*(2), 130-136.

Orne, M. T. (1962). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *American Psychologist, 17*(11), 776-783.

Ozonoff, S., Rogers, S. J., & Pennington, B. F. (1991). Asperger's syndrome: Evidence of an empirical distinction from high-functioning autism. *Journal of Child Psychology and Psychiatry, 32*(7), 1107-1122.

Ozonoff, S., Rogers, S. J., Pennington, B. F. (1991). Asperger's syndrome: evidence of an empirical distinction from high-functioning autism. *Journal of Child Psychology and Psychiatry, 32*, 1107-1122.

Pearson, D. A., Loveland, K. A., Lachar, D., Lane, D. M., Reddoch, S. L., Mansour, R., et al. (2006). A Comparison of Behavioral and Emotional Functioning in Children and Adolescents with Autistic Disorder and PDD-NOS. *Child Neuropsychology, 12*(4), 321-333.

Piazza, C. C., Fisher, W. W., Hanley, G. P., LeBlanc, L. A., Worsdell, A. S., Lindauer, S. E., et al. (1998). Treatment of pica through multiple analyses of its reinforcing functions. *Journal of Applied Behavior Analysis, 31*(2), 165-189.

Pickles, A., Bolton, P., Macdonald, H., Bailey, A., Le Couteur, A., Sim, C. H., et al. (1995). Latent-class analysis of recurrence risks for complex phenotypes with selection and measurement error: a twin and family history study of autism. *American Journal of Human Genetics, 57*(3), 717-726.

Piven, J., Bailey, J., Ranson, B. J., & Arndt, S. (1998). No difference in hippocampus volume detected on magnetic resonance imaging in autistic individuals. *Journal of Autism and Developmental Disorders, 28*(2), 105-110.

Piven, J., Palmer, P., Jacobi, D., & Childress, D. (1997). Broader autism phenotype: Evidence from a family history study of multiple-incidence autism families. *American Journal of Psychiatry, 154*(2), 185-190.

Polimeni, M. A., Richdale, A. L., & Francis, A. J. P. (2005). A survey of sleep problems in autism, Asperger's disorder and typically developing children. *Journal of Intellectual Disability Research, 49*(4), 260-268.

Prior, M., Eisenmajer, R., Leekam, S., Wing, L., Gould, J., Ong, B., et al. (1998). Are there subgroups within the autistic spectrum? A cluster analysis of a group of children with autistic spectrum disorders. *Journal of Child Psychology and Psychiatry, 39*(6), 893-902.

Prior, M., & MacMillan, M. B. (1973). Maintenance of sameness in children with Kanner's syndrome. *Journal of Autism & Childhood Schizophrenia, 3*(2), 154-167.

Prior, M., Perry, D., & Gajzago, C. (1975). Kanner's syndrome or early-onset psychosis: A taxonomic analysis of 142 cases. *Journal of Autism and Childhood Schizophrenia, 5*(1), 71-80.

Quintana, H., Birmaher, B., Stedge, D., & Lennon, S. (1996). Use of methylphenidate in the treatment of children with autistic disorder. *Annual Progress in Child Psychiatry & Child Development*, 295-307.

Raja, M., & Azzoni, A. (2008). Comorbidity of Asperger's syndrome and bipolar disorder. *Clinical Practice and Epidemiology in Mental Health, 4*.

Rapp, J. T., Vollmer, T. R., & Hovanetz, A. N. (2005). Evaluation and Treatment of Swimming Pool Avoidance Exhibited by an Adolescent Girl With Autism. *Behavior Therapy, 36*(1), 101-105.

Realmuto, G. M., & August, G. J. (1991). Catatonia in autistic disorder: A sign of comorbidity or variable expression? *Journal of Autism and Developmental Disorders, 21*(4), 517-528.

Redcay, E., & Courchesne, E. (2005). When is the brain enlarged in autism? A meta-analysis of all brain size reports. *Biological Psychiatry, 58*(1), 1-9.

Reiss, S. (1988). Dual diagnosis in the United States. *Australia & New Zealand Journal of Developmental Disabilities, 14*(1), 43-48.

Reynolds, C. R., & Kamphaus, R. W. (2004). *BASC-2: Behavior assessment system for children, second edition manual*. Circle Pines, MN: American Guidance Service.

Rice, S. A., Bigler, E. D., Cleavinger, H. B., Tate, D. F., Sayer, J., McMahon, W., et al. (2005). Macrocephaly, corpus callosum morphology, and autism. *Journal of Child Neurology, 20*(1), 34-41.

Rimland, B. (1964). *Infantile autism: The syndrome and its implications for a neural theory of behavior*. East Norwalk, CT US: Appleton-Century-Crofts.

Risch, N., Spiker, D., Lotspeich, L., Nouri, N., Hinds, D., Hallmayer, J., et al. (1999). A genomic screen of autism: evidence for a multilocus etiology. *American Journal Of Human Genetics, 65*(2), 493-507.

Ritvo, E. R., Freeman, B., Scheibel, A., Duong, T., Robinson, H., Guthrie, D., et al. (1986). Lower Purkinje cell counts in the cerebella of four autistic subjects: initial findings of the UCLA-NSAC Autopsy Research Report. *Am J Psychiatry, 143*(7), 862-866.

Ritvo, E. R., Freeman, B. J., Pingree, C., & Mason-Brothers, A. (1989). The UCLA-University of Utah epidemiologic survey of autism: Prevalence. *American Journal of Psychiatry, 146*(2), 194-199.

Robertson, H. A., Kutcher, S. P., Bird, D., & Grasswick, L. (2001). Impact of early onset bipolar disorder on family functioning: Adolescents' perceptions of family dynamics, communication, and problems. *Journal of Affective Disorders, 66*(1), 25-37.

Rojahn, J., Matson, J. L., Lott, D., Esbensen, A. J., & Smalls, Y. (2001). The Behavior Problems Inventory: An instrument for the assessment of self-injury, stereotyped behavior, and

aggression/destruction in individuals with developmental disabilities. *Journal of Autism and Developmental Disorders, 31*(6), 577-588.

Rojahn, J., Matson, J. L., Mahan, S., Fodstad, J. C., Knight, C., Sevin, J. A., et al. (2009). Cutoffs, norms, and patterns of problem behaviors in children with an ASD on the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT-Part 3). *Research in Autism Spectrum Disorders, 3*(4), 989-998.

Romanow, K. (2010). Pennsylvania Adds Swallowing Coverage to Medicaid: Advocacy Efforts Result in Policy Change for Children. [Article]. *ASHA Leader, 15*(14), 10-10.

Ronald, A., Happac, F., Bolton, P., Butcher, L. M., Price, T. S., Wheelwright, S., et al. (2006). Genetic heterogeneity between the three components of the autism spectrum: a twin study. *Journal of The American Academy of Child And Adolescent Psychiatry, 45*(6), 691-699.

Russell, A. J., Mataix-Cols, D., Anson, M., & Murphy, D. G. M. (2005). Obsessions and compulsions in Asperger syndrome and high-functioning autism. *British Journal of Psychiatry, 186*(6), 525-528.

Rutter, M. (1983). Cognitive deficits in the pathogenesis of autism. *Journal of Child Psychology and Psychiatry, 24*(4), 513-531.

Rutter, M. (1985). The treatment of autistic children. *Journal of Child Psychology and Psychiatry, 26*(2), 193-214.

Rutter, M. (2005). Incidence of autism spectrum disorders: changes over time and their meaning. *Acta Paediatrica (Oslo, Norway: 1992), 94*(1), 2-15.

Rutter, M., Graham, P., Chadwick, O. F., & Yule, W. (1976). Adolescent turmoil: Fact or fiction? *Journal of Child Psychology and Psychiatry, 17*(1), 35-56.

Rutter, M., Silberg, J., O'Connor, T., & Siminoff, E. (1999). Genetics and child psychiatry: II. Empirical research findings. *Journal of Child Psychology and Psychiatry, 40*(1), 19-55.

Sakurai, T., Reichert, J., Hoffman, E. J., Cai, G., Jones, H. B., Faham, M., et al. (2008). A large-scale screen for coding variants in SERT/SLC6A4 in autism spectrum disorders. *Autism Research: Official Journal of the International Society for Autism Research, 1*(4), 251-257.

Santosh, P. J., Baird, G., Pityaratstian, N., Tavare, E., & Gringras, P. (2006). Impact of comorbid autism spectrum disorders on stimulant response in children with attention deficit hyperactivity disorder: A retrospective and prospective effectiveness study. *Child: Care, Health and Development, 32*(5), 575-583.

Schisterman, E. F., Perkins, N. J., Liu, A., & Bondell, H. (2005). Optimal Cut-Point and its Corresponding Youden Index to Discriminate Individuals Using Pooled Blood Samples. *Epidemiology, 16*(1), 73.

Schopler, E. (1985). Convergence of learning disability, higher-level autism, and Asperger's syndrome. *Journal of Autism and Developmental Disorders, 25*, 561-578.

Schopler, E., Reichler, R. J., DeVellis, R. F., & Daly, K. (1980). Toward objective classification of childhood autism: Childhood Autism Rating Scale (CARS). *Journal of Autism and Developmental Disorders, 10*(1), 91-103.

Schopler, E., Reichler, R. J., & Renner, B. R. (1988). *The Childhood Autism Rating Scale (CARS)*. Los Angeles, CA: Western Psychological Services.

Schreck, K. A., & Mazur, A. (2008). Behavior analyst use of and beliefs in treatments for people with autism. *Behavioral Interventions, 23*(3), 201-212.

Schreck, K. A., Mulick, J. A., & Rojahn, J. (2003). Development of the Behavioral Evaluation of Disorders of Sleep Scale. *Journal of Child and Family Studies, 12*(3), 349-359.

Schreck, K. A., Williams, K., & Smith, A. F. (2004). A Comparison of Eating Behaviors between Children with and without Autism. *Journal of Autism and Developmental Disorders, 34*(4), 433-438.

Senatore, V., Matson, J. L., & Kazdin, A. E. (1985). An inventory to assess psychopathology of mentally retarded adults. *American Journal of Mental Deficiency, 89*(5), 459-466.

Sevin, J. A., Matson, J. L., Coe, D., Love, S. R., Matese, M. J., & Benavidez, D. A. (1995). Empirically derived subtypes of pervasive developmental disorders: A cluster analytic study. *Journal of Autism and Developmental Disorders, 25*(6), 561-578.

Shalom, D. B., Mostofsky, S. H., Hazlett, R. L., Goldberg, M. C., Landa, R. J., Faran, Y., et al. (2006). Normal Physiological Emotions but Differences in Expression of Conscious Feelings in Children with High-Functioning Autism. *Journal Of Autism And Developmental Disorders, 36*(3), 395-400.

Shang-Ying, S., & Constantine, G. (2008). The predictive receiver operating characteristic curve for the joint assessment of the positive and negative predictive values. [Article]. *Philosophical Transactions of the Royal Society A: Mathematical, Physical & Engineering Sciences, 366*(1874), 2313-2333.

Shattuck, P. T., Seltzer, M. M., Greenberg, J. S., Orsmond, G. I., Bolt, D., King, S., et al. (2006). Changes in autism and maladaptive behaviors in adolescents and adults with an Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders, 37*, 1735-1747.

Siegel, B. (1986). Empirically derived subclassification of the autistic syndrome. *Journal of Autism and Developmental Disorders, 16*(3), 275-293.

Sigman, M., & Ruskin, E. (1999). Continuity and change in the social competence of children with autism, Down syndrome, and developmental delays. *Monographs of the Society for Research in Child Development, 64*(1), v-114.

Smalley, S. L., McCracken, J., & Tanguay, P. (1995). Autism, affective disorders, and social phobia. *American Journal of Medical Genetics, 60*(1), 19-26.

Solomon, M., Goodlin-Jones, B. L., & Anders, T. F. (2004). A Social Adjustment Enhancement Intervention for High Functioning Autism, Asperger's Syndrome, and Pervasive Developmental Disorder NOS. *Journal Of Autism And Developmental Disorders, 34*(6), 649-668.

Souders, M. C. (2008). *Sleep behaviors and sleep quality in children with autism spectrum disorders.*, ProQuest Information & Learning, US.

Staudenmeier, J. J., & Jacoby, I. (1998). Trends in prescribing psychotropic medications. *JAMA: Journal of the American Medical Association, 280*(2), 132-134.

Steffenburg, S., Gillberg, C., Hellgren, L., & Andersson, L. (1989). A twin study of autism in Denmark, Finland, Iceland, Norway and Sweden. *Journal of Child Psychology and Psychiatry, 30*(3), 405-416.

Steg, J. P., & Rapoport, J. L. (1975). Minor physical anomalies in normal, neurotic, learning disabled, and severely disturbed children. *Journal of Autism & Childhood Schizophrenia, 5*(4), 299-307.

Sturm, H., Fernell, E., & Gillberg, C. (2004). Autism spectrum disorders in children with normal intellectual levels: Associated impairments and subgroups. *Developmental Medicine & Child Neurology, 46*(7), 444-447.

Sturmey, P. (2006). In Response to Lindsay and Emerson. [Article]. *Journal of Applied Research in Intellectual Disabilities, 19*(1), 125-129.

Sturmey, P., Sevin, J. A., & Matson, J. L. (1994). Defining and assessing autism. *Autism in children and adults: Etiology, assessment, and intervention.* (pp. 13-36). Belmont, CA US: Thomson Brooks/Cole Publishing Co.

Szatmari, P. (1992). The validit of autism spectrum disorders: A literature review. *Journal of Autism and Developmental Disorders, 22*, 583-600.

Szatmari, P., Archer, L., Fisman, S., & Streiner, D. L. (1995). Asperger's syndrome and autism: Differences in behavior, cognition, and adaptive functioning. *Journal of the American Academy of Child & Adolescent Psychiatry, 34*(12), 1662-1671.

Szatmari, P., Volkmar, F., & Walther, S. (1995). Evaluation of diagnostic criteria for autism using latent class models. *Journal of the American Academy of Child & Adolescent Psychiatry, 34*(2), 216-222.

Tabachnick, B., & Fidell, L. (2001). *Using Multivariate Statistics* (4th ed.). Needham Heights, MA: Allyn & Bacon.

Tantam, D. (2000). Psychological disorder in adolescents and adults with Asperger syndrome. *Autism, 4*(1), 47-62.

Tantam, D., & Frith, U. (1991). Asperger syndrome in adulthood *Autism and Asperger syndrome.* (pp. 147-183). New York, NY, US: Cambridge University Press.

Thomas, R. C. (2002). *Peer assessment of pathological personality: An item response theory analysis of rater and target characteristics.* ProQuest Information & Learning, US.

Thompson, W. W., Price, C., Goodson, B., Shay, D. K., Benson, P., Hinrichsen, V. L., et al. (2007). Early thimerosal exposure and neuropsychological outcomes at 7 to 10 years. *The New England Journal Of Medicine, 357*(13), 1281-1292.

Thomsen, P. H. (1994). Obsessive-compulsive disorder in children and adolescents: A 6-22-year follow-up study: Clinical descriptions of the course and continuity of obsessive-compulsive symptomatology. *European Child & Adolescent Psychiatry, 3*(2), 82-96.

Tiratira, N. L. (2009). Cutoff scores: The basic Angoff method and the item response theory method. *The International Journal of Educational and Psychological Assessment, 1*(1), 39-47.

Toichi, M. (2006). Obsessive and compulsive traits in pervasive developmental disorder. *Japanese Journal of Child and Adolescent Psychiatry, 47*(2), 127-134.

Tonge, B. J. (2002). Autism, autistic spectrum and the need for a better definition. *Medical Journal of Austrailia*(176), 412-413.

Tonge, B. J., Brereton, A. V., Gray, K. M., & Einfeld, S. L. (1999). Behavioural and emotional disturbance in high-functioning autism and Asperger syndrome. *Autism, 3*(2), 117-130.

Trikalinos, T. A., Karvouni, A., Zintzaras, E., Ylisaukko-oja, T., Peltonen, L., Jarvelna, I., et al. (2006). A heterogeneity-based genome search meta-analysis for autism-spectrum disorders. *Molecular Psychiatry, 11*(1), 29-36.

Tsai, L. Y. (1996). Breif Report: Comorbid psychiatric disorders of autistic disorder. *Journal of Autism and Developmental Disorders, 26*, 159-163.

Twachtman-Reilly, J., Amaral, S. C., & Zebrowski, P. P. (2008). Addressing feeding disorders in children on the autism spectrum in school-based settings: Physiological and behavioral issues. *Language, Speech, and Hearing Services in Schools, 39*(2), 261-272.

Vincent, G. M. (2004). *Investigating the legitimacy of adolescent psychopathy assessments: Contributions of item response theory*. ProQuest Information & Learning, US.

Volkmar, F. R., Klin, A., Schultz, R., Bronen, R., Marans, W. D., Sparrow, S., et al. (1996). Asperger's syndrome. *Journal of the American Academy of Child & Adolescent Psychiatry, 35*(1), 118-123.

Volkmar, F. R., Klin, A., Siegel, B., & Szatmari, P. (1994). Field trial for autistic disorder in DSM-IV. *American Journal of Psychiatry, 151*(9), 1361-1367.

Walker, H. A. (1977). Incidence of minor physical anomaly in autism. *Journal of Autism & Childhood Schizophrenia, 7*(2), 165-176.

Wallace, G. L., & Treffert, D. A. (2004). Head size and autism. *The Lancet, 363*(9414), 1003-1004.

Waterhouse, L., Morris, R., Allen, D., Dunn, M., Fein, D., Feinstein, C., et al. (1996). Diagnosis and classification in autism. *Journal of Autism and Developmental Disorders, 26*(1), 59-86.

Webb, S. J., Nalty, T., Munson, J., Brock, C., Abbott, R., & Dawson, G. (2007). Rate of head circumference growth as a function of autism diagnosis and history of autistic regression. *Journal Of Child Neurology, 22*(10), 1182-1190.

Weiss, L. A., Shen, Y., Korn, J. M., Arking, D. E., Miller, D. T., Fossdal, R., et al. (2008). Association between microdeletion and microduplication at 16p11.2 and autism. *The New England Journal of Medicine, 358*(7), 667-675.

White, S. W., Ollendick, T., Scahill, L., Oswald, D., & Albano, A. M. (2009). Preliminary efficacy of a cognitive-behavioral treatment program for anxious youth with autism spectrum disorders. *Journal Of Autism And Developmental Disorders, 39*(12), 1652-1662.

White, S. W., Oswald, D., Ollendick, T., & Scahill, L. Anxiety in Children and Adolescents with Autism Spectrum Disorders. *Clinical Psychology Review, In Press, Accepted Manuscript*.

Wilkins, J., & Matson, J. L. (2009). A comparison of social skills profiles in intellectually disabled adults with and without ASD. *Behavior Modification, 33*(2), 143-155.

Wing, L. (1981). Asperger's syndrome: A clinical account. *Psychological Medicine, 11*(1), 115-129.

Wing, L. (1996). Autism spectrum disorder (Editorial). *British Medical Journal, 312*, 327-328.

Wing, L., & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: Epidemiology and classification. *Journal of Autism and Developmental Disorders, 9*(1), 11-29.

Wing, L., Gould, J., & Gillberg, C. (2011). Autism spectrum disorders in the DSM-V: Better or worse than the DSM-IV? *Research in Developmental Disabilities, 32*(2), 768-773.

Wing, L., & Potter, D. (2002). The epidemiology of autistic spectrum disorders: Is prevalence rising? *Mental Retardation and Developmental Disabilities Research Reviews, 8*(3), 151-161.

Wing, L., & Shah, A. (2000). Catatonia in autistic spectrum disorders. *British Journal of Psychiatry, 176*, 357-362.

Wing, L., Yeates, S. R., Brierley, L. M., & Gould, J. (1976). The prevalence of early childhood autism: comparison of administrative and epidemiological studies. *Psychological Medicine, 6*(1), 89-100.

Woodard, C., Groden, J., Goodwin, M., Shanower, C., & Bianco, J. (2005). The Treatment of the Behavioral Sequelae of Autism with Dextromethorphan: A Case Report. *Journal of Autism and Developmental Disorders, 35*(4), 515-518.

World Health Organization. (1979). *International Statistical Classification of Diseases and Related Health Problems* (9th ed.). Geneva: Author.

World Health Organization. (1992). *International Statistical Classification of Diseases and Related Health Problems* (10th ed.). Geneva: Author.

Worley, J. A., & Matson, J. L. (2011). Psychiatric symptoms in children diagnosed with an Autism Spectrum Disorder: An examination of gender differences. *Research in Autism Spectrum Disorders, 5*(3), 1086-1091.

Yeargin-Allsopp, M., Rice, C., Karapurkar, T., Boyle, C., Murphy, C., & Doernberg, N. (2003). Prevalence of autism in a US metropolitan area. *Journal of the American Medical Association, 289*(1), 49-55.

Youden, W. J. (1950). Index for rating diagnostic tests. *Cancer, 3*(1), 32.

Zafeiriou, D. I., Ververi, A., & Vargiami, E. (2007). Childhood autism and associated comorbidities. *Brain & Development, 29*(5), 257-272.

Zaw, F. K. M., Bates, G. D. L., Murali, V., & Bentham, P. (1999). Catatonia, autism, and ECT. *Developmental Medicine & Child Neurology*, *41*(12), 843-845.

Zucker, N. L., Losh, M., Bulik, C. M., LaBar, K. S., Piven, J., & Pelphrey, K. A. (2007). Anorexia nervosa and autism spectrum disorders: Guided investigation of social cognitive endophenotypes. *Psychological Bulletin, 133*(6), 976-1006.

Appendix

Glossary of Acronyms

ABA – Applied Behavior Analysis

ACI-PL – Autism Co-Morbidity Interview – Present and Lifetime

AD – Autistic Disorder

ADHD – Attention Deficit/Hyperactivity Disorder

ADI-R – Autism Diagnostic Interview - Revised

ADOS – Autism Diagnostic Observation Schedule

ASD – Autism Spectrum Disorders

ASD-BPC – Autism Spectrum Disorders – Behavior Problems for Children

ASD-CC – Autism Spectrum Disorders-Comorbid for Children

ASD-DC – Autism Spectrum Disorders – Diagnostic for Children

AS – Asperger's Syndrome (Disorder)

AUC - Area Under the Curve

BASC – Behavioral Assessment System for Children

BISCUIT – Baby and Infant Screen for Children with aUtIsm Traits

CARS – Childhood Autism Rating Scale

CBCL – Child Behavior Checklist

CBT: Cognitive Behavioral Therapy

CDD – Childhood Disintegrative Disorder

CDC – Center for Disease Control

DFA – Discriminant Function Analysis

DSM – Diagnostic and Statistical Manual

fMRI – Functional Magnetic Resonance Imaging

FTT – Failure to Thrive

HFA – High Functioning Autism

ICD – International Classification of Disorders

ID – Intellectual Disability

IRT – Item Response Theory

KSADS – Kiddie Schedule for Affective Disorders and Schizophrenia

MR – Mental Retardation

MRI – Magnetic Resonance Imaging

NPV – Negative Predictive Value

OCD – Obsessive Compulsive Disorder

PAC – Psychopathology in Autism Checklist

PET – Positron Emission Tomography

PIQ – Performance Intelligence Quotient

PDD-NOS – Pervasive Developmental Disorder, Not Otherwise Specified

PPV – Positive Predictive Value

ROC – Receiver Operator Characteristics

SAD – Social Anxiety Disorder

TCC – Total Correct Classification

VIQ – Verbal Intelligence Quotient

Vita

Ryan Thomas Thorson was born in April, 1980, in Austin, Minnesota. Ryan attended Minnesota State University, Mankato, from 1998 through 2003 where he earned Bachelor in Science degrees in both psychology and management information systems. Ryan enrolled in the clinical psychology graduate training program at Louisiana State University in Baton Rouge, Louisiana, in 2004. Ryan's research and clinical training focused primarily on assessment and treatment of individuals with developmental disabilities including intellectual disability and autism spectrum disorders. Ryan also focused on comorbid psychopathology and behavioral problems. Ryan completed his pre-doctoral internship at the Munroe-Meyer Institute, University of Nebraska Medical Center as a part of the Nebraska Internship Consortium in Professional Psychology.