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Autism Severity and Comorbid Symptoms in Children with ASD

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AUTISM SEVERITY AND COMORBID SYMPTOMS IN CHILDREN WITH ASD

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ABSTRACT

Individuals with autism spectrum disorder (ASD) are reported to evince high rates of comorbid symptoms. Co-occurring disorders among individuals with ASD are often difficult to assess and diagnose accurately. Also, comorbid conditions frequently exacerbate symptoms of ASD. Different treatment regimens may be effective for comorbid symptoms in ASD; however, research looking at comorbid symptoms and ASD is limited. The current study aimed to extend the literature in this area by examining the relationship between ASD and comorbid symptoms. First, the current study assessed how often and how severely comorbid symptoms were endorsed. Further, autism severity was used to predict comorbid symptoms. Autism severity was measured using the *Autism Spectrum Disorder- Diagnostic Child Version* (*ASD-DC*), and comorbid symptoms were obtained using the *Autism Spectrum Disorders-Comorbidity Child Version* (*ASD-CC*). A simple regression was conducted using the *ASD-DC* total score as the predictor and *ASD-CC* total score as the dependent variable. Then, a series of regression analyses was conducted with ASD severity as the predictor and *ASD-CC* subscores as dependent variables. In the current study, a high rate of comorbid behaviors was reported. Also, the current study found that autism severity predicted overall comorbid symptoms. Specifically, autism severity significantly predicted repetitive behaviors, tantrum behaviors, and avoidant behaviors. This finding is of considerable clinical value as it suggests that individuals with more severe ASD symptoms also contend with greater comorbid symptoms. This is concerning as these comorbid symptoms alter symptom presentation and further exacerbate deficits, indicating that it is crucial for clinicians to routinely evaluate these comorbid symptoms. Further implications of these findings are discussed.

INTRODUCTION

As the reported prevalence of autism spectrum disorder (ASD) has dramatically increased in the last two decades, ASD has become an increasingly popular area of study (Matson, Tureck, Turygin, Beighley, & Rieske, 2012). ASD is a neurodevelopmental disorder that is characterized by persistent deficits in socialization and communication, as well as the presence of stereotyped and repetitive behaviors. Research on these core deficits of ASD has been well investigated (Cappadocia & Weiss, 2011; Chowdhury, Benson, & Hillier, 2010; Fodstad, Matson, Hess, & Neal; 2009; Gaspar de Alba & Bodfish, 2011; Matson & Boisjoli, 2008; Matson, Dempsey, LoVullo, & Wilkins, 2008; Matson, Kozlowski, Hattier, Horovitz, & Sipes, 2012; Matson & Wilkins, 2009; Tidmarsh & Volkmar, 2003). In addition to core deficits of ASD, children with ASD are reported to have other behavioral and emotional problems (Lainhart, 1999), often due to comorbid conditions. Comorbidity, defined as the simultaneous presence of two or more psychological disorders in the current paper, is more common than previously believed in individuals with ASD. However, comorbid psychopathology in ASD is often difficult to identify because of the communication impairments and intellectual disabilities (ID) often associated with ASD (Lord & Paul, 1997; Volkmar & Cohen, 1991). Also, core symptoms of ASD may obscure or overshadow less pronounced comorbid symptoms.

It is crucial to identify and diagnose comorbid psychopathology accurately in individuals with ASD because these co-occurring disorders may exacerbate symptoms and cause clinically significant impairments (Matson et al., 2011; Matson, Boisjoli, & Mahan, 2009; Matson & Rivet, 2008; Mayes et al., 2012). A better understanding of comorbid psychopathology across individuals with ASD is needed. In the current study, the prevalence of comorbid psychopathology symptoms and the relationship between autism severity and comorbid

symptoms were examined. More specifically, autism severity was used as a predictor of comorbid symptoms. First, an overview of ASD will be discussed, followed by discussion of comorbidity in ASD.

AUTISM SPECTRUM DISORDERS

History of ASD

What is known as autism today was first described by Leo Kanner of Johns Hopkins University in 1943 in an article entitled, "Autistic disturbances of affective contact." Kanner provided a detailed report on 11 children who exhibited unique characteristics that had not been reported previously. Some of the common characteristics were deficits in socialization, effective communication, and obsessive insistence on sameness, which are the three areas that resemble our current understanding of autism (Kanner, 1943).

Kanner (1943) noted that the fundamental characteristic of this disorder was the children's "inability to relate themselves in the ordinary way to people and situations" (p. 242). He reported that the children were not interested in interacting with others and preferred to be alone. An "extreme autistic aloneness" was seen from early development as the children failed to develop social awareness (Kanner, 1943).

Kanner also described communication deficits observed in the children. Three of the children he described were mute, and language in the remaining eight children was not functional. Although the children were able to repeat and recite an excess of information on very specific topics, such as nursery rhymes, prayers, the roster of presidents, the alphabet forward and backward, and poems, they did not use language as a means of communication. Because the children with speech did not use language for functional communication, Kanner argued that there was no fundamental difference between those children and the three mute children (Kanner, 1943; Kanner, 1971).

In addition to describing deficits in socialization and communication, Kanner also discussed the children's stereotyped behaviors and their non-functional insistence on sameness.

Kanner reported that the children became upset when their routines and activities were changed or did not get completed. He explained that their insistence on sameness was a factor of their monotonous repetitiousness, which limited spontaneous activities (Kanner, 1943).

By 1943, Kanner had seen nearly 100 children who exhibited similar behaviors, and he coined the term *early autism* in 1944 to describe a pattern of behaviors observed in these children (Kanner, 1951; Kanner, 1965). Initially, Kanner's *early autism* term created confusion about the disorder because the term *autism* was first introduced by a Swiss psychiatrist, Eugene Bleuler, in 1913. Bleuler used this term to describe withdrawal symptoms in patients with schizophrenia who removed themselves from their previous social participation. Kanner (1943) used the same term, despite the fact that the previous definition did not apply to the children he observed. He noted that the withdrawal seen in children with early autism was different than the withdrawal seen in children and adults with schizophrenia as he observed "extreme autistic aloneness" from the start of development in those children with early autism (p. 242). For example, Kanner described how almost all children failed to assume an anticipatory posture when being picked up by their parents (Kanner, 1943). Although the autism described by Kanner and Bleuler was clearly different, early infantile autism was frequently misdiagnosed as Bleuler's version of autism (Rutter, 1978).

Around the same time, an Austrian pediatrician named Hans Asperger (1944) published "Autistic-psychopathy in childhood," which described common characteristics of the disorder that we now know as Asperger's disorder. It is interesting to note that the symptoms that Asperger called autistic were very similar to those described by Kanner, although it was unlikely that Asperger was aware of Kanner's work (Asperger, 1944). Identified patterns of behaviors

described by Asperger included a lack of social relationships, deficits in emotions and facial expressions, absence of a sense of humor, and peculiar/abnormal interest in objects.

Initially, Asperger's work was not widely recognized because the papers were published exclusively in German. It was not until 1991 that Asperger's work began receiving attention when Uta Frith translated and incorporated it as a book chapter (Frith, 2004). Like Kanner, Asperger said that the children he described as autistic were different from those whom Bleuler described; he reported that the children were not psychotic and that a lack of social contact was apparent/exhibited from the start in these children, unlike schizophrenic patients who lost contact progressively. Similar to Kanner's descriptions, Asperger observed impairments in socialization in the children. The children were unaware of their surroundings and preferred to isolate themselves. According to Asperger, their displays of affection and emotions were severely impaired, as they neither liked to be treated nicely nor tried to treat others nicely. Another characteristic discussed by Asperger was their lack of a sense of humor -- they did not understand jokes. Asperger also reported that autistic children often engaged in stereotypic activities, including unusual body movements and monotonous/repetitive play with parts of objects. Children often were impulsive and had peculiar interests, and conflicts arose when attempts were made to change peculiarities (Asperger, 1944). Unlike the children described by Kanner, children described by Asperger did not demonstrate speech impairments. Also, the children in Asperger's paper were reported to have above-average intellect with milder symptoms than those described in Kanner's paper.

During the 1950s and 1960s, the medical community continued to think that children with autism had schizophrenia. Bruno Bettelheim, a professor and child development specialist, described the refrigerator theory, which blamed autism on mothers, stating that the mothers were

cold and distant and failed to bond with their children, which produced autistic symptoms (Bettelheim, 1967). This theory went unchallenged until Bernard Rimland published *Infantile Autism: The Syndrome and its Implications for a Neural Theory of Behavior*, which directly attacked the refrigerator theory by providing empirical evidence that autism was a neurological disorder (Rimland, 1964).

Autism was not included as a diagnosis in the first two releases of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*), the standard classification of mental disorders published by American Psychiatric Association (APA; APA, 1952; APA, 1968). During that time, children who exhibited symptoms of autism were still being diagnosed with childhood schizophrenia. The word "autistic" appeared under the schizophrenia category to describe schizophrenic symptoms as "autistic, atypical, and withdrawn" (*DSM-II*; APA, 1968).

In 1977, Michael Rutter and Susan Folstein published the first autism twin study (Folstein & Rutter, 1977). The study consisted of 21 pairs of twins where at least one twin was diagnosed with autism. Of the 11 pairs of identical twins, four co-twins were also diagnosed with autism, and of the 10 fraternal twins, no co-twin was diagnosed with autism. Results of this study revealed evidence for a genetic basis for autism. Rutter was also influential in developing a definition of autism. In 1978, he redefined the signs and symptoms of autism by specifying four criteria, still considered one of the most influential definitions of autism (Matson & Minshawi, 2006; Rutter, 1978). The four primary criteria included: (1) impaired social relationships, (2) delayed language and pre-language skills, (3) insistence on sameness, and (4) onset before 30 months.

Infantile autism was first included as a diagnostic category in the *Diagnostic and Statistical Manual, Third Edition* (*DSM-III*) in 1980 (APA, 1980). Six characteristics were listed

as diagnostic criteria for infantile autism: (1) onset before 30 months of age, (2) lack of responsiveness to others, (3) deficits in language development, (4) peculiar pattern of speech, such as echolalia and metaphorical language, if speech is present, (5) unusual responses to the environment, including resistance to change, and (6) absence of schizophrenic characteristics (e.g., delusions, hallucinations, and incoherence). The *Diagnostic and Statistical Manual, Third Edition-Revised* (*DSM-III-R*; APA, 1987) included more concrete and detailed descriptions of behaviors. The term "infantile autism" was replaced with "autistic disorder." Three main domains were listed: impairment in social interaction, impairment in communication, and restricted repertoire of activities and interests. At least eight items out of 16 had to be present in a child in order for the child to be diagnosed with autistic disorder. Changes in the *DSM-III-R* and other concurrent factors resulted in a rapid increase in the number of individuals being diagnosed with autism (Factor, Freeman, & Kardash, 1989).

The autism criteria was further refined in the *Diagnostic and Statistical Manual, Fourth Edition* (*DSM-IV*; APA, 1994). A total of six or more items from three domains, with at least two items from the socialization domain and one each from the communication and restricted and repetitive behavior domain, were needed to be diagnosed with autism. Until recently, the *Diagnostic and Statistical Manual, Fourth Edition-Text Revised* (*DSM-IV-TR*; APA, 2000) was utilized to diagnose ASD with the same number of criteria needed as stated above for the *DSM-IV*. The *DSM-IV-TR* included five heterogeneous pervasive developmental disorders (PDDs): Autistic disorder; Pervasive developmental disorder, not otherwise specified (PDD-NOS); Asperger's disorder; Rett's disorder; and childhood disintegrative disorder.

Autistic Disorder. In order to meet criteria for autistic disorder, a total of six or more items from three domains had to be present, with onset of delays prior to three years of age. The

three domains included impairments in social interaction, impairments in communication, and presence of restricted, repetitive, and stereotyped behavior. More specifically, at least two items from the social domain and one item from each the communication and repetitive/restricted domain were required. The social interaction domain included the following items: (1) impairment in nonverbal behaviors such as eye-to-eye gaze, facial expression, and body postures; (2) inappropriate developmental level of peer relationships; (3) failure to share enjoyment, interests, or achievements with others; and (4) lack of social or emotional reciprocity. The following items were included in the communication domain: (1) delay or lack of verbal language, (2) inability to initiate or maintain conversations, (3) stereotyped and repetitive language, and (4) lack of make-believe play or imitative play. Items in the stereotypies domain included: (1) preoccupation with one or more stereotyped/restricted patterns of interest, (2) inflexible adherence to nonfunctional routines or rituals, (3) stereotyped and repetitive motor movement (e.g., hand flapping, body rocking), and (4) persistent preoccupation with parts of objects (APA, 2000).

Asperger's Disorder. Asperger's disorder was diagnosed when three items were endorsed, with at least two items from the social interaction domain and at least one item from the restricted, repetitive, and stereotyped behavior domain. Items from these domains were consistent with those for autistic disorder. Unlike autistic disorder, individuals with Asperger's disorder had no clinically significant delay in language.

Rett's Disorder. In order to meet criteria for Rett's disorder, all of the following items needed to be endorsed: (1) normal prenatal and perinatal development, (2) normal psychomotor development through the first five months after birth, and (3) normal head circumference at birth. In addition, onset of all of the following items after the period of normal development were

required: (1) deceleration of head growth between ages 5 and 48 months, (2) loss of previously acquired hand skills between ages 5 and 30 months, (3) loss of social interaction early in the course, (4) poorly coordinated gait or trunk movement, and (5) impaired language with severe psychomotor retardation (APA, 2000).

Childhood Disintegrative Disorder (CDD). According to the *DSM-IV-TR*, CDD was diagnosed when the child had a normal development for at least the first two years after birth and then demonstrated clinically significant loss of previously learned skills before the age of 10 in at least two of the following areas: (1) expressive or receptive language, (2) social/adaptive behavior, (3) bowel/bladder control, (4) play, and (5) motor skills. In addition, at least two abnormalities in social interaction, communication, and restricted and repetitive behaviors had to be present.

Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS). The diagnosis of PDD-NOS was given when an individual demonstrated pervasive impairment in socialization, communication, and stereotyped behavior but did not meet criteria for a specific PDD.

Current Diagnostic Criteria for ASD

Some limitations of the *DSM-IV-TR* included the lack of reliability and robustness of the autism subtypes. One of the most notable concerns was the validity of the PDD subcategories; separate diagnoses (e.g., high-functioning autistic disorder vs. Asperger's disorder) were inconsistently applied across different clinics and centers (Gibbs, Aldridge, Chandler, Witzlsperger, & Smith, 2012; Klin, Lang, Ciccehetti, & Volkmar, 2000; Lord et al., 2012; Szatmari, 1992; Worley & Matson, 2012). The validity of some diagnoses, such as CDD, was another weakness of the *DSM-IV-TR*; whether CDD should be considered a distinct category had

been debated (Hendry, 2000; Volkmar & Rutter, 1995). Vague criteria could lead to a high false positive rate and decrease specificity of the criteria (McPartland, Reichow, & Volkmar, 2012; Wing, Gould, & Gillberg, 2011).

In response to such criticism, the fifth edition of the *DSM* (*DSM-5*) published in May 2013 included significant modifications to the diagnostic criteria for ASD with the hope of making the autism diagnosis more specific, reliable, and valid. One major change was the merging of a set of PDD (e.g., autistic disorder, Asperger's disorder, and PDD-NOS) into one umbrella term, "Autism Spectrum Disorder." The *DSM-5* committee reasoned that this change would help clinicians be more precise in their diagnoses and prevent different clinicians from giving different diagnoses to the same person (APA, 2012). They also reasoned that autism should have a single name since it is characterized by a common set of behaviors (APA, 2012). Rett syndrome was removed as a separate disorder with the reasoning that ASD is defined by a set of behaviors, not by etiology (APA, 2012). Moreover, CDD was subsumed under a broader ASD category.

Another critical change was that the new criteria were divided into two domains, social communication/interaction and restricted and repetitive behaviors, instead of three domains in the *DSM-IV-TR*. To diagnose an individual with ASD, all of the following symptoms must be present in the social communication/interaction domain: (1) difficulties in reciprocating social or emotional interaction (e.g., maintaining conversations and interaction; initiating an interaction; sharing attention, emotions, or interests with others); (2) problems maintaining relationships (e.g., pretend play); and (3) nonverbal communication problems (e.g., eye contact, abnormal posture, facial expressions, tone of voice, and gestures). Two of the four symptoms in the restricted and repetitive behavior domain must be present: (1) stereotyped or repetitive speech or

motor movements; (2) excessive adherence to routines, ritualized behavior, or resistance to change; (3) abnormal restricted interest; and (4) abnormal reactivity to sensory input or atypical sensory interest (a new diagnostic symptom). In addition, the new criteria do not specify the age of onset in ASD that qualify for a diagnosis other than to state "early in developmental period." The *DSM-5* specifies the severity levels within the ASD based on the individual's perceived need for support: level 1 (requiring support), level 2 (requiring substantial support), and level 3 (requiring very substantial support) for each of the domains. In addition, specifiers, such as "with or without intellectual impairments," "with or without language impairments," "associated with a known medical or genetic condition or environmental factor," "associated with another neurodevelopmental, mental, or behavioral disorder," and "with catatonia" were included in the *DSM-5*.

Although the *DSM-5* may result in increased specificity, even before the changes were finalized, researchers were concerned about its reduced sensitivity. Researchers reported that 30-47% of individuals diagnosed based on the *DSM-IV-TR* criteria would lose their ASD diagnosis with the *DSM-5* changes (McPartland et al., 2012; Matson, Belva, Horovitz, Kozlowksi, & Bamburg, 2012; Turygin, Matson, Adams, & Belva, 2013; Worley & Matson, 2012). This situation was especially alarming to those individuals and their families who were previously diagnosed with Asperger's disorder or PDD-NOS because of the uncertainty regarding how schools and insurance companies would react to these changes. In response to these concerns, the *DSM-5* includes a statement that individuals with a well-established *DSM-IV-TR* diagnosis of autistic disorder, Asperger's disorder, or PDD-NOS can retain the ASD diagnosis, even if they do not meet criteria under the *DSM-5*. Therefore, individuals with a previous diagnosis do not have to worry about losing that diagnosis.

In addition, the *DSM-5* includes the new diagnosis of social communication disorder (SCD). SCD is not part of the autism spectrum disorder; this new diagnostic category is a communication disorder and applies to individuals who exhibit symptoms in social communication but do not have restricted, repetitive patterns of behavior. Some children who would have received PDD-NOS using the *DSM-IV* should be evaluated for SCD. However, concerns remain for more high-functioning individuals who do not have a previous diagnosis. They may no longer meet the new criteria for ASD despite having the same core deficits and, therefore, may have difficulties securing treatment authorizations from funding sources for services that are viewed as medically necessary to treat ASD but not updated to reflect their effectiveness in treating SCD. Continued monitoring of how the new *DSM-5* affects autism diagnosis is necessary; the committee has emphasized that the *DSM-5* criteria can change as new studies and evidence emerge.

Current Prevalence of ASD

The Centers for Disease Control and Prevention (CDC) recognizes that ASD is an urgent public health concern, as its prevalence rate has dramatically increased in the last several decades (Baron-Cohen et al., 2009; CDC, 2012; Chakrabarti & Fombonne, 2001). Prevalence studies before 1985 reported autism rates to be 4 to 5 per 10,000 children for the broader autism spectrum and about 2 per 10,000 for the classic autism definition. For instance, in 1966, Victor Lotter estimated that approximately 4.1 in 10,000 children were afflicted by autism (Lotter, 1966). Previous studies demonstrate an apparent increasing trend of autism. Wing estimated the rate of ASD at 20 per 10,000 in the early 1990s (Wing, 1993). In the early 2000s, researchers estimated that the combined rate of all PDDs occurred at 60 to 70 per 10,000 (Bertrand et al., 2001; Chakrabararti & Fombonne, 2001; Fombonne, 2003). In his review that examined

epidemiology of PDDs, Fombonne reported that autism afflicted one in 150 children (Fombonne, 2009), and a previous study by Autism and Developmental Disabilities Monitoring (ADDM) reported that autism affected one in 110 children. Government studies have reported that the prevalence rate of autism is increasing 10-17% annually (Cavagnaro, 2007).

The most recent prevalence study reported that autism now affects approximately 1 in 88 children in the United States (CDC, 2012). Currently, more children are diagnosed with ASD than with pediatric AIDS, juvenile diabetes, and childhood cancer combined (CDC, 2012). Autism affects individuals of all ethnic, racial, and socioeconomic backgrounds (Baird et al., 2000; Bertrand et al., 2001; Chien, Lin, Chou, & Pesus, 2011; Gillberg, Cederlund, Lamberg, & Zeijlon, 2006; Kim et al., 2011). No definite cause to account for this dramatic increase has been identified, but different explanations, such as broadening diagnostic criteria, greater public awareness, and overuse of ASD diagnoses to qualify for funding, have been proposed (Leonard et al., 2010; Matson & Kozlowski, 2010; Wing & Potter, 2002).

COMMONLY CO-OCCURING PSYCHOPATHOLOGY

Autism often co-occurs with medical disorders, including gastrointestinal disorders, tuberous sclerosis, epilepsy, fragile X syndrome, visual impairment, hearing impairment, and motor disorders (Bauman, 2010; Gillberg & Billstedt, 2000; Kielinen, Rantala, Timonen, Linna, & Molianen, 2004; Ming, Brimacombe, Chaaban, Zimmerman-Bier, & Wagner, 2007; Tsai, 1996). Epilepsy is reported to occur in about 20%-25% of the ASD population (Canitano, 2007; Tuchman & Rapin, 2002). Hearing impairments also occur more commonly in the ASD population than in the general population (Rosenhall, Nordin, Sandstrom, Ahlsen, & Gillberg, 1999). The frequency of tuberous sclerosis in ASD population is about 1 to 4% (Smalley, 1998; Wiznitzer, 2004). In addition to medical disorders, ID (previously known as mental retardation) and ASD are reported to co-occur frequently, although studies have published widely varying ranges of such co-occurrence. For example, LaMalfa and colleagues (2004) found that 70% of individuals with ASD have ID. Yeargin and colleagues (2003) reported that 64% of their sample children with autism had ID, and 68% had cognitive impairments. De Bildt and colleagues (2005) found a 16.7% prevalence rate of comorbidity. The discrepancy may be associated with inconsistent methodology used in these studies; a variety of instruments, diagnostic criteria, and sampled population are used in different studies (De Bildt, Sytema, Kraijer, & Minderaa, 2005; Matson & Shoemaker, 2009). Regardless of this discrepancy, researchers agree that ID is one of the most common co-occurring disorders with ASD and a strong predictor of poorer prognosis (Ben Itzchack, Lahat, Burgin, & Zachor, 2008; Harris & Handleman, 2000; Matson & Shoemaker, 2009; Wing & Gould, 1979).

Comorbid psychopathology in individuals with ASD is often difficult to diagnose for several reasons. One factor is the overlap in ASD and ID. It is challenging to study

psychopathology within the context of ASD with ID because many of the same factors apply to both conditions (Matson & Shoemaker, 2009). Communication impairment in individuals with ASD is another factor clouding the comorbidity assessment in ASD. Up to one-half of individuals with ASD are non-verbal (Leyfer et al., 2006), and those who have adequate language often lack skills, such as theory of mind, complex information processing, perspective taking, and executive functioning (Baron-Cohen, 1991a, 1991b; McEvoy, Rogers, Pennington, 1993; Ozonoff, Strayer, McMahon, & Filloux, 1994; Rehfeldt, Dillen, Ziomek, & Kowlchuck, 2007). Therefore, individuals with ASD often have difficulty communicating their mental states and experiences, which makes it even more challenging to determine if problems they are experiencing are due to a comorbid disorder or other factors (Leyfer et al., 2006). Diagnostic overshadowing is another challenge that makes evaluating comorbidity in ASD difficult (Ghaziuddin, Tsai, & Ghaziuddin, 1992; Matson & Nebel-Schwalm, 2007; Reiss, Levtan, & Szyszko, 1982; Simonoff et al., 2008). Diagnostic overshadowing refers to a phenomenon of not recognizing the second disorder due to a negative bias of the clinician to attribute the symptoms and behaviors to the first disorder (Neil, Moum, & Sturmey, 2014). In addition, heterogeneity in ASD symptoms makes identifying comorbid psychopathology in ASD particularly difficult (Matson & Nebel-Schwlam, 2007; Simonoff et al., 2008).

As previously mentioned, core features of ASD, which include deficits in socialization, communication impairments, and presence of restricted and repetitive behaviors, have been investigated extensively (Fodstad et al., 2009; Horovitz & Matson, 2010; Matson, Dempsey, & Fodstad, 2009; Matson et al., 2008; Matson, LeBlanc, & Weinheimer, 1999; Matson, Smiroldo, & Bamburg, 1998; Matson & Wilkins, 2008a, 2009; Smith & Matson, 2010a, 2010b, 2010c). However, it is only recently that comorbid psychopathology in ASD has started to receive

attention, and this topic has less frequently been addressed compared to other psychiatric disorders.

Existing research suggests that comorbid psychopathology in individuals may be higher than previously believed. For example, Leyfer and colleagues (2006) found that 72% of the children in their study of individuals with ASD had at least one psychiatric disorder. Specific phobia, obsessive-compulsive disorder (OCD), and attention-deficit/hyperactivity disorder (ADHD) were the most common comorbid disorders in their sample of children. Simonoff et al. (2008) also found a high prevalence rate of comorbid disorders; 70% of their study participants with ASD had at least one comorbid disorder and 41% had two or more. Their participants demonstrated a high prevalence of anxiety disorders, ADHD, and oppositional defiant disorder (ODD). For the purpose of this paper, those comorbid disorders that are most relevant to ASD will be discussed.

Attention-Deficit/Hyperactivity Disorder (ADHD)

The core features of ADHD are persistent inattention and/or hyperactivity-impulsivity that interfere with typical development and functioning (Barkley, 1997; Burns, Boe, Walsh, Sommers-Flannagan, & Teegarden, 2001; Cunningham & Siegal, 1987; DuPaul, Power, Anastopoulos, & Reid; 1998; Hinshaw, 2002; Luk, 1985; Turygin, Matson, & Tureck, 2013). According to the new *DSM-5*'s criteria for predominantly inattentive presentation, children up to age 16 must have six or more and adolescents/adults of age 17 and older must have five or more following symptoms: (1) often fails to pay attention to details or makes careless mistakes at school, work, or during other activities; (2) often has difficulty maintaining attention during lectures, conversations, or other tasks/activities; (3) often does not listen when spoken to; (4) often has difficulty following instructions and fails to complete tasks; (5) often has difficulty

organizing; (6) avoids to do tasks/work that require sustained mental effort; (7) loses materials; (8) easily distracted by other external factors; and (9) often forgets to do daily activities/errands. To meet criteria for predominantly hyperactive-impulsive presentation, children up to 16 years must have six or more symptoms, and adolescents/adults of age 17 and older must have at least five of the following symptoms: (1) often fidgets, squirms in seat, or taps hands or feet; (2) has difficulty seating and remaining seated; (3) often runs or climbs when those activities are inappropriate; (4) often has difficulty playing quietly; (5) often is "on the go," acting as if "driven by a motor"; (6) often talks too much; (7) often has difficulty waiting for his/her turn to speak and blurts out an answer before a question has been asked; (8) has difficulty waiting for his/her turn; and (9) often interrupts others' conversations and activities without permission. Symptoms must be present prior to age 12, and these symptoms must have persisted for at least 6 months across two or more settings. Also, it must be clear that these symptoms interfere with normal functioning. Based on the types of symptoms, one of three types of ADHD diagnoses may be warranted: *Predominantly Inattentive Presentation*, *Predominantly Hyperactivity-Impulsive Presentation*, or *Combined Presentation* (APA, 2013).

The previous diagnostic criteria (*DSM-IV-TR)* did not allow the dual diagnosis of ASD and ADHD. However, results from previous studies suggest that ASD and ADHD are distinct disorders and that comorbidity rates of these two disorders are high (Leyfer et al., 2006; Soorya & Halpern, 2009; Tureck, Matson, May, & Turygin, 2013; Yerys et al., 2009). Researchers have estimated 20-70% comorbidity rates of ASD and ADHD (Charnsil & Sriapai, 2011; Goldstein & Schwebach, 2004; Sinzig, Morsch, & Lehmkuhl, 2008; Sinzig, Walter, & Doepfner, 2009; Stahlberg, Soderstrom, Rastam, & Gillberg, 2004; Yoshida & Uchiyama, 2004). For example, Leyfer et al. (2006) reported that 55% of their sample children with autism had ADHD

symptoms. Thirty-one percent of them met criteria for ADHD, and 24% just fell short of meeting criteria. Goldstein and Schwebach (2004) found that 59% of their sample children who met diagnostic criteria for a PDD according to the *DSM-IV-TR* also met criteria for ADHD. Sinzig and colleagues (2008) estimated that 52% of their sample children with autism also met criteria for the comorbid diagnosis of ADHD. Additionally, Jensen, Larrieu, and Mack (1997) and Yoshida and Uchiyama (2004) reported ASD and ADHD co-occurrence was over 70%.

Researchers also examined how ADHD symptoms are expressed in ASD. For example, Sinzig et al. (2008) found that children with ADHD had more inattention difficulties than children with ASD. Also, some researchers show that children diagnosed with ASD are reported to have ADHD inattentive type. Leyfer et al. (2006) found that 65% of their sample children had the inattentive type. In the study by Ogino et al. (2005), among 16 children with autism, five met criteria for the inattentive type and the rest met criteria for the combined type. The hyperactive type is reportedly most common in typically developing children (Leyfer et al., 2006). Based on these studies, the *DSM-5* removed the restriction and now allows for the dual diagnosis of ASD and ADHD.

Recognizing comorbid ADHD among individuals with ASD and providing effective treatment are important because the co-occurrence of these disorders have been found to worsen challenging behaviors. Recently, researchers reported that children with comorbid ASD and ADHD exhibit higher rates of tantrum behaviors than children with ASD or ADHD alone (Goldin, Matson, Tureck, Cervantes, & Jang, 2013; Konst, Matson, Turygin, 2013; Tureck et al., 2013). In addition, children with comorbid ASD and ADHD evinced higher rates and more severe comorbid symptoms (Jang et al., 2013). As such, presence of these comorbid conditions make it more difficult for children to cope and adapt.

Anxiety Disorders

Although anxiety has been assumed to be a common aspect of autism, impairing anxiety is not a core symptom of autism (Attwood, 2000; Leyfer et al., 2006). Anxiety symptoms in the ASD population have been reported for a while. Indeed, Kanner (1943), in his initial description of autism, noted anxiety problems in children that he observed. Rates of comorbidity of anxiety and autism widely vary from 11% to 84% (Ando & Yoshimura, 1979; Bellini, 2004; de Bruin, Ferdinand, Meester, de Nijs, & Verheij, 2007; Evans, Canavera, Kleinpeter, Maccubbin, & Taga, 2005; Gadow, DeVincent, Pomeroy, & Azizian, 2005; Lecavalier, 2006; Leyfer et al., 2006; Muris, Steerneman, Merkelbach, Holdrinet, & Meesters, 1998; Rumsey, Raoport, & Sceery, 1985; Simonoff et al., 2008). De Bruin and colleagues (2007) reported that over 55% of their sample children with PDD-NOS met criteria for at least one anxiety disorder, and Siminoff and colleagues (2008) found that approximately 42% of individuals with ASD met criteria for an anxiety disorder. Some of the most common anxiety disorders seen in ASD are specific phobia, social phobia, generalized anxiety disorder, and separation anxiety (Bellini, 2004; de Bruin et al., 2007; Evans et al., 2005; Gadow et al., 2005; Muris et al., 1998; Simonoff et al., 2008; White, Oswald, Ollendick, & Scahill, 2009).

Social Anxiety Disorder. According to the *DSM-5*, criteria for social anxiety disorder include: (1) presence of fear or anxiety about one or more social situations, including social interactions, being observed, and performing in public; (2) fears of being negatively evaluated; (3) fear or anxiety almost always proved by social situations; (4) avoidance of social situations or endurance with extreme fear or anxiety; (5) fear or anxiety disproportionate to the actual threat posed by the social situation; (6) symptoms present for over 6 months; and (7) clinically significant distress in social functioning as a result of symptoms (APA, 2013).

Simonoff et al. (2008) reported that social anxiety disorder was the most commonly co-occurring psychiatric disorder in their sample of children with ASD. As a deficit in socialization is one of the defining features of ASD, controversy exists with respect to whether ASD and anxiety are separate problems. Some suggest that anxiety may compound the already existing social impairments in ASD, which may further isolate individuals with ASD from peers and social opportunities (Myles, Barnhill, Hagiwara, Griswold, & Simpson, 2001). However, extant research in this area is limited and primarily focused on individuals with higher functioning autism. Many higher functioning individuals with ASD are reportedly aware of their social impairments and wish they could be changed (Attwood, 2000). Bellini (2004) examined levels of anxiety in higher functioning adolescents with ASD and found that almost half of the sample reported clinically impairing social anxiety, and their anxiety levels were significantly higher than the normative samples. Kuusikko and colleagues (2008) had similar findings that children and adolescents with higher functioning ASD reported more social anxiety symptoms compared to a normative sample. Rieske and colleagues also found that higher functioning individuals with ASD reported greater rates of anxiety compared to their typically developing peers (Rieske, Matson, May, & Kozlowski, 2012).

Specific Phobia. Currently, specific phobia is diagnosed when the following criteria are met: (1) presence of marked fear or anxiety about a specific object or situation, (2) immediate fear or anxiety upon the presence of the phobic object/situation, (3) an active avoidance of the phobic object/situation, (4) excessive and unreasonable fear or anxiety compared to the actual danger posed by the specific object/situation, (5) symptoms persistent for at least 6 months, and (6) impairment in daily life functioning due to symptoms (APA, 2013).

In his original report on autism, Kanner reported that one child was "tremendously frightened by running water, gas burners, and many other things" (p. 231). Two other children were reported to have fears of mechanical noise; one of them was so frightened of the vacuum cleaner that she would avoid going near the closet where the vacuum cleaner was kept, and she left the house when it was used (Kanner, 1943).

Matson and Love (1990) conducted the first systematic group study of phobias in children with autism. They examined the intensity of phobias of children with autism and compared to those of typically developing peers. Results of this study showed that children with autism had more intense fears of thunderstorms, dark places, dentists, large crowds, and closed places than typically developing children. On the other hand, typically developing children were more afraid of small animals, getting injured, and receiving criticism (Matson & Love, 1990). Evans and colleagues (2005) replicated this study and found similar results in that children with autism evinced different and uncommon phobias compared to typically developing children. The children with autism were reported to have fewer fears of harm compared to those without autism (Evans et al., 2005). Leyfer et al. (2006) also reported that children with autism had a phobia of loud noises, which was not common in typically developing children.

Oppositional Defiant Disorder (ODD)

In the *DSM-5*, ODD is characterized by a pattern of angry/irritable mood, argumentative/defiant behavior, or vindictiveness. Three symptoms of the Angry/Irritable Mood category are: (1) easily loses temper, (2) easily annoyed, and (3) often angry and resentful. Four symptoms of the Argumentative/Defiant Behavior category are: (1) often argues with adults, (2) is often noncompliant with requests/rules, (3) deliberately annoys others, and (4) blames others

for own mistakes. In order to be diagnosed with ODD, at least four symptoms of aforementioned hostile and defiant behavior must be present for at least six months (APA, 2013).

In Kanner's early report, one child was reported to demonstrate defiant and hostile behavior. He was reportedly so destructive that his mother reported "the furniture in his room looks like it has hunks out of it" (p. 213). His mother also reported that after the child broke a crayon into two parts and said, "*You* had a beautiful purple crayon and now it's two pieces. Look at what *you* did" (p. 213).

Rates of comorbidity of ASD and ODD are high as many children with ASD exhibit symptoms of ODD. Leyfer et al. (2006) reported that 7% of their sample of children with ASD had comorbid ODD. Other studies found higher rates of ODD. For example, Gadow, DeVincent, and Drabick (2008) found that 27% of their sample children with ASD (6-12 years old) also met criteria for ODD according to their parents. Simonoff et al. (2008) also found that 28% of their sample children with ASD had ODD, making it one of the most common comorbid disorders.

Gadow et al. (2008) examined the clinical features of ODD in children with ASD. In the study, the ASD sample was divided into four different groups: ODD, ADHD, ODD+ADHD, and neither ADHD nor ODD. The authors were able to differentiate all three ODD/ADHD groups clearly from the group with no ADHD or ODD diagnosis. The group with both ODD and ADHD diagnoses exhibited the most severe symptoms, and differences were found between the ASD+ODD and ASD+ADHD groups. Findings of this study added support to existing research that ODD is a distinguishable disorder in children with ASD (Gadow, Devincent, & Drabick, 2008).

Obsessive Compulsive Disorder (OCD)

The new *DSM-5* criteria no longer includes OCD an anxiety disorder. In fact, obsessive-compulsive and related disorders now have their own section in the *DSM*. OCD is characterized by the presence of obsessions, compulsions, or both. According to *DSM-5* criteria, obsessions are defined by (1) recurrent and persistent thoughts, urges, or images that cause anxiety or distress and (2) trying to suppress or neutralize such persistent thoughts, urges, or images with some other thought or action. Compulsions are defined by (1) performing repetitive behaviors or mental acts (e.g., hand washing, ordering, checking, praying, counting) in response to an obsession and (2) performing behaviors or mental acts in order to prevent or to reduce anxiety not in a realistic way. The obsessions or compulsions are clinically impairing in daily life functioning and are time-consuming (APA, 2013).

One of the main characteristics of ASD is presence of repetitive, restrictive, and stereotyped behavior, which meets the criteria of OCD from a definitional standpoint. In his early report, Kanner reported obsessive and compulsive symptoms that resemble our current notion of OCD in the children that he observed (Kanner, 1943). One child was reported to ask questions of an obsessive nature and "was inexhaustible in bringing up variations" (p.222). Another child "repeat(s) over and over one word or statement. He almost never says a sentence without repeating it" (p. 233). Furthermore, one child was reported to "push aside the first spoonful of every dish" (p. 238). Therefore, debates exist regarding whether ASD and OCD can be differentiated (Matson & Nebel-Schwalm, 2007). Although repetitive behaviors are common factors of both ASD and OCD, assessing the underlying driving forces in these two disorders may be difficult.

McDougle and colleagues (1995) compared the types of repetitive thoughts and behaviors demonstrated by individuals with ASD and individuals with OCD. The authors found a significant difference in the types of repetitive thoughts and behaviors demonstrated between the two groups. The ASD group was significantly less likely to experience repetitive thoughts with aggressive, contamination, sexual, religious, symmetry, and somatic content. Also, the ASD group was more likely to demonstrate repetitive ordering, hoarding, telling, asking, tapping, and rubbing behavior and less likely to exhibit other behaviors, such as cleaning, checking, and counting.

Existing research shows that the comorbid rate of OCD and ASD varies from 1.5% to 81% (Ghaziuddin et al., 1992; Leyfer et al., 2006; Muris et al., 1998; Rumsey et al., 1985). For example, Leyfer et al. (2006) found that 37% of their sample children with autism also met criteria for OCD. Green et al. (2000) reported that adolescents with Asperger's showed greater OCD symptoms than individuals with conduct disorder.

Major Depressive Disorder

Currently, five or more of the following symptoms must be present to meet criteria for major depressive disorder: (1) depressed mood (e.g., feels sad, empty, hopeless) most of the day; (2) loss of interest or pleasure in almost all activities most of the day; (3) significant weight gain or loss or decrease/increase appetite almost every day; (4) insomnia or hypersomnia; (5) psychomotor agitation observable by others; (6) fatigue or loss of energy; (7) feelings of worthlessness or guilt; (8) decreased ability to think and concentrate; (9) recurrent thoughts of death and suicidal ideation, or a suicide attempt or a specific plan for committing suicide (APA, 2013).

There have not been large population studies examining the prevalence rate of depression in individuals with ASD. Only a few studies looked at the prevalence of depression in individuals with ASD; however, these studies are variable in their sample size, diagnostic criteria, age, and study period. Also, the prevalence rate of depression in ASD was found to vary widely in these studies. Ghaziuddin, Tsai, and Ghaziuddin (1992) reported that approximately 4% of their sample had depression. Leyfer et al. (2006) found that nearly a quarter of their sample children met criteria for impairing major depression. Tantam (1991) also found that 11% of their participants with ASD had depression as the most common comorbid diagnosis. Ghaziduddin and colleagues found that comorbidity rates of depression and ASD in children with Asperger's syndrome are as high as 30% (Ghaziuddin, Weidmer-Mikahil, & Ghaziduddin, 1998; Wing, 1981).

Despite methodological differences among these studies, high rates of depression in children with autism were noted. Diagnosing depression in individuals with ASD is often difficult because the diagnosis of depression requires verbal and communication skills, which may explain higher prevalence rates in higher functioning groups (Ghaziuddin, Ghaziuddin, & Greden, 2002). In addition, social withdrawal, which is a main symptom of depression, may be overlooked because it is considered "normal" in individuals with ASD. Because it is not easy to assess subjective feelings (i.e., feelings of worthlessness, guilt, thoughts of suicide) in the ASD population, especially in lower functioning groups, researchers suggest looking for vegetative signs of depression, such as sleep disturbance, decreased appetite, changes in weight, and presence of irritability and aggression in lower functioning groups (Ghaziuddin et al., 2002; Stewart, Barnard, Pearson, Hasan, & O'Brien, 2006), symptoms that are often also assessed in typical children with the disorder.

Bipolar Disorder

Bipolar disorders involve manic/hypomanic episodes, which may be preceded and followed by hypomanic or major depressive episodes. Current criteria for a manic episode are: (1) presence of abnormally elevated or irritable mood and abnormally increased energy for at least 1 week; (2) three or more unusual symptoms (e.g., inflated self-esteem, decreased need for sleep, talkative, flight of ideas, distractibility, increased goal-directed activity, excessive involvement); (3) impaired social functioning due to mood disturbances; and (4) episodes not due to other substances. Some of the symptoms of a major depressive episode include depressed mood most of the day, diminished interest or pleasure in daily activities, weight loss or gain, insomnia or hypersomnia, and fatigue or loss of energy (APA, 2013).

To date, little is known about the prevalence of comorbid bipolar disorder and ASD. Only a handful of bipolar cases have been reported. Gillberg (1985) presented a single case of bipolar in a 14-year-old boy with Asperger's disorder. Realmuto and August (1991) described bipolar symptoms in three patients with autistic disorder. Researchers found varied rates of bipolar disorder in autism (Ghaziuddin et al., 1992; Wozniak et al., 1997; Leyfer et al., 2006). Diagnosing bipolar disorder in autism is particularly difficult since many children with autism laugh at inappropriate times and context. Moreover, emotions in children with autism are reactive and easily fluctuate contingent on their environment (Leyfer et al., 2006).

Eating and Feeding Disorders

Children with ASD are often reported to exhibit unusual eating patterns (Ahearne, Castine, Nault, & Green, 2001). Abnormal eating habits were described in Kanner's early description of autism. One child reportedly had eating problems from infancy. Formulas had to be frequently changed, and he had never shown a normal appetite. According to his parent,

"seeing children eating candy and ice cream had never been a temptation to him" (p. 217). Another child's father reported that feeding was his child's main problem and required frequent hospitalizations. The father reported, "There is a long story of trying to get food down. We have tried everything under the sun" (p. 237). Although no other physical disorder was ever found, the child reportedly did not feed well since day one. Problems with eating, such as food selectivity, food refusal, pica, hoarding, and overeating, are common in children with ASD (Gillberg & Billstedt, 2000). Research on eating/feeding disorders in the ASD population is limited to small clinical sample studies.

Avoidant/restrictive Food Intake Disorder. Symptoms of avoidant/restrictive food intake disorder include disturbance in eating or feeding, which may lead to significant weight loss, significant nutritional deficiency, dependence on enteral feeding, or interference with psychosocial functioning.

Existing research shows that children with ASD demonstrate abnormal eating habits, such as food and/or texture selectivity and refusal of liquids (Ahearne et al., 2001; Burd, Shantz, Swearingen, Ahearn, & Kerwin, 1995; Farrell, Amari, & Hagopian, 1996). Schreck, Williams, and Smith (2004) compared caregiver reports of eating behaviors in children with and without autism and found that children with autism eat a significantly narrower range of foods compared to their typically developing peers. Emond, Emmet, Steer, and Golding (2010) found that children with ASD showed signs of feeding symptoms in infancy; they were more usually described as "slow feeders" and had late acceptance of food compared to the control group. Moreover, children with ASD had a very selective preference of food starting at 15 months of age; children with ASD were reported to consume fewer vegetables, fruits, and salads compared to their typically developing peers.

Pica and Rumination Disorder. Pica is characterized by persistent eating of nonnutritive substances (e.g., paper, soap, dirt, hair, clothing) that is inappropriate for an individual's developmental level. The eating behavior is not part of a culturally supported or socially normative practice. Although effects of pica in children are less severe than in adults, approximately 24% of children with pica are reported to have lead poisoning (Matson, Belva, Hattier, & Matson, 2011). Furthermore, pica may lead to serious consequences, such as complicated medical conditions or even death (Decker, 1993; Kamal, Thompson, & Paquette, 1999; McLoughlin, 1988).

Pica is seen as a distinct disorder that is maintained by operant/environmental factors (Matson, Belva, et al., 2011) and is reported to occur most frequently in persons with ASD and/or ID (Beecroft, Bach, Tunstall, & Howard, 1988). Emond and colleagues (2010) used a population-based cohort to examine feeding patterns of children with ASD and found that children with ASDs had higher rates of pica than the control group. More recently, Jang, Dixon, Tarbox, and Granpeesheh (2011) found that 28.6% of their sample children with ASD mouthed or swallowed objects causing bodily harm. Another feeding disorder common in those with ID and, to a lesser extent, ASD, is rumination disorder, which is diagnosed when the individual repeatedly regurgitates food for at least one month and when the regurgitation is not due to an associated gastrointestinal or other medical condition.

PURPOSE

In addition to core deficits, comorbid disorders are common among individuals with ASD (de Bruin et al., 2007). They reportedly experience significantly more emotional and behavioral impairments compared to atypically developing peers without ASD (Brereton, Tonge, & Einfield, 2000; Smith & Matson, 2010a, b, c). Although a debate exists regarding whether previously mentioned comorbid disorders actually warrant a separate diagnosis or they are just part of the core symptoms of ASD, available literature suggests that comorbid disorders and ASD are, in fact, co-occurring, and the prevalence of co-occurrence is higher than previously believed. As previously mentioned, diagnostic overshadowing is a significant factor that complicates distinguishability of ASD symptoms and symptoms of comorbid disorder; autism is often blamed for additional emotional and behavioral problems that are actually due to the presence of another psychiatric disorder. For example, it is not uncommon to say that a child does not pay attention because he has autism when, in fact, the child actually may meet criteria for ADHD. Oftentimes, these symptoms are difficult to differentiate from ASD because they resemble core autism symptoms, and some symptoms are better explained by autism itself. It is important to assess comorbid symptoms in ASD effectively, and more varied treatments are needed to address both core symptoms of ASD and additional emotional and behavior difficulties. Researchers have found that behavioral interventions and cognitive behavior therapy may be effective in treating anxiety symptoms in children with autism (Dawson & Burner, 2011; Weiss & Lunsky, 2010). More research on systematic assessment of other psychiatric disorders is needed in order to better diagnose and treat ASD.

Autism severity is an important factor determining treatment outcome, as it is highly associated with cognitive abilities (Ben Itzchak & Zachor, 2007; Ben Itzchak et al., 2008; Zachor

& Ben Itzchak, 2010), challenging behaviors (Jang et al., 2011; Matson & Rivet; 2008), and social skills (Zachor & Ben Itzchak, 2010). Individuals with severe autism symptoms engage in more frequent and severe challenging behaviors (Jang et al., 2011; Matson & Rivet; 2008; Matson, Wilkins, & Macken, 2008). Moreover, less severe autism symptoms are associated with better cognitive and social skills. This issue is important to address because all these factors are related to better treatment outcomes, effective education, and improved social relationships (Anderson, Laken, Bradley, & Chen, 1992; Carr, Taylor, & Robinson, 1992; Horner, Diemer, & Brazeau, 1992; Matson & Wilkins, 2007; Myrbakk & Tezchner 2008).

Limited research exists on the relationship between comorbid symptoms and ASD. Recently, researchers have started examining autism severity and some comorbid symptoms. Tureck and colleagues (in press) found that autism severity is significantly correlated with ADHD symptoms, such as inattention and impulsivity (Tureck, Matson, Cervantes, & Turygin, in press). More recently, Tureck, Matson, Cervantes, and Konst (2014) examined the relationship between ASD, ID, and comorbid symptoms in children. The authors found that having an autism diagnosis significantly predicted rates of tantrum behaviors, avoidant behaviors, and repetitive behaviors. Several studies examined the relationship between comorbid symptoms and ASD; however they approached ASD as a categorical variable (Konst & Matson, 2014). Because ASD is a spectrum disorder, and especially with the new *DSM* specifying the severity levels of ASD, the current study assessed the relationship between autism severity and a wide range of commonly co-occurring symptoms. To our knowledge, no previous studies have assessed this relationship. Therefore, the current study will add to this area of research by examining whether autism severity and comorbid symptoms are associated. First, the prevalence of comorbid psychopathology symptoms in autism was assessed in the current

study. It was hypothesized that autism severity would be related to comorbid symptoms generally, indicating that the more severe the ASD symptoms, the more comorbid symptoms overall. More specifically, the current study examined the relationship between autism severity and the comorbid subtypes. Based on existing research on comorbid symptoms and ASD (e.g., Tureck et al., 2014), it was hypothesized that autism severity would significantly predict repetitive behaviors, tantrum behaviors, and avoidant symptoms.

METHOD

Participants

Participants in the current study included 207 children and adolescents between the ages of 2 and 16 years (*M*=7.94, *SD*=3.48). The children and adolescents were recruited from a variety of different settings, including schools, clinics, and community organizations across the United States. Many of the participants in the study were clients at the Psychological Services Center (PSC) at Louisiana State University. Participants at the PSC were referred for further assessment for developmental delays, learning disorders, attentional difficulties, anxiety issues, and other social or emotional concerns. Participants were part of a larger dataset. Data have been collected for multiple years and continue to be collected. All participants included in the sample received a diagnosis of ASD. Diagnostic decisions were made by a licensed clinical psychologist with over 30 years of experience using a comprehensive assessment battery, including structured interviews, behavioral observation (e.g., *Childhood Autism Rating Scale*; Schopler, Reichler, DeVellis, & Daly, 1980), rating scales (e.g., *Autism Spectrum Disorders-Diagnostic Child Version*; Matson & Gonzalez, 2007), and developmental/medical history.

Table 1: Demographic characteristics

Demographic characteristics (N=207)	
Age (in years), Mean (SD)	7.94 (3.48)
Male, no. (%)	173 (83.6%)
Female, no. (%)	31 (16.4%)
Race/ethnicity, no. (%)	
African American	19 (9.2%)
Caucasian	143 (69.1%)
Hispanic	7 (3.4%)
Others	7 (3.4%)
Didn't report	31 (15%)

Of the 207 participants, 173 were males and 34 were females. Of the total participants, 9.2% were African Americans, 69.1 % were Caucasians, 3.4% were Hispanic, 3.4% were reported as "other," and 15% did not report ethnicity.

Measures

Autism Spectrum Disorder- Diagnostic Child Version (ASD-DC; Matson, Gonzales, Wilkins, & Rivet, 2008*)*. Autism symptom severity was measured by the *ASD-DC*. The *ASD-DC* is an informant-based rating scale that was designed by Matson and colleagues to assess symptoms of autism, PDD-NOS, and Asperger's disorder in children. Parents or caregivers are asked to rate 40 items by comparing the child to typical children his/her age using a 3-point Likert scale: 0= not different, no impairment; 1= somewhat different, mild impairment; 2= very different, severe impairment. Items were created through a review of ASD literature, *DSM-IV-TR* and *ICD-10*, and clinical observations. Items were designed to be easily understood by persons unfamiliar with mental health terminology, and they have been found to have good reliability and validity. The internal consistency was .99 which is considered excellent based on current guidelines (Ciccihetti, 1994), and the inter-rater reliability and test-retest reliability were.67 and .77, respectively (Matson, Gonzales, Wilkins, et al., 2008), which are considered good (Cicchetti & Sparrrow, 1981). The *ASD-DC* was found to have good sensitivity (84.3%) and specificity (98.2%) to correctly identify ASD, and the overall rate of correct classification was good at 91.3% (Matson, Gonzales, et al., 2009).

Autism Spectrum Disorders-Comorbidity Child Version (ASD-CC; Matson & Gonzalez, 2007*)*. The *ASD-CC* is an informant rating scale that was designed to assess commonly co-occurring disorders and symptoms, such as depression, conduct disorder, ADHD, tic disorder, OCD, phobias, and eating disorders in children ages 2 to 18 years. Parents or other caregivers

rate 39 items on a 3-point Likert scale where 0 = not a problem or impairment, 1 = mild problem or impairment, and 2 = severe problem or impairment. The *ASD-CC* items are loaded onto seven factors: worry/depressed, avoidant behavior, tantrum behaviors, repetitive behavior, under-eating, over-eating, and conduct problems (Matson, LoVullo, Rivet, & Boisjoli, 2009). Reliability analyses of the *ASD-CC* show that the measure has high internal consistency (α = .91) and moderate test-retest reliability and inter-rater reliability (κ = .51, κ = .46, respectively; Matson & Wilkins, 2008b). Also, convergent validity has been established between the *ASD-CC* factors and the subscales of the *Behavior Assessment System for Children, Second Edition* (Matson, LoVullo, et al., 2009).

Procedure

Parent/caregivers of the participants were administered a battery of rating scales, including the *ASD-DC* and the *ASD-CC*. All informants provided informed consent for themselves and their child to participate. Doctoral-level graduate clinicians working under the supervision of a licensed clinical psychologist administered measures and answered questions. All measures were scored by the same graduate clinicians who administered the scale and then were recorded into a database. The study was granted approval by the Louisiana State University Institutional Review Board.

Statistical Procedures

First, endorsement of all comorbid symptoms assessed by the *ASD-CC* items was computed. Items that were rated as 1 (mild problem or impairment) or 2 (severe problem or impairment) were included to compute the total endorsement, and only the items that were rated as 2 were used to compute severe endorsement percentage.

An a priori power analysis program, G*Power, was used to determine the expected number of participants for this study (Erdfelder, Faul & Buchner, 1996). For a simple regression with a medium effect of size of .30, the power at .80, and the significance level at $\alpha = .05$, a total sample size of 64 would be needed (Hinkle, Wiersma & Jurs, 2003).

To examine the relationship between ASD severity and comorbid symptoms, a simple regression was conducted using the *ASD-DC* total score as the predictor and *ASD-CC* total score as the dependent variable (DV). Then, a series of regression analyses was conducted with ASD severity as the predictor and *ASD-CC* subscores (e.g., tantrum behavior total score, repetitive behavior total score, worry/depressed total score, avoidant behavior total score, under-eating total score, conduct total score, over-eating total score) as DVs. A more conservative alpha level of .01 was used to decrease the probability of making a Type 1 error. All assumptions underlying the simple linear regression analysis were tested for all eight regression analyses. First, to assess that the relationship between the DV and IV is linear, a scatterplot was generated and inspected. The Durbin-Watson test statistic was computed to see if the assumption of independent errors was violated. Field (2009) stated the test statistic can vary between 0 and 4; a value of 2 indicates that the residuals are uncorrelated. Values less than 1 or greater than 3 are problematic (Field, 2009). To test for heteroscedasticity, a scatterplot of *ZRESID and *ZPRED was generated and inspected. In addition, the histogram and the Normal P-P Plot were produced to see whether the residuals were normally distributed.

RESULTS

First, descriptive statistics of comorbid symptoms were calculated. The total *ASD-CC* scores ranged from 0 to 55 (*M*=22.82, *SD*=11.90). See Table 2 for mean and standard deviations for each comorbidity subscale.

Table 2: Mean and standard deviations of comorbidity subscales

ASD-CC subscale	*M* (*SD*)
Tantrum	7.60 (4.46)
Repetitive behaviors	4.87 (3.41)
Avoidant	4.30 (3.72)
Worry/Depressed	2.35 (2.25)
Conduct	1.72 (1.83)
Over-eating	1.15 (1.57)
Under-eating	.82 (1.37)

Endorsement percentage on *ASD-CC* items was computed (see Table 3). Among the most commonly endorsed comorbid symptoms were easily becomes upset (87.9%), finishes assigned tasks (72.9%), fidgets or squirms (72.5%), compliance with demands (70.5%), tantrums (68.6%), will eat only certain foods (68.1%), withdraws or removes him/herself from social situations (68.1%), and easily becomes angry (68.1%). Items that were reported as severe impairments (ratings of 2) included easily becomes upset (33.8%), will eat only certain foods (32.4%), easily becomes angry (26.1%), fidgets or squirms (25.1%), and tantrums (25.1%).

Table 3: *Percentage endorsement for ASD-CC items*

Item	% endorsed	% endorsed as severe
Easily becomes upset	87.9%	33.8%
Finishes assigned tasks (e.g., schoolwork, chores, or duties)	72.9%	20.8%
Fidgets or squirms	72.5%	25.1%
Compliance with demands	70.5%	17.4%
Tantrums	68.6%	25.1%
Will eat only certain foods	68.1%	32.4%
Withdraws or removes him/herself from social situations	68.1%	20.8%
Easily becomes angry	68.1%	26.1%

Table 3 continued: *Percentage endorsement for ASD-CC*

Avoids specific situations, people, or events	59.4%	14.0%
Engages in repetitive behaviors (e.g., ordering objects, handwringing, handwashing, etc.) for no apparent reason or to reduce stress	58.5%	19.8%
Engages in behaviors that impair daily routines or activities	57.5%	13.0%
Crying	55.6%	11.1%
Irritable mood	52.7%	8.7%
Has trouble sleeping	52.2%	15.9%
Blurts out comments or words at inappropriate times	50.7%	15.0%
Persistent or recurring impulses that interfere with activities (e.g., impulse to shout)	47.8%	13.0%
Sudden, rapid, repetitive movement or vocalization that occurs for no apparent reason	46.9%	12.6%
Experiences excessive worry or concern	45.9%	11.1%
Avoids specific objects, persons, or situations causing interference with his/her normal routine	44.9%	6.8%
Loses belongings	44.4%	14.5%
Has persistent or recurring thoughts that cause distress	44.0%	13.0%
Tearful or weepy	41.1%	6.3%
Destroys others' property	40.1%	8.2%
Blames others for his/her misdeeds	40.1%	10.6%
Fear of being around others in school, at home, or in social situations	38.7%	8.7%
Damages property	37.7%	7.2%
Eats too quickly	37.2%	14.0%
Sudden, rapid, repetitive movements or vocalizations that are not associated with a physical disability	34.8%	12.1%
Checking on play objects excessively	33.3%	8.7%
Eats too much	29.0%	8.7%
Eats too little	28.5%	8.7%
Low energy or fatigue	27.1%	4.3%
Has a poor appetite	26.6%	9.2%
Spiteful, vindictive, revengeful, or wanting to get back at others	26.6%	3.9%
Feelings of worthlessness or excessive guilt	25.1%	5.8%
Eats things that are not meant to be eaten	24.6%	7.2%
Lies to obtain goods or favors	20.8%	3.9%
Weight gain	19.8%	5.3%
Weight loss	6.8%	2.4%

To evaluate the relationship between ASD severity and comorbid items, a simple regression was conducted using the *ASD-DC* total score as the predictor and *ASD-CC* total score as the DV. All graphs and scatterplots testing for assumptions can be found in Appendix A. First, a scatterplot assessing the linearity between the DV and IV was generated and inspected. From visual inspection of the scatterplot, there was a linear relationship between the total autism severity score and the total comorbidity score. The Durbin-Watson test computed a coefficient of 2.02, which indicates that there was independence of errors (Field, 2009). To test for heteroscedasticity, a scatterplot was generated. From visual inspection of the scatterplot, the data appeared to be evenly dispersed around zero in a plot of *ZRESID and *ZPRED. In addition, the histogram and the Normal P-P Plot were produced to see whether the residuals were normally distributed. The assumption of normality was not violated. After all the assumptions were met, a simple linear regression established that the total *ASD-DC* scores could significantly predict total *ASD-CC* score, $F(1, 205)=40.83$, $p<.0005$, and autism severity accounted for 17% of the explained variability in *ASD-CC* total scores. The regression was: predicted comorbid symptoms scores = 8.624+ .3 x (autism severity score measured by *ASD-DC*).

Further, to examine the relationship between autism severity and comorbid subscales, a series of simple regressions was conducted with *ASD-DC* total score as the predictor and *ASD-CC* subscales as DVs. Seven subscales included tantrum behaviors, repetitive behavior, worry/depressed, avoidant behavior, under-eating, conduct problems, and over-eating (Matson, LoVullo, Rivet, & Boisjoli, 2009).

Tantrum Behaviors Subscale

First, a simple regression was conducted using the *ASD-DC* total score as the predictor and the tantrum behaviors subscale as the DV. A scatterplot assessing the linearity assumption

revealed that there was a linear relationship between the total ASD severity and the tantrum behaviors. The Durbin-Watson computed a coefficient of 2.11, which indicated that there was independence of errors. To test for heteroscedasticity, a scatterplot was generated. From visual inspection of scatterplot, the assumption of heteroscedasticity was not violated. The histogram and the Normal P-P Plot indicated that the residuals were normally distributed. All graphs and scatterplots testing for assumptions can be found in Appendix B. The alpha level was set at .01 to decrease the probability of making a Type 1 error. A linear regression established that autism severity could significantly predict tantrum behaviors, F (1, 205)=19.38, p<.0005, and autism severity accounted for 8.2% of the explained variability in tantrum behaviors. The regression equation was: predicted tantrum behaviors = 3.77+ .08 x (autism severity score).

Repetitive Behavior Subscale

A simple regression was conducted using the *ASD-DC* total score as the predictor and the repetitive subscale as the DV. A scatterplot assessing the linearity assumption revealed that there was a linear relationship between the total ASD severity and the repetitive behaviors. The Durbin-Watson computed a coefficient of 1.8 indicating independence of errors. To test for heteroscedasticity, a scatterplot was generated. Initial visual inspection of the data yielded concerns regarding heteroscedasticity. To address this concern, a heteroscedasticity-consistent standard error estimator for ordinary least squares regression was implemented using SPSS syntax described by Hayes and Cai (2007). The histogram and the Normal P-P Plot indicated that the residuals were normally distributed. All graphs and scatterplots testing for assumptions can be found in Appendix C. The alpha level was set at .01 to decrease the probability of making a Type 1 error. A linear regression established that autism severity could significantly predict repetitive behaviors, F(1, 205)=41.58, p<.0005, and the total repetitive behavior score

accounted for 20% of the explained variability in ASD total scores. The regression equation was: predicted repetitive behaviors = .39+.09 x (autism severity score).

Worry/Depressed Subscale

A simple regression was conducted using the *ASD-DC* total score as the predictor and the worry/depressed subscale as the DV. There was a linear relationship between the DV and the IV. The Durbin-Watson computed a coefficient of 1.72, which revealed that there was independence of errors. To test for heteroscedasticity, a scatterplot was generated. From visual inspection of scatterplot, the assumption of heteroscedasticity was not violated. All graphs and scatterplots testing for assumptions can be found in Appendix D. The histogram indicated that the residuals were not normally distributed; to convert a moderately positively skewed data to normality, a "square root" transformation was applied. The alpha level was set at .01 to decrease the probability of making a Type 1 error. A linear regression between the worry/depressed subscale and the total *ASD-DC* score was not statistically significant, F (1, 205)=2.28, p >.01.

Avoidant Behavior Subscale

A simple regression was conducted using the *ASD-DC* total score as the predictor and the avoidant behavior subscale as the DV. A scatterplot assessing the linearity assumption revealed that there was a linear relationship between the total ASD severity and the avoidant behaviors. The Durbin-Watson computed a coefficient of 1.98, which indicates that there is independence of errors. Visual inspection of scatterplot indicated that the assumption heteroscedasticity was violated. Again, a heteroscedasticity-consistent standard error estimator was applied to address this concern (Hayes & Cai, 2007). The histogram and the Normal P-P Plot indicated that the residuals were normally distributed. All graphs and scatterplots testing for assumptions can be found in Appendix E. The alpha level was set at .01 to decrease the probability of making a

Type 1 error. A linear regression established that autism severity could statistically significantly predict avoidant behavior, $F(1, 205)=65.09$, $p<.0005$, and the total avoidant behavior score accounted for 24% of the explained variability in ASD total scores. The regression equation was: predicted avoidant behaviors = .43+.08 x (autism severity score).

Under-Eating Subscale

A simple regression was conducted using the *ASD-DC* total score as the predictor and the under-eating subscale as the DV. The assumptions of linearity and independence of errors were met. The Durbin-Watson computed a coefficient of 2.09. The assumption of heteroscedasticity was violated. To address this concern, a heteroscedasticity-consistent standard error estimator was applied. All graphs and scatterplots testing for assumptions can be found in the Appendix F. The alpha level was set at .01 to decrease the probability of making a Type 1 error. A linear regression between the under-eating subscale and the total *ASD-DC* score was not statistically significant, $F(1, 205)=2.65$, $p>.01$.

Conduct Subscale

A simple regression was conducted using the *ASD-DC* total score as the predictor and the conduct subscale as the DV. A scatterplot revealed that the assumption of linearity was met. The Durbin-Watson computed a coefficient of 1.81, which indicated that there was independence of errors. From visual inspection of scatterplot, the assumption of heteroscedasticity was not violated. All graphs and scatterplots testing for assumptions can be found in Appendix G. The alpha level was set at .01 to decrease the probability of making a Type 1 error. A linear regression between the conduct subtype and the total *ASD-DC* score was not statistically significant, $F(1, 205)=.02$, $p>.01$.

Overeating Subscale

A simple regression was conducted using the *ASD-DC* total score as the predictor and the overeating subscale as the DV. Both the linearity and independence of errors assumptions were not violated. The Durbin-Watson computed a coefficient of 1.7. From visual inspection of scatterplot, the assumption of heteroscedasticity was not violated. All graphs and scatterplots testing for assumptions can be found in Appendix H. The alpha level was set at .01 to decrease the probability of making a Type 1 error. A linear regression between the overeating subtype and the total ASD-DC score was not statistically significant, F (1, 205)=6.81, p =.01.

DISCUSSION

Across the study's sample, there generally was a high level of reported comorbid symptoms. These results are in agreement with previous research (e.g., Thorson & Matson, 2012; Tureck et al., 2014). Previously, researchers who used the *ASD-CC* examined the rates of comorbid symptoms using the subtypes of the *ASD-CC* (Rieske et al., in press, Tureck, Matson, May, Davis, & Whiting, 2013; Tureck, Matson, May, Whiting, & Davis, 2014). The current study assessed the rates of each of the items of the *ASD-CC* to see which specific items were being endorsed. Fifteen items of the *ASD-CC* were endorsed at 50% or higher rates. Seven out of 15 items were from the tantrum behavior subscale (i.e., easily becomes upset; finishes assigned tasks; compliance with demands; tantrums; easily becomes angry; crying; and irritable mood). One interesting finding was that items that pertained to property destruction were not endorsed as high as other items in the tantrum subscale. Four out of the 15 items were from the avoidant behavior subscale (i.e., will eat only certain foods; withdraws or removes him/herself from social situations; avoids specific situations, people, or events; and has trouble sleeping). Three items were from the repetitive behavior subscale (i.e, fidgets or squirms; engages in repetitive behaviors [e.g., ordering objects, handwringing, hand washing, etc.] for no apparent reason or to reduce stress; and engages in behaviors that impair daily routines or activities). One item was from the conduct behavior subscale (i.e., blurts out comments or words at inappropriate times). All items that pertained to the worry/depressed, under-eating, and over-eating subscales were endorsed at lower than 50%.

As hypothesized, autism severity significantly predicted overall comorbid symptoms. These results suggest that individuals with more severe ASD symptomology also exhibit increased comorbid symptoms. This indicates additional barriers to overcome; individuals with

more severe ASD symptoms have more skills to acquire and are also contending with greater co-morbid symptoms. Specific findings of the current study were that autism severity significantly predicted tantrum behaviors, repetitive behaviors, and avoidant behaviors.

Tantrum behaviors measured in this study included easily becoming upset, crying, destroying property, noncompliance, and irritable mood. Individuals with ASD, especially children, frequently exhibit tantrum behaviors (de Bruin et al., 2007; Dominick et al., 2007; Horner, Carr, Strain, Todd, & Reed, 2002; Maskey, Warnell, Parr, Le Couteur, & McConachie, 2013; Matson, 2009). The current study showed that autism severity accounted for 8.2% of the variation in the tantrum subscale and established that autism severity could statistically predict tantrum behaviors, replicating the findings of Konst et al. (2013) that revealed that autism severity and tantrum behaviors were correlated.

While tantrum behaviors are developmentally appropriate, it could be problematic when they are severe, excessive, and chronic. Previous studies established that tantrum behaviors occur more frequently and are more serious among children with ASD (Matson, 2009; Tureck et al., 2013). Individuals with ASD may exhibit more frequent and severe tantrum behaviors as an expression of their frustration due to their impairments in communication (Donnellan, Mesaros, & Anderson; 1984; Lainhart, 1999). It is important to understand the nature and function of tantrum behaviors in young children and adolescents, as they may be early signs of later externalizing behaviors (Giesbrecth, Miller, & Muller, 2010; Kennan & Wakschlag, 2000). If not treated, tantrum behaviors are likely to persist over time (Murphy et al., 2005). Beyond evident reasons, this is a serious problem because tantrum behaviors can interfere with effective education and social development (Matson, 2009).

Three tantrum items (i.e., easily becomes upset, easily becomes angry, tantrums) were among the items on the *ASD-CC* that were most commonly endorsed as severe. If these behaviors develop to become more severe and aggressive as the children age, these behaviors may potentially be much more serious and debilitating in adults (Matson & Jang, 2014). Currently, psychologically-based therapies using the principles and procedures of applied behavior analysis (ABA) are available to treat aggression among individuals with ASD; they have also proven to be most effective. Pharmacotherapy used alone to treat aggression has had limited effectiveness among individuals with ASD; further, medication is much more intrusive and may result in prolonged side effects (Matson & Jang, 2014). There is limited research evaluating combined psychological and psychotherapy treatment in aggression treatment; more attention in this area of research is needed to treat aggressive behaviors effectively (Matson & Jang, 2014).

The current study established that autism severity could statistically predict repetitive behaviors and can account for 20% of the variation in the repetitive subscale. It should be noted that repetitive symptoms measured in the current study were consistent with those observed with compulsion/stereotypies (i.e., checking on play objects excessively; engaging in repetitive behaviors such as ordering objects, handwringing, hand washing for no apparent reason or to reduce stress; and engaging in behaviors that impair daily routine or activities), tics (i.e., sudden, rapid, repetitive movements or vocalizations that are not associated with a physical disability; persistent or recurring impulses that interfere with activities [e.g., impulse to shout]), or other repetitive symptoms (i.e., fidgets or squirms, eats things that are not meant to be eaten).

Symptoms such as obsessions, repetitive behaviors, restricted interests, and compulsions overlap in ASD and OCD, and physical presentation of such symptoms may be similar (Matson

& Cervantes, 2014; Wu, Rudy, & Storch, 2014). Given the high comorbid rates between the two disorders, an accurate differential diagnosis is crucial between symptoms. Wu et al. (2014) discussed that individuals with OCD usually do not enjoy the obsessive thoughts. They often want to stop having such thoughts, resulting in significant distress. On the other hand, obsessive thoughts usually do not cause distress for individuals with ASD. Rather, they often enjoy thinking of repetitive and obsessive thoughts, and trying to stop them from thinking the thoughts may cause distress for them (Turner-Brown, Lam, Holtzclaw, Dichter, & Bodfish, 2011; Wu et al., 2014). While individuals with OCD often engage in repetitive behaviors to reduce anxiety, repetitive behaviors in individuals with ASD may be self-stimulatory (Wu et al., 2014); therefore, investigating the function of the behavior may help to make a more accurate differential diagnosis.

The current study also showed that autism severity could statistically predict avoidant behaviors, accounting for 24% of the variation in the avoidant subscale. Two of the avoidant symptoms pertained to avoidance of social situations (i.e., fear of being around others in school, at home, or in social situations, withdraws or removes him/herself from social situations). Researchers have found that social anxiety disorder (previously known as social phobia and hereafter referred as social phobia) and ASD can co-occur, and some studies reported that social phobia was the most common anxiety disorder in individuals with high-functioning autism (Kuusikko et al., 2008). However, differential diagnosis of ASD and social phobia is difficult since presence of social skill deficits is the core symptom for each disorder (White, Schry, & Kreiser, 2014). Examining the onset of social skills deficit (White & Schry, 2011), the reason for avoidance (White & Schry, 2011; White et al., 2014), and interaction styles may help differentiate the two disorders. For instance, social skills deficits in individuals with social

phobia may worsen over time as a result of avoiding social interactions. Consequently, social phobia symptoms may appear gradually for these individuals. On the other hand, social skills deficits appear early in development among individuals with ASD (White & Schry, 2011). While individuals with social phobia may avoid social situations because they have an irrational fear of getting evaluated (may be negative or positive) and have anxiety about being rejected (White & Schry, 2011), individuals with ASD may avoid social interactions because they do not have skills to appropriately initiate and maintain social interactions.

Social anxiety in individuals with ASD who already have pervasive social impairment is potentially detrimental in that it further diminishes their social interaction opportunities and increases isolatio. Although not much research has been done on social anxiety treatment for individuals with ASD, available literature suggests that modified cognitive behavior therapy (CBT) seems promising (Moree & Davis, 2010; Reaven et al., 2009; Wood et al., 2009). Traditional CBT is tailored to accommodate specific deficits in ASD by increasing the structure of the session, using visual prompts, providing more opportunities to practice skills, and encouraging more parental involvement (White & Schry, 2011).

Four of the avoidant items pertained to avoiding specific situations, people, objects, or events, which may be related to specific phobia. Davis and Ollendick (2014) discussed that, while it is not difficult to distinguish between ASD and specific phobia, deciding whether an individual with ASD should also receive a separate diagnosis of specific phobia is rather difficult. For example, it would be difficult to determine whether an individual with hypersensitivity to sound would warrant a diagnosis of specific phobia of loud noise (Davis & Ollendick, 2014). Also, if an individual with ASD avoids eating certain food, it would be

difficult to determine what causes the refusal: is it due to inflexibility, sensitivity, or phobia? (Davis & Ollendick, 2014).

Despite the high comorbid rates between ASD and specific phobia, with some researchers reporting it as the most common anxiety disorders in individuals with ASD (Leyfer et al., 2006; Muris et al., 1998), very few researchers actually examined the relationship between specific phobia and ASD. One study reported that phobias of needles and crowds were the most common phobias in children with ASD (Leyfer et al., 2006). Similarly, Muris et al. (1998) reported that medical-related phobias were the most common phobias in children with ASD. Davis and Ollendick (2014) hypothesized that this may be due to aversive experiences that children with ASD have with medical professionals.

In summary, available research suggests that there are high rates of comorbid symptoms in ASD. Furthermore, the current study revealed that individuals with more severe ASD symptomology also have more comorbid symptoms. This is concerning because more time and resources are needed to address comorbid symptoms in those with greater deficits when they have more skills to acquire (i.e., communication, socialization) and more challenging behaviors to manage than those with mild deficits. Additionally, the co-occurring ASD and other conditions may alter symptom presentation and further exacerbate deficits bi-directionally and result in more psychiatric difficulties (Jang et al., 2013; Matson et al., 2011; Matson, Boisjoli, & Mahan, 2009; Matson & Rivet, 2008; Mayes et al., 2012; Tureck et al., 2013). Thus, it is crucial to recognize and treat comorbid conditions in individuals with ASD (LoVullo & Matson, 2009; Matson, Mahan, & LoVullo, 2009). As previously discussed, differential diagnosis between ASD and comorbid psychopathology is difficult. Therefore, additional assessment scales and measures are needed. Assessments specifically designed to measure comorbid psychopathology

in individuals with ASD may help clinicians determine which symptoms are typical and are within the average range for children with ASD and which symptoms are due to co-occurring emotional disturbances.

Since the current study is a preliminary looking at this topic, further studies should use clinically diagnosed comorbid conditions. The participants in the current study were not assessed for comorbid disorders. As such, comorbid symptoms discussed in the current study were assessed using a single measure. Diagnostic decisions should be made by experts with many years of experience using a comprehensive assessment battery with multiple informants, as well as thorough clinical observation. Thus, further studies should include participants with clinical diagnoses of ASD and other psychopathologies. Though the current study answered some questions about autism severity and comorbid symptoms, more research is warranted. The current study did not account for other factors that are correlated with comorbid disorders, such as age, level of functioning, communication abilities, and degree of social impairments (Davis et al., 2012; Mayes et al., 2011; White et al., 2009). Although the ages of participants in the current study did not range extensively, different types of comorbid symptoms may be affected by age. Thus, further studies considering age as a factor are warranted. Notwithstanding these limitations, the current study adds to this literature by providing preliminary data on the relationship between ASD severity and commonly occurring psychopathologies, providing an emphasis that individuals with more severe ASD symptomology also have more comorbid symptoms. In summary, in order to better assess and diagnose comorbid conditions in individuals with ASD, the extensive study is necessary. Thus, replications and extension of the current study may aid in the identification of specific comorbid psychopathology based on severity of ASD, resulting in additional and more tailored assessment and treatments.

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APPENDIX A

Assumptions for a simple regression using the *ASD-DC* total score as the predictor and *ASD-CC* as the DV.

Figure A1. Linearity Assumption

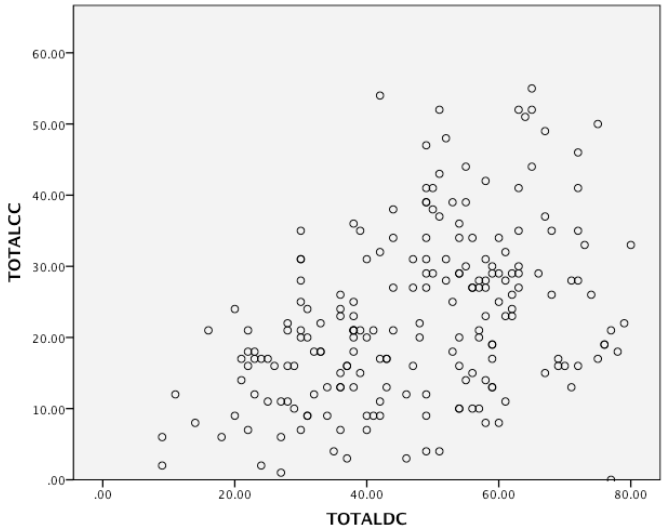

Figure A1. Linearity between the DV and IV. A linear relationship is established from visual inspection of the scatterplot.

Figure A2. Heteroscedasticity Assumption

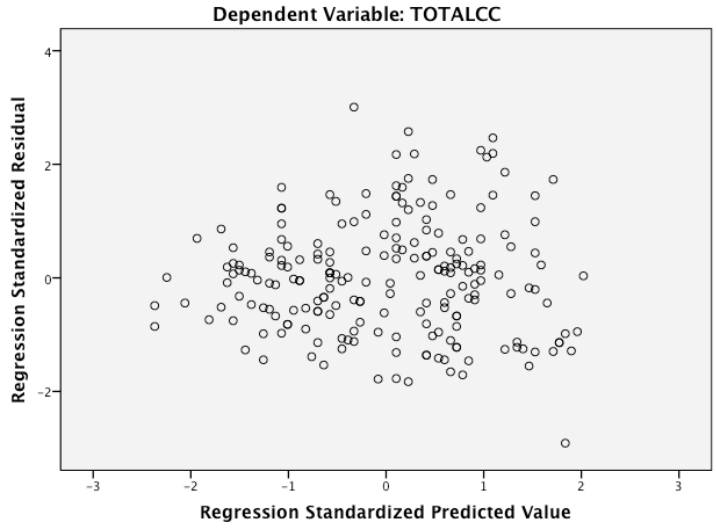

Figure A2. A scatterplot was generated to test for heteroscedasticity. The data appeared to be evenly dispersed around zero in a plot of *ZRESID and *ZPRED.

Figure A3. Normal Distribution Assumption: Histogram

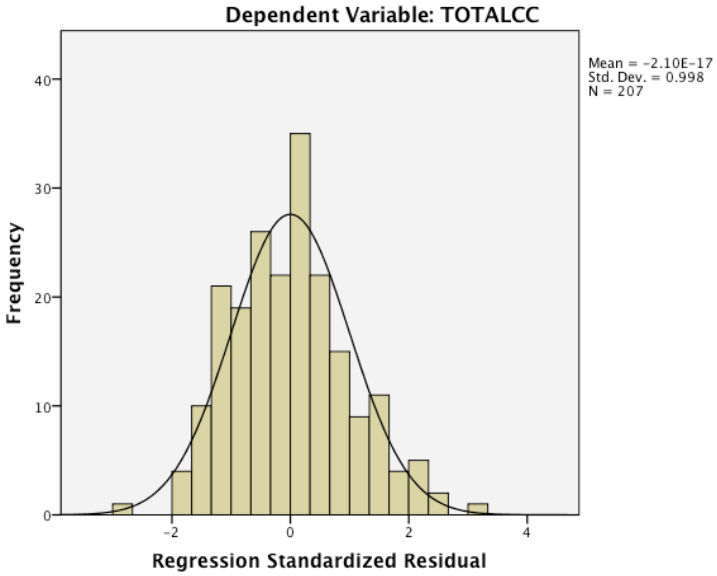

Figure A3: The histogram was produced to test for normality. The normality was not violated.

Figure A4. Normal Distribution Assumption: The Normal P-P Plot

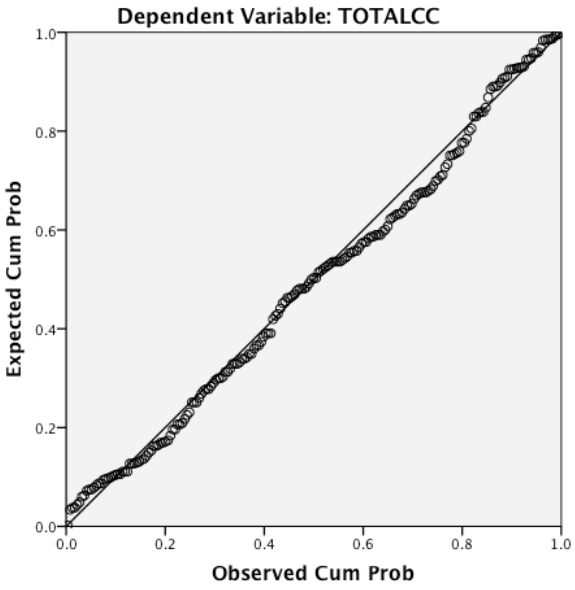

Figure *A4*: The Normal P-P Plot was produced to test of normality. The normality was not violated.

APPENDIX B

Assumptions for a simple regression using the *ASD-DC* total score as the predictor and the tantrum behavior subscale as the DV.

Figure B1. Linearity Assumption

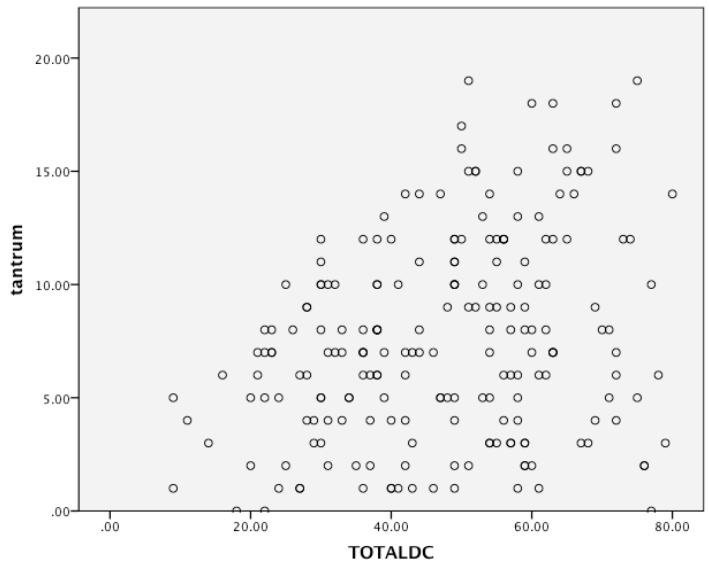

Figure B1. A scatterplot assessing the linearity assumption revealted that there was a linear relationp between the total ASD severity and tantrum behaviors.

Figure B2. Heteroscedasticity Assumption

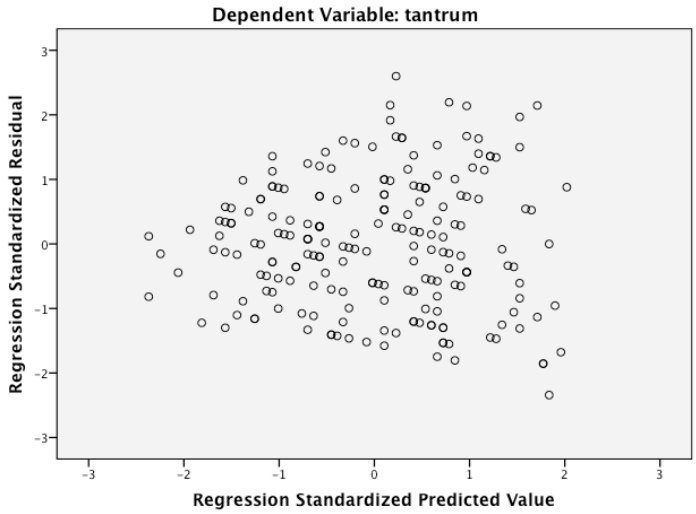

Figure B2. To test for heteroscedasticity, a scatterplot was generated. From visual inspection of scatterplot, the assumption of heteroscedasticity was not violated.

Figure B3. Normal Distribution Assumption: Histogram

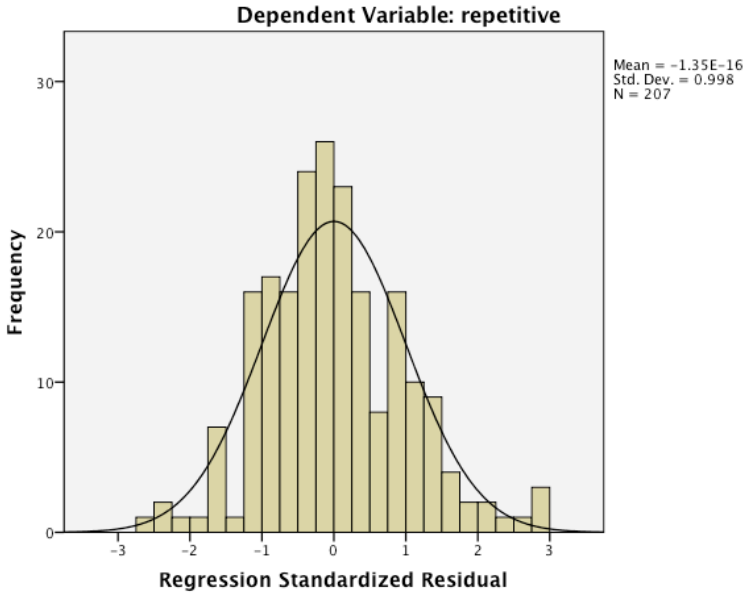

Figure B3. The histogram was produced to test for normality. The normality was not violated.

Figure B4. Normal Distribution Assumption: The Normal P-P Plot

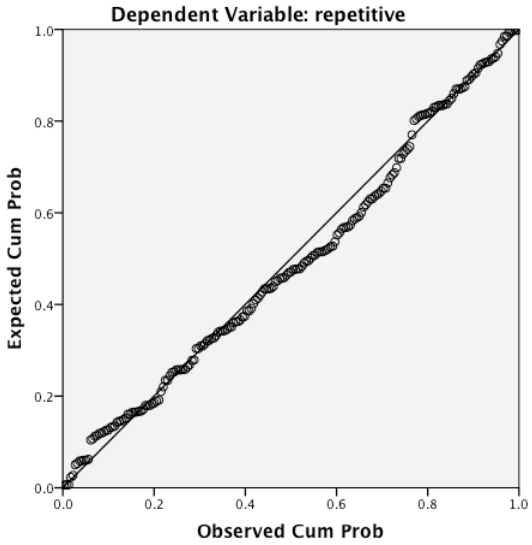

Figure B4. The Normal P-P Plot was produced to test of normality. The normality was not violated.

APPENDIX C

Assumptions for a simple regression using the *ASD-DC* total score as the predictor and the repetitive behavior subscale as the DV.

Figure C1. Linearity Assumption

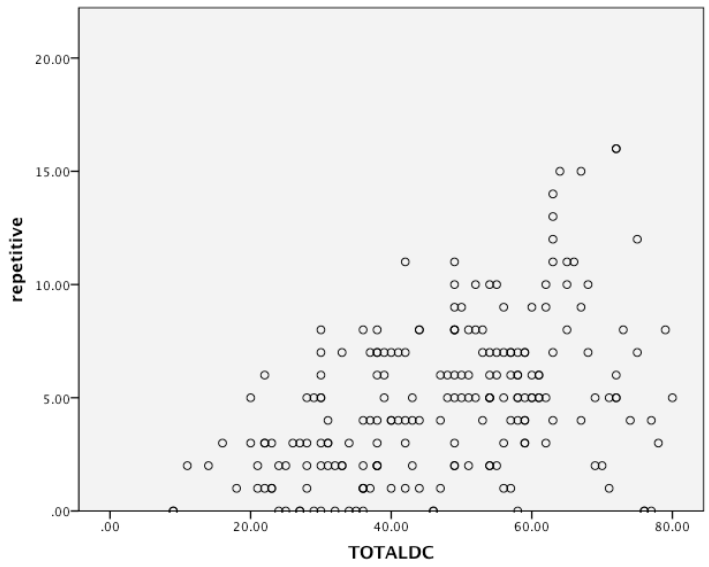

Figure C1. A scatterplot assessing the linearity assumption revealed that there was a linear relationship between the total ASD severity and the repetitive behaviors.

Figure C2. Heteroscedasticity Assumption

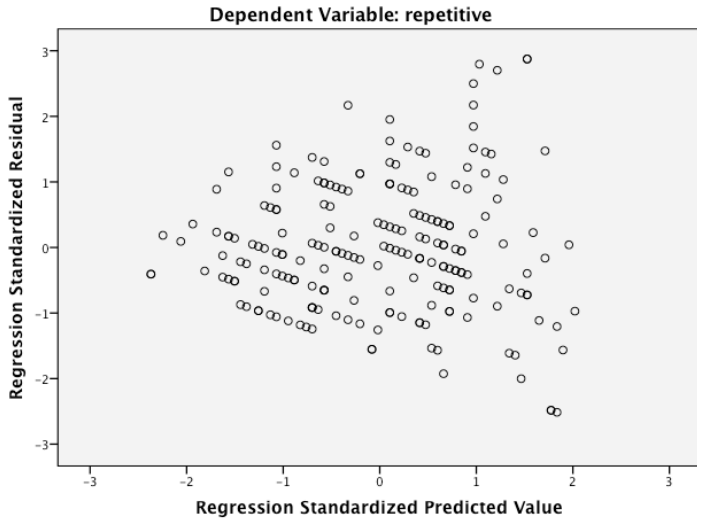

Figure C2. Initial visual inspection of the data yielded concerns regarding heteroscedasticity. To address this concern, a heteroscedasticity-consistent standard error estimator for ordinary least squares regression was implemented using SPSS syntax described by Hayes and Cai (2007).

Figure C3. Normal Distribution Assumption: Histogram

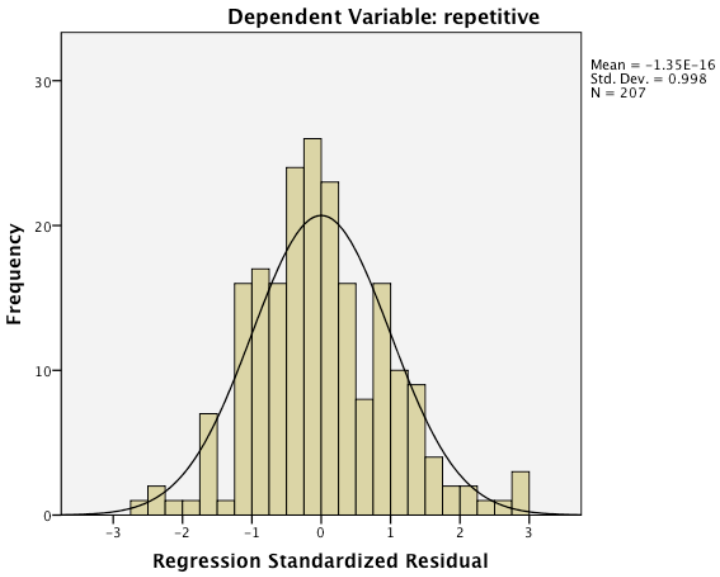

Figure C3. The histogram was produced to test for normality. The normality was not violated.

Figure C4. Normal Distribution Assumption: The Normal P-P Plot

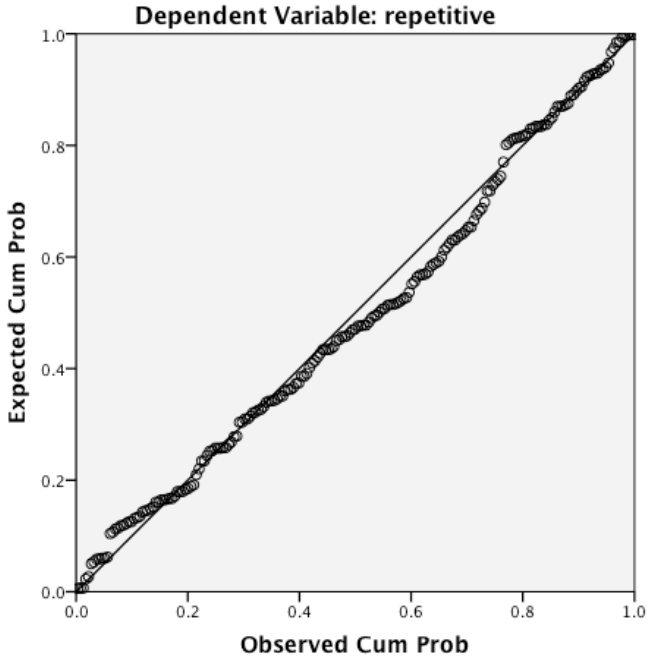

Figure C4. The Normal P-P Plot was produced to test of normality. The normality was not violated

APPENDIX D

Assumptions for a simple regression using the *ASD-DC* total score as the predictor and the worry/depressed subscale as the DV

Figure D1. Linearity Assumption

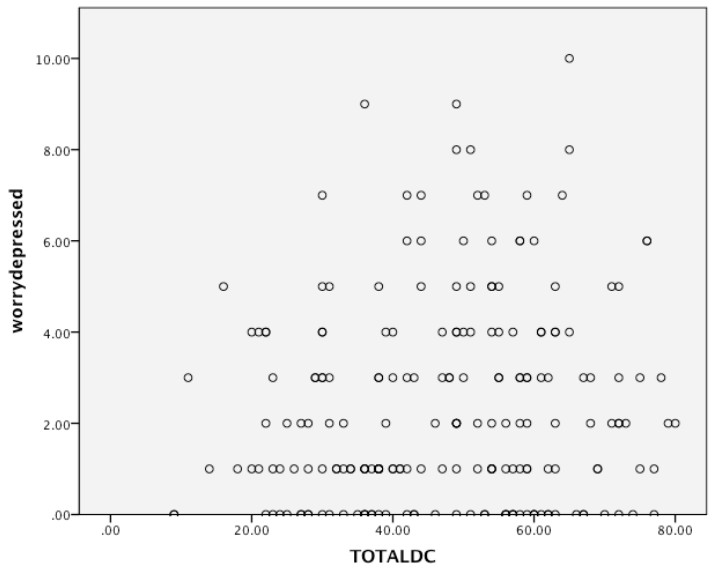

Figure D1. A scatterplot assessing the linearity assumption revealed that there was a linear relationship between the total ASD severity and the repetitive behaviors.

Figure D2. Heteroscedasticity Assumption

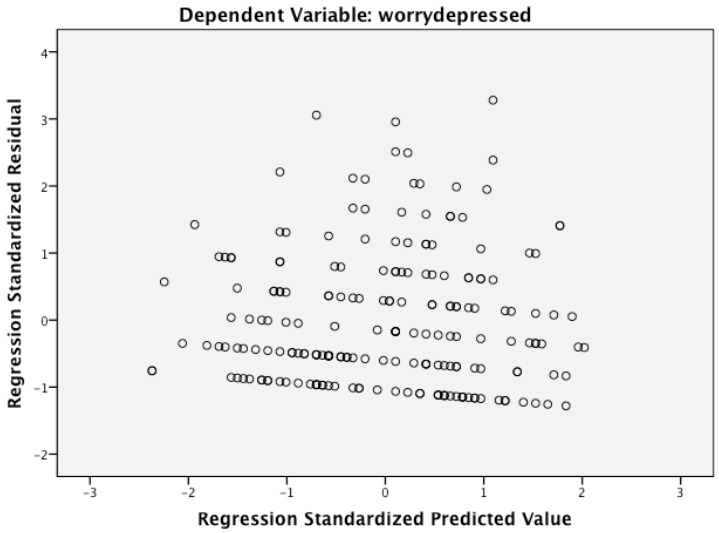

Figure D2. From visual inspection of scatterplot, the assumption of heteroscedasticity was not violated.

Figure D3. Normal Distribution Assumption: Histogram

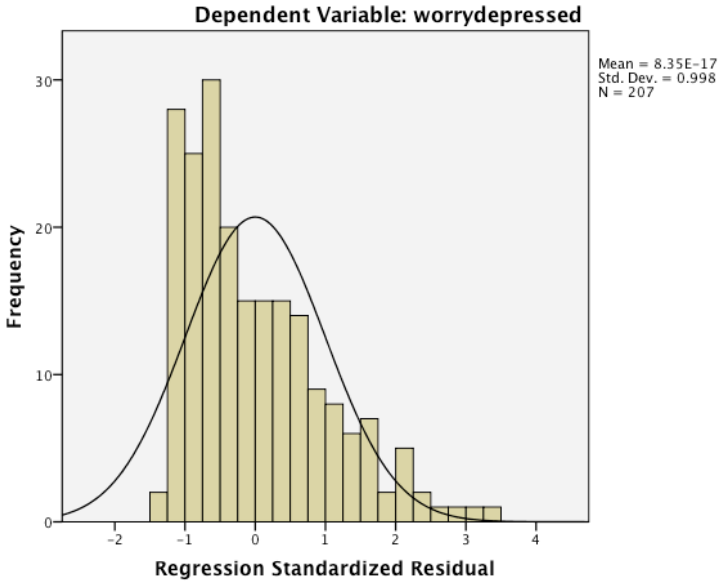

Figure D3. The histogram was produced to test for normality. The histogram indicated that the residuals were not normally distributed. To convert a moderately positively skewed data to normality, a "square root" transformation was applied.

Figure D4. Normal distribution assumption: the Normal P-P Plot

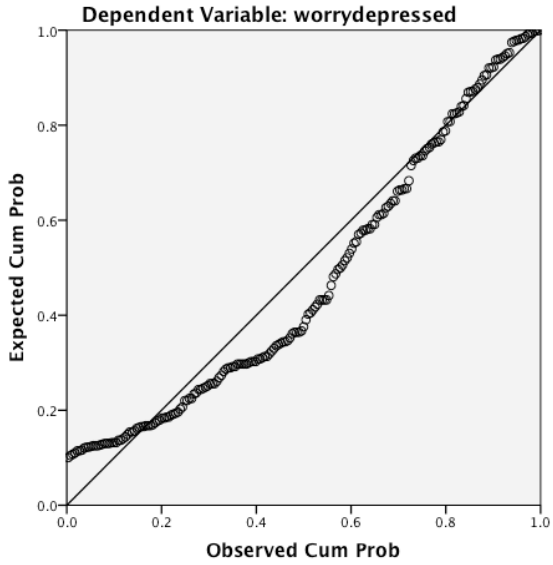

Figure D4. The Normal P-P Plot was produced to test of normality. A "square root" transformation was applied to convert skewed data to normality.

APPENDIX E

Assumptions for a simple regression using the *ASD-DC* total score as the predictor and the avoidant subscale as the DV.

Figure E1. Linearity Assumption

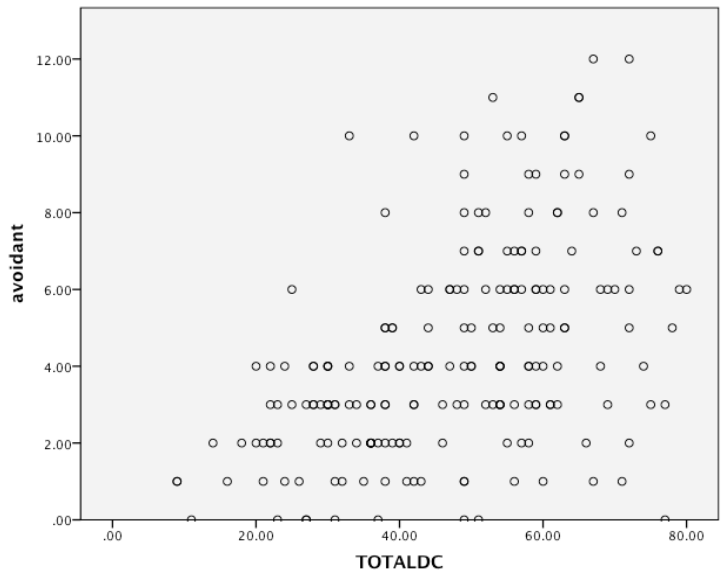

Figure E1. A scatterplot assessing the linearity assumption revealed that there was a linear relationship between the total ASD severity and the avoidant behaviors

Figure E2. Heteroscedasticity Assumption

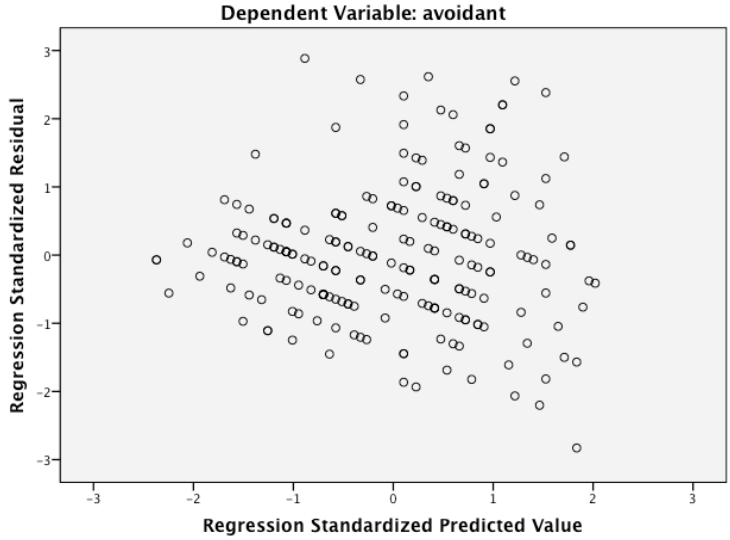

Figure E2. Initial visual inspection of the data yielded concerns regarding heteroscedasticity. Again, a heteroscedasticity-consistent standard error estimator was applied.

Figure E3. Normal Distribution Assumption: Histogram

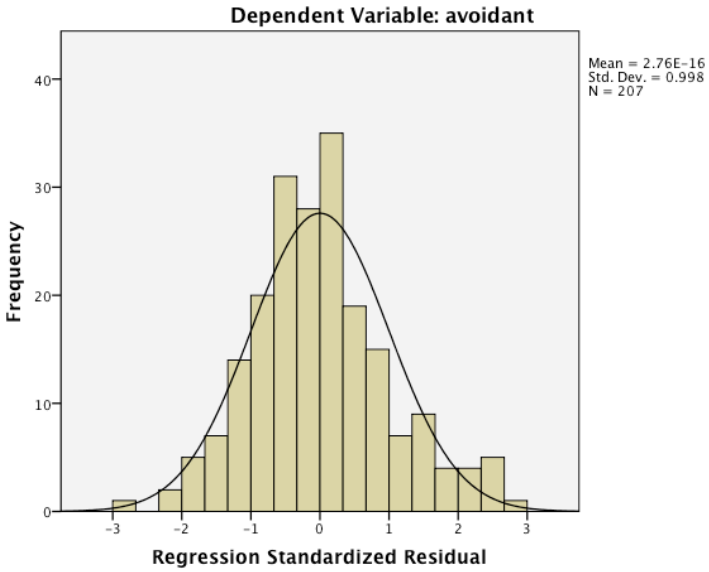

Figure E3. The histogram was produced to test for normality. The normality was not violated.

Figure E4. Normal Distribution Assumption: The Normal P-P Plot

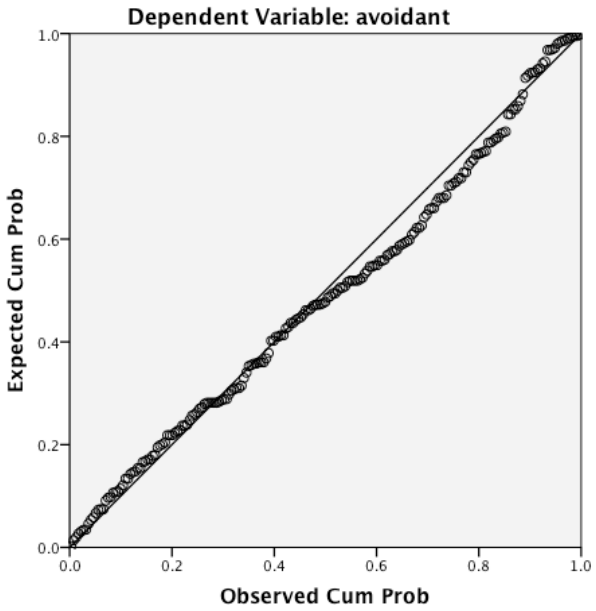

Figure E4. The Normal P-P Plot was produced to test of normality. The normality was not violated

APPENDIX F

Assumptions for a simple regression using the *ASD-DC* total score as the predictor and the under-eating subscale as the DV.

Figure F1. Linearity Assumption

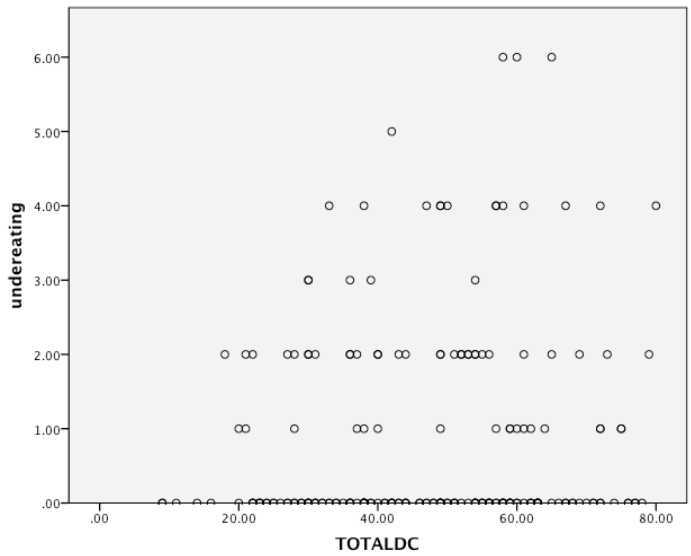

Figure F1. The assumptions of linearity and independence of errors were met.

Figure F2. Heteroscedasticity Assumption

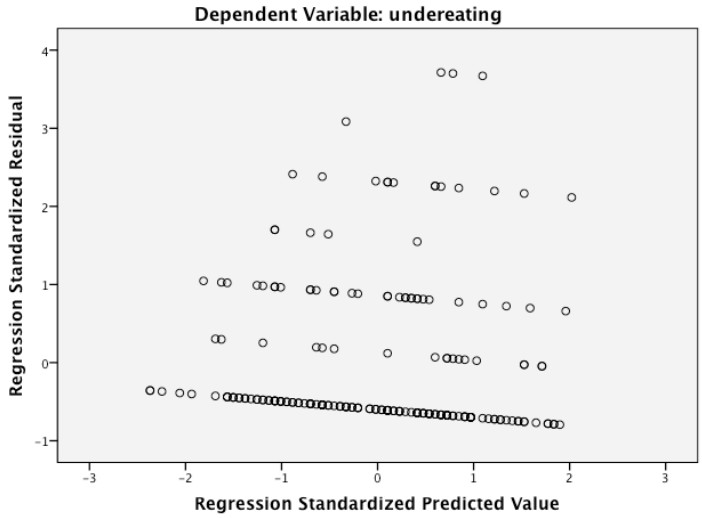

Figure F2. The assumption of heteroscedasticity was violated. To address this concern, a heteroscedasticity-consistent standard error estimator was applied.

APPENDIX G

Assumptions for a simple regression using the *ASD-DC* total score as the predictor and the conduct subscale as the DV.

Figure G1. Linearity Assumption

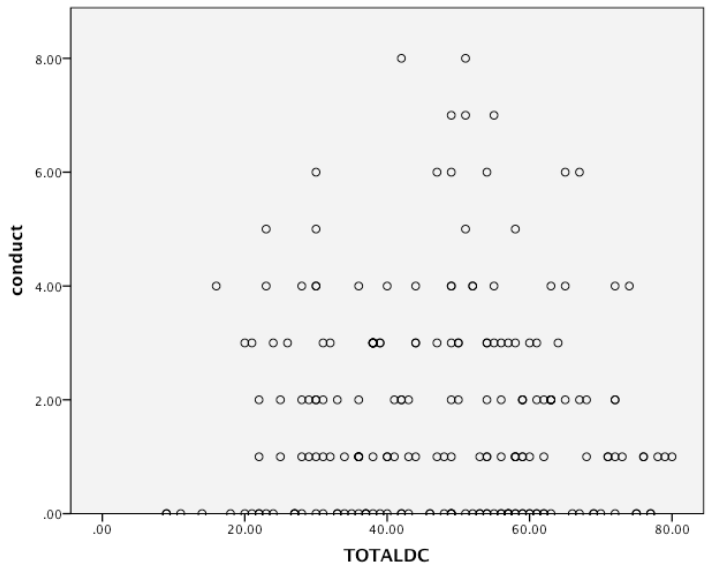

Figure G1. The scatterplot was generated to test of linearity. The scatterplot revealed that the assumption of linearity was met.

Figure G2. Heteroscedasticity assumption

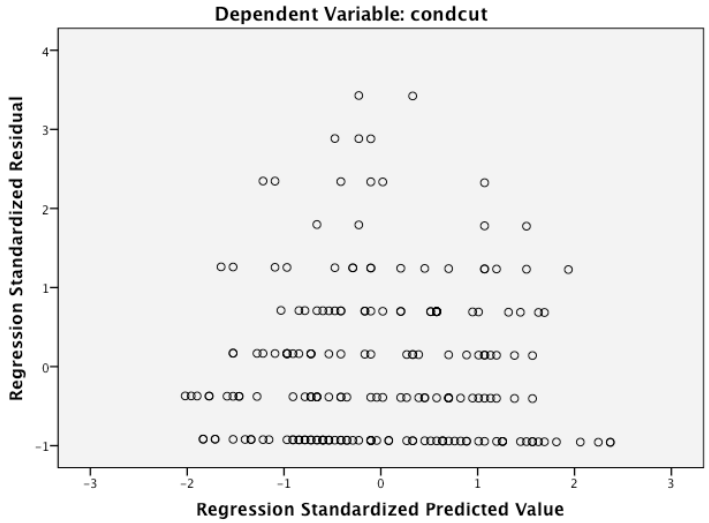

Figure G2. From visual inspection of scatterplot, the assumption of heteroscedasticity was not violated.

APPENDIX H

Assumptions for a simple regression using the *ASD-DC* total score as the predictor and the overeating subscale as the DV.

Figure H1. Linearity Assumption

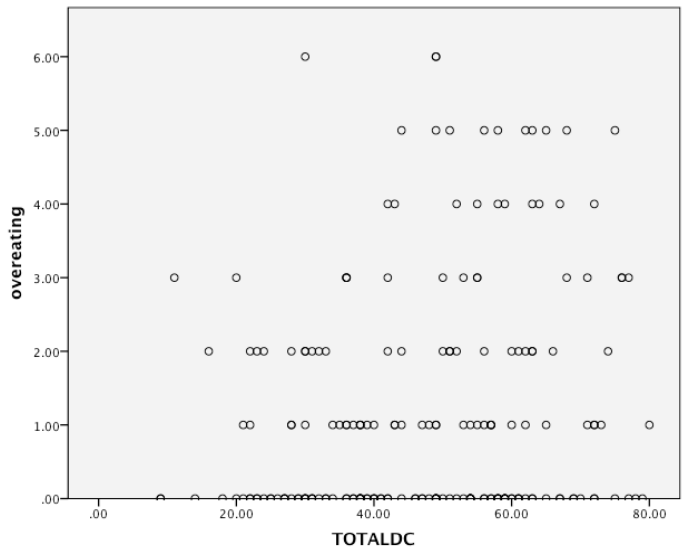

Figure H1. The scatterplot was generated to test of linearity. The scatterplot revealed that the assumption of linearity was met.

Figure H2. Heteroscedasticity Assumption

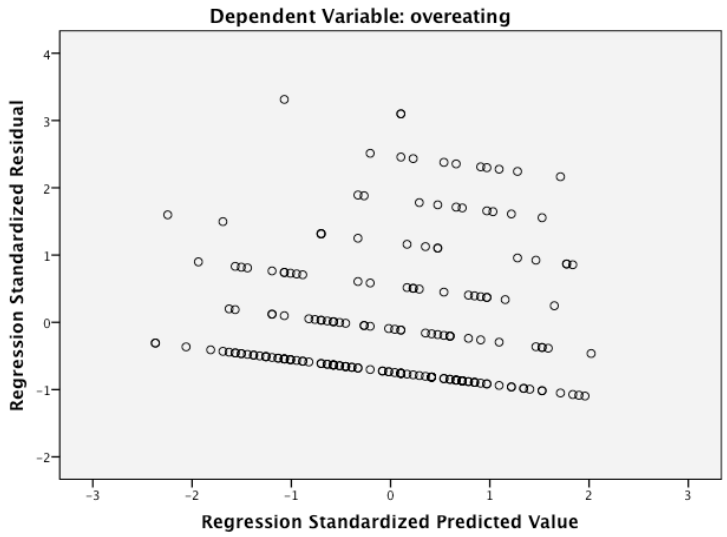

Figure H2. From visual inspection of scatterplot, the assumption of heteroscedasticity was not violated.

APPENDIX I

Bobby Jindal
GOVERNOR

Kathy Kliebert
SECRETARY

State of Louisiana

Department of Health and Hospitals

December 4, 2013

Dr. Johnny L. Matson
Department of Psychology
Louisiana State University
324 Audubon Hall
Baton Rouge, LA 70803

Via email: johnmatson@aol.com

Re: Autism in Early Childhood

Dear Dr. Matson:

Thank you for submitting the above-referenced proposal. We have taken into advisement information provided in the proposal package. We find that all areas of concerns were clarified and the project has been approved by Expedited Review.

The IRB approves the project for the purposes of investigating developmental patterns and differences in atypically developing children with and without autism spectrum disorders. If you should desire to conduct additional research using the data collected under this project, that proposal much be submitted separately to the IRB for review.

I am requesting that the Principal investigator report to the DHH IRB any emergent problems, serious adverse reactions, or changes to protocol that may affect the status of the investigation and that no such changes be instituted prior to DHH IRB review, except where necessary in order to eliminate immediate hazards. The investigator also agrees to periodic review of this project by the DHH IRB at intervals appropriate to the degree of risk to assure that the project is being conducted in compliance with the DHH IRB's understanding and recommendations.

If I can be of any further assistance to you, please feel free to contact me.

Sincerely,

Nell W. Allbritton, MPA
Director, Institutional Review Board
Department of Health and Hospitals
628 North 4th Street, Third Floor
Baton Rouge, Louisiana 70802
(225) 342-4169
nell.allbritton@la.gov

Application for Exemption from Institutional Oversight

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

Unless qualified as meeting the specific criteria for exemption from Institutional Review Board (IRB) oversight, ALL LSU research/ projects using living humans as subjects, or samples, or data obtained from humans, directly or indirectly, with or without their consent, must be approved or exempted in advance by the LSU IRB. This Form helps the PI determine if a project may be exempted, and is used to request an exemption.

– Applicant,Please fill out the application in its entirety and include the completed application as well as parts A-F, listed below, when submitting to the IRB. Once the application is completed, please submit two copies of the completed application to the IRB Office or to a member of the Human Subjects Screening Committee. Members of this committee can be found at http://research.lsu.edu/CompliancePoliciesProcedures/InstitutionalReviewBoard%28IRB%29/item24737.html

– A Complete Application Includes All of the Following:
(A) Two copies of this completed form and two copies of parts B thru F.
(B) A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1&2)
(C) Copies of all instruments to be used.
*If this proposal is part of a grant proposal, include a copy of the proposal and all recruitment material.
(D) The consent form that you will use in the study (see part 3 for more information.)
(E) Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing or handling data, unless already on file with the IRB. Training link: (http://phrp.nihtraining.com/users/login.php)
(F) IRB Security of Data Agreement: (http://research.lsu.edu/files/item26774.pdf)

1) Principal Investigator: Dr. Johnny L. Matson **Rank:** Clinical Director

Dept: Clinical Psychology **Ph:** (225) 578-8745 **E-mail:** johnmatson@aol.com

2) Co Investigator(s): please include department, rank, phone and e-mail for each
*If student, please identify and name supervising professor in this space

IRB# E8292 LSU Proposal #
✓ Complete Application
✓ Human Subjects Training

3) Project Title: Autism in Early Childhood

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 4/30/2016

4) Proposal? (yes or no) no **If Yes, LSU Proposal Number**

Also, if YES, either ◯ **This application completely matches the scope of work in the grant**
OR ◯ **More IRB Applications will be filed later**

5) Subject pool (e.g. Psychology students) Young children assessed for developmental delay via EarlySteps
*Circle any **"vulnerable populations" to be used**: (children <18; the mentally impaired, pregnant women, the ages, other). Projects with incarcerated persons cannot be exempted.

6) PI Signature J Matson **Date** 4-19-13 (no per signatures)

** **I certify my responses are accurate and complete.** If the project scope or design is later changes, I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at LSU for three years after completion of the study. If I leave LSU before that time the consent forms should be preserved in the Departmental Office.

Screening Committee Action: Exempted ✓ Not Exempted ____ Category/Paragraph 4
Signed Consent Waived?: Yes / No
Reviewer Mathews **Signature** Robert C Mathews **Date** 5/1/13

VITA

Jina Jang received her Bachelor of Arts degree in psychology from University of California, Los Angeles in 2010. She was employed at Center for Autism and Related Disorders as a research assistant, analytics coordinator, and behavior therapist. She entered the Clinical Psychology program at Louisiana State University in 2012. Her research interests include early identification and intervention for autism spectrum disorders and other developmental disorders, with particular emphasis on factors such as cultural differences impacting diagnosis and treatment.