INVESTIGATION OF INDIVIDUAL FACTORS ASSOCIATED WITH ANXIETY IN YOUTH WITH AUTISM SPECTRUM DISORDERS

by

ASHLEY DUBIN

(Under the Direction of Rebecca Lieberman Betz)

ABSTRACT

As youth with autism spectrum disorders (ASD) are more likely to suffer from anxiety than youth in the general population, investigation of associated factors is important for diagnosis and treatment. The purpose of the present study is to extend prior research on predictors of anxiety disorders using a large, nationally representative sample of youth with ASD. Logistic regression analyses indicated anxiety risk was related to age, parent-rated social problems, and average or above-average cognitive functioning. Higher levels of adaptive social behaviors were associated with anxiety risk in youth with low cognitive functioning, although no relation was present for youth with higher cognitive functioning. Results from the present study provide support for previously identified anxiety risk factors; however, further investigation is necessary to uncover additional risk factors and to explore how their relation to anxiety differs across individuals with ASD with varying levels of cognitive functioning.

INDEX WORDS: Autism Spectrum Disorder, Anxiety, Cognitive Functioning, Logistic Regression
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by

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B.S., University of Maryland, College Park, 2007

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

MASTER OF ARTS

ATHENS, GEORGIA

2013
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December 2013
ACKNOWLEDGEMENTS

I would like to express my gratitude to my family and friends, whose constant support and encouragement has been a tremendous help throughout this process. I would especially like to thank my parents, Elaine and Alan Dubin, for instilling in me a sense of intellectual curiosity and always believing in me. I would like to thank my co-major professors, Drs. Rebecca Lieberman-Betz and Michele Lease, for their willingness to take on a new student and their guidance throughout the thesis process. I would also like to thank Dr. Stacey Neuharth-Pritchett for her support and helpful feedback.
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CHAPTER 1
INTRODUCTION

Autism spectrum disorders (ASDs) are defined by the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR) as a group of pervasive developmental disorders (PDD), including autistic disorder (AD), Asperger’s Disorder (AspD), Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS), Rett’s Disorder, and Childhood Disintegrative Disorder (CDD), characterized by dysfunction in three core areas of functioning, which include social reciprocity, communication, and the presence of repetitive stereotyped behaviors, restricted activities, and interests (APA, 2000). In the recently released fifth edition of the DSM (DSM-5), Rett’s disorder and CDD are no longer included in the list of PDDs, and those remaining are subsumed under the broad umbrella term ASD (APA, 2013). The shift toward a dimensional diagnostic model reflects the shared qualitative impairments that vary only in severity across DSM-IV-TR diagnosed PDDs (Mahjouri & Lord, 2012) with two rather than three core deficits (i.e., social communication; restrictive interests and repetitive behaviors) rated on a severity scale required for a diagnosis of ASD (APA, 2013). Within the new framework, the diagnosis of ASD encompasses a wide range of functioning, symptom manifestation, and associated problems.

In addition to the core deficits inherent in an ASD diagnosis, individuals can experience associated emotional and behavioral symptoms, such as anxiety. Research
indicates anxiety is highly prevalent in individuals with ASD and might impart additional impairment (Van Steensel, Bogels, & Perrin, 2011; White, Oswald, Ollendick, & Scahill, 2009). For example, studies suggest anxiety in youth with ASD is associated with social skills deficits and impaired social responsivity (e.g., Bellini, 2004; Sukhodolsky et al., 2008), greater ASD symptom severity (Kelly, Garnett, Attwood, & Peterson, 2008), and lower quality of social interactions (Eussen et al., 2012). Given the heterogeneity of symptom presentation among those with an ASD diagnosis, it is necessary to pinpoint individual risk and protective factors associated with anxiety, which can guide implementation of treatments targeting ASD-specific deficits and associated problems.

The purpose of the current study is to investigate individual factors previously cited as associated with anxiety symptoms and the potentially moderating effect of intellectual functioning using a large, well-described sample of children and adolescents with ASD. Additionally, consistent with prior research demonstrating the independence of ASD-specific social disability (e.g., impaired social reciprocity) and social abilities (e.g., socialization skills necessary to function in the real world (Klin et al., 2007; Kanne et al., 2010), the current study will augment knowledge from prior research by investigating the relationship of social abilities with risk for anxiety problems in children and adolescents with ASD.

Classification of Autism Spectrum Disorder

The present study uses data from the Simons Simplex Collection (SSC; http://sfari.org/simons-simplex-collection), a nationally representative database of youth diagnosed with AD and their families. Youth in the database were diagnosed using the DSM-IV-TR criteria; therefore a brief description of these criteria is necessary to
adequately characterize the sample. The DSM-IV-TR describes AD as the clearest representation of the triad of ASD symptoms. Symptoms include the presence of qualitative impairments in social interaction and communication as well as restricted, repetitive, and stereotyped patterns of interests and behaviors (APA, 2000). Examples of restricted, repetitive, and stereotyped patterns of interests and behaviors include insistence on sameness, preoccupation with parts of objects, and stereotyped body movements (e.g., body rocking, hand flapping), all of which are abnormal in either intensity or focus. A diagnosis of AD additionally requires delayed onset or deficit in the development of communication skills (e.g., spoken language, pragmatics, ability to initiate or sustain conversation). Communication impairments may also include difficulties with comprehension and abnormal intonation or pitch (APA, 2000). Impaired social behaviors are a primary core deficit in AD and include lack of social or emotional reciprocity, difficulties with nonverbal social behaviors (e.g., eye contact), and difficulties forming and maintaining relationships. Delays in the triad of symptoms must be apparent prior to age three to warrant a diagnosis of AD according to the DSM-IV-TR. Individuals diagnosed with AD differ considerably in symptom severity and developmental course (APA, 2000).

AspD differs from AD primarily on the basis of language; specifically, individuals with AspD evidence typical early expressive language development. However, similar to individuals with AD, those with AspD experience impairments in the social use of language, deficits in social interaction, and present with restricted, repetitive patterns of behavior and interests (APA, 2000). An additional difference between AspD and AD is with the exception of adaptive social behaviors, a diagnosis of AspD requires
the absence of clinically significant delays in cognitive and adaptive functioning. In contrast, AD can be diagnosed in individuals with a wide range of cognitive and adaptive functioning. While social deficits associated with AsPD are comparable to those associated with AD, impairment may manifest differently across the two conditions (APA, 2000).

The DSM-IV-TR diagnosis of PDD-NOS, or “atypical autism” is generally applied when an individual experiences functional impairment stemming from one or more of the three core deficits (i.e., impaired social reciprocity, communication impairments, and restricted, repetitive behaviors); however, because of subthreshold symptoms or functional impairment in less than three areas, the individual does not meet criteria for another PDD (APA, 2000). One example of an atypical presentation that would fall under the category of PDD-NOS may include individuals meeting diagnostic criteria for AD with the exception of age of onset (i.e., age of onset later than three). As PDD-NOS is primarily used as a diagnosis for those individuals not fully meeting AD criteria for a variety of reasons, the diagnostic category is highly heterogeneous in developmental course and symptom presentation (APA, 2000).

In the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), ASDs remain categorically distinct from other childhood diagnoses; however, the DSM-IV-TR conceptualization of PDDs as five categorically distinct diagnoses is replaced with a dimensional classification system. The proposed hybrid categorical and dimensional framework is likely the most parsimonious way to classify autism symptoms based on exploratory and latent factor analytic research (Frazier et al., 2012). The act of forcing autism traits, which likely lie on a severity continuum, into a categorical
framework creates false boundaries, thereby producing unreliable diagnoses that rely heavily on clinical judgment rather than empirical evidence (Lord et al., 2012). For example, research findings regarding the differentiation of AspD from AD regarding diagnosis and prognosis have been inconsistent. The majority of evidence points toward few or no differences (Howlin, 2003; Miller & Ozonoff, 2000); of the studies where AD was found to differ from AspD, differences were quantitative rather than qualitative in nature (Macintosh & Dissanayake, 2004). While individuals with high functioning (i.e., average or above average cognitive abilities) autism (HFA) may appear more impaired than individuals with AspD during early childhood, by adolescence the two groups are often indistinguishable (e.g., Gilchrist et al., 2001). In their review of the literature comparing individuals with AD and AspD, Macintosh and Dissanayake (2004) noted outcomes for individuals with AspD and AD are both highly variable. Along with similar prognosis across AspD and HFA, it is often difficult to obtain a reliable retrospective report of words spoken before age three further complicating attempts to distinguish conditions on the basis of a language delay (Happe, 2011). Therefore, in the DSM-5, AD, AspD, and PDD-NOS, are subsumed under the single label of ASD, as these diagnoses are considered too qualitatively similar to be categorized as different disorders, especially when controlling for cognitive abilities (Happe, 2011; Howlin, 2003; Miller & Ozonoff, 2000).

Research supporting the shift from categorical to dimensional classification of mental disorders cites problems inherent to the diagnostic standards of the DSM-IV-TR, including issues of comorbidity (Caron & Rutter, 1991) and heterogeneity within diagnostic classes (Krueger & Bezjian, 2009). Comorbidity, (i.e., meeting criteria for
more than one psychiatric disorder [Pennington, 2002]), is especially relevant when discussing autism, as comorbid psychiatric problems, including anxiety, are highly prevalent in this population (Van Steensel et al., 2011; White et al., 2009). Comorbidity has implications for diagnosis and treatment, as presentations and appropriate interventions will differ depending on co-occurring conditions. For example, an individual with ASD and a comorbid anxiety disorder is likely to present differently and require different treatment than a child with ASD who has comorbid ADHD.

A related problem inherent to the DSM-IV-TR diagnostic framework across all disorders is that of heterogeneity within diagnostic classes. Heterogeneity arises from diagnostic criteria requiring only a small percentage of symptoms from a larger selection for diagnosis of a disorder. Given the range of potential symptom combinations possible when classifying disorders this way, individuals with the same diagnosis may have entirely different symptom presentations (Krueger & Bezjian, 2009). In both treatment planning and etiological research, diagnostic categories are assumed to be homogenous. Heterogeneity is therefore problematic, as diagnostic labels provide little information about an individual’s specific problems because of diverse presentations within a single category.

The newly published DSM-5 seeks to reflect the broad research base favoring a hybrid categorical and dimensional rather than strictly categorical diagnostic system, consistent with research supporting a distinction between ASD and typical development but not between separate PDD diagnoses. In the DSM-5 classification scheme, different presentations of ASD are accounted for by the severity of empirically defined ASD-specific symptoms (i.e., level of supportive services required by the individual due to
symptoms) and specifiers related to common co-occurring impairments (e.g., intellectual
disability, language delay) (APA, 2013). For example, a child diagnosed with a
communication disorder and intellectual disability in addition to ASD will present
differently than a child with high verbal and nonverbal intelligence.

DSM-5 changes specific to the definition of ASD concern core deficits and
typical emergence of symptoms. Given the limited specificity of language delay to ASD
(Bishop & Norbury, 2002), the tendency for individuals to use communication in a
stereotyped repetitive manner and the integrated nature of social interaction and
communication, the communication dimension is now subsumed into social and
repetitive behavioral dimensions respectively. As such, the DSM-5 diagnosis of ASD is
defined by 2 rather than 3 core deficits: (1) social communication/social interaction and
(2) restricted, repetitive behaviors and interests. Presence of all three symptoms of social
communication impairment (i.e., deficits in social-emotional reciprocity, nonverbal
communicative behaviors, and relationship development, maintenance, and
understanding) is required for a diagnosis of ASD, reflecting the centrality of social
communication deficits to ASD (APA, 2013). Information regarding current language
level is measured along a continuum ranging from the absence of expressive language to
full verbal abilities, as it is necessary to understand functioning and inform treatment
(Lord & Roberts, 2012). Finally, in light of research indicating similar prognoses for
individuals whose symptoms were present before and after three years of age, especially
those with higher levels of functioning (e.g., Bennett et al., 2008; Macintosh &
Dissanayake, 2004), the requirement that symptoms present prior to age three has been
removed. Due to the developmental nature of ASD, it is maintained that symptoms must
first appear in early childhood with the caveat that symptoms may not become apparent until social demands exceed a child’s limited abilities.

The changes in the new DSM-5 are thought to better represent the true occurrence of ASD in nature and may provide a better picture of an individual’s overall symptom severity and broad behavioral profile. However, additional research is necessary to determine more specific risk and protective factors for common associated problems, such as anxiety.

**Anxiety in ASD**

Anxiety disorders are highly prevalent and among the most commonly diagnosed forms of psychopathology in typically developing children and adolescents (Merikangas, Nakamura, & Kessler, 2009). Specifically, DSM-IV-TR includes a number of anxiety disorders, including Generalized Anxiety Disorder (GAD), Obsessive Compulsive Disorder (OCD), Panic Disorder, Post-Traumatic Stress Disorder (PTSD), Separation Anxiety Disorder (SAD), Specific Phobia, and Social Phobia (APA, 2000). These disorders remain in the DSM-5; however, they are separated into three separate but related chapters (i.e., Anxiety Disorders, Obsessive-Compulsive and Related Disorders, and Trauma- and Stressor-Related Disorders), which emphasize the distinctiveness of the categories comprising the chapters while still acknowledging similarities across the three categories (APA, 2013). In typically developing youth, anxiety symptoms and disorders commonly co-occur with other mental or physical health problems and are associated with functional impairment (Kendall et al., 2010). The common co-occurrence of internalizing psychopathology may reflect the shared trait of negative affectivity or general distress across anxiety and depressive disorders, as conceptualized by the
tripartite model (Clark & Watson, 1991). In the tripartite model, anxiety and depressive disorders are differentiated based on the presence of physiological hyperarousal or low positive affect (i.e., anhedonia). Specifically, anxiety disorders are characterized by high levels of both negative affect and physiological hyperarousal whereas depressive disorders feature high levels of negative affect and anhedonia (Clark & Watson, 1991).

In addition to ASD specific impairments, many children and adolescents with ASD present with co-occurring psychiatric disorders, with anxiety frequently cited as one of the most common comorbid impairments (Rosenberg et al., 2011; Simonoff et al., 2008). Recent reviews of the literature have estimated prevalence rates of anxiety in ASD to range from 11-84%; the wide range is partially attributable to whether anxiety symptoms or diagnoses were investigated (Van Steensel et al., 2011; White et al., 2009). A question remains as to whether the high prevalence rate of anxiety symptoms in ASD represents true comorbidity or may be attributed to symptom overlap, as core features of ASD (e.g., impaired social functioning, insistence on sameness, fearfulness) share commonalities with symptoms of anxiety disorders. For example, insistence on sameness is seen in both ASD and OCD. ASD and social anxiety in particular have similar features, such as social skill deficits; however, research using factor analysis has demonstrated the symptoms of the two disorders to be independent even though highly correlated (White, Ollendick, & Bray, 2011). Awareness of social difficulties paired with desire for social connection represents an additional proposed reason for high levels of anxiety in ASD, especially in individuals with HFA (Bellini, 2004).

Regardless of the source of anxiety in individuals with ASD, the high prevalence rate and additional impairment imparted by symptoms of anxiety is a replicated finding in
the extant literature (Van Steensel et al., 2011; White et al., 2009). Much research has been devoted to the investigation of factors associated with anxiety in children with ASD, which is necessary to identify risk factors for the development of anxiety and help guide treatment.

**Factors Associated with Anxiety**

Numerous factors, including cognitive functioning, age, autism severity, ASD specific social and communication deficits, and adaptive functioning have been investigated to determine their role in the development of anxiety symptoms in children with an ASD diagnosis. While such research has broadened the understanding of anxiety in cases of ASD, disparate findings across studies leave many unanswered questions (see Table 1).

**Table 1**

*Prior Investigation of Factors Associated with Anxiety in Youth with ASD*

<table>
<thead>
<tr>
<th>Author (year)</th>
<th>N*</th>
<th>Sample characteristics</th>
<th>Anxiety measure</th>
<th>Primary findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bellini (2004)</td>
<td>41</td>
<td>HFA (19), AspD (16), PDD-NOS (6); age range: 12-18 (M:14), no MR (IQ M: 99.94)</td>
<td>BASC (P), MASC (S), SAS-A (S)</td>
<td>Assertive social skills negatively associated with social anxiety ($r = - .313, p &lt; .05$); curvilinear relationship between empathic skills and social anxiety</td>
</tr>
<tr>
<td>Chang et al. (2012)</td>
<td>53</td>
<td>HFA (28), AspD (4), PDD-NOS (21); comorbid anxiety dx; age range: 7-11 (M:9.55)</td>
<td>ADIS-C/P (P)</td>
<td>More severe social anxiety disorder related to greater social functioning impairments ($r = -.368, p &lt; .01$)</td>
</tr>
<tr>
<td>Eussen et al. (2012)</td>
<td>134</td>
<td>AD (15), AspD (10), PDD-NOS (109); age range: 6-13 (M: 9); IQ range 48-124 (M: 91.4)</td>
<td>CBCL (P)</td>
<td>Levels of anxiety were negatively associated with quality of social relations ($r = -.21, p &lt; .05$) and symptom severity ($r = -.30, p &lt; .01$)</td>
</tr>
<tr>
<td>Study</td>
<td>N</td>
<td>Group Descriptions</td>
<td>Measure(s)</td>
<td>Findings</td>
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<tr>
<td>Gadow et al. (2005)</td>
<td>301</td>
<td>AD (103), AspD (80), PDD-NOS (118); age range: 6-12 (M:8)</td>
<td>CSI-4 (P)</td>
<td>Parents and teachers rated children with AD as having more severe anxiety than those with AspD or PDD-NOS</td>
</tr>
<tr>
<td>Kelly et al. (2008)</td>
<td>322</td>
<td>AD (76), AspD (188), PDD-NOS (21), subclinical (37); age range: 6-16 (M:11); 21% IQ&lt;70</td>
<td>SDQ-P (P)</td>
<td>Positive association between ASD symptomatology and anxiety/depression</td>
</tr>
<tr>
<td>Matilla et al. (2010)</td>
<td>50</td>
<td>AS (27), HFA (23); age range: 9-16 (M:12.7); IQ &gt; 75</td>
<td>K-SADS-PL (P)</td>
<td>Adaptive functioning lower in children with comorbid psychopathology, including anxiety disorders.</td>
</tr>
<tr>
<td>Mayes et al. (2011)</td>
<td>627</td>
<td>AD; age range: 1-17 (M:6.6); IQ range 16-146 (M:88)</td>
<td>PBS (P)</td>
<td>Higher levels of anxiety and depression as age, IQ, and ASD symptom severity increase</td>
</tr>
<tr>
<td>Mazurek &amp; Kanne (2010)</td>
<td>1,202</td>
<td>ASD: age range: 4-17 (M:9.1); IQ range: 39-167 (M:92.4)</td>
<td>CBCL (P)</td>
<td>Greater ASD symptom severity and fewer friendships associated with fewer anxiety/depression symptoms; higher IQ associated with more anxiety/depression symptoms</td>
</tr>
<tr>
<td>Niditch et al. (2012)</td>
<td>231</td>
<td>AD (140), AspD (10), PDD-NOS (81); age range: 2-9 (M:5), IQ (M:64.2)</td>
<td>BASC-2 (P)</td>
<td>Significant positive association between IQ and anxiety; association mediated by social understanding and aggression</td>
</tr>
<tr>
<td>Rosenberg et al. (2011)</td>
<td>4,343</td>
<td>AD (2161), AspD (1158), PDD-NOS (1024); age range: 5-18 (M:8.9); ID (1170)</td>
<td>Anxiety disorder dx (P)</td>
<td>Prevalence of parent reported comorbid anxiety diagnosis higher in youth with higher autism severity, increased age, and diagnosis of AspD or PDD-NOS</td>
</tr>
<tr>
<td>Simonoff et al. (2008)</td>
<td>112</td>
<td>AD (62), other ASD (50); age range: 10-14 (M:11.5); IQ range: 19-93 (M:72.7)</td>
<td>CAPA (P)</td>
<td>Autism severity, IQ, and adaptive functioning were not significantly associated with comorbid anxiety diagnosis.</td>
</tr>
<tr>
<td>Snow &amp; Lecavalier (2011)</td>
<td>108</td>
<td>AD (54), PDD-NOS (54); age range: 2.5-12 (M: 5.5); IQ (AD M: 74; PDD-NOS M: 76)</td>
<td>CBCL (P)</td>
<td>Autism severity was inversely related to anxiety symptoms.</td>
</tr>
<tr>
<td>Strang et al. (2012)</td>
<td>95</td>
<td>ASD; age range: 6-18 (M:11.7); IQ range: 71-144</td>
<td>CBCL (P)</td>
<td>No association between anxiety symptoms and age, IQ, or autism symptom severity.</td>
</tr>
<tr>
<td>Study</td>
<td>Sample Size</td>
<td>Sample Description</td>
<td>Tools</td>
<td>Findings</td>
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<tr>
<td>Sukhodolsky et al. (2008)</td>
<td>171</td>
<td>AD (151), AspD (6), PDD-NOS (14) age range: 5-17 (M: 8.2); IQ: &gt;70 (48), ≤70 (106), no score (17)</td>
<td>CASI (P)</td>
<td>Higher IQ, presence of functional language, and higher levels of stereotyped behaviors associated w/ greater anxiety; greater impairments in social reciprocity related to higher levels of anxiety in higher IQ children; exploratory analyses suggest positive association between anxiety and both adaptive behaviors and problem behaviors</td>
</tr>
<tr>
<td>Weisbrot et al. (2005)</td>
<td>483</td>
<td>AD (170), AspD (104), PDD-NOS (209); age range: 3-12; children 3-5 IQ (M:79), children 6-12 IQ (M: 87)</td>
<td>ECI-4/CSI-4 (P)</td>
<td>More severe symptoms of anxiety associated with higher IQ and more severe ratings of psychotic symptoms</td>
</tr>
<tr>
<td>White and Roberson-Nay (2009)</td>
<td>20</td>
<td>AD (2), AspD (15), PDD-NOS (3); age range: 7-14 (M:12); mean IQ = 92 (no ID)</td>
<td>MASC (S), CBCL (P)</td>
<td>Self-report: social disability and loneliness were not related to levels of anxiety in full sample; when split into groups, high anxiety group reported more social loneliness; parent report: higher levels of social initiation associated with less anxiety</td>
</tr>
</tbody>
</table>

Note. AD = autistic disorder, ASD = autism spectrum disorder; HFA = high functioning autism; AspD = Asperger’s Disorder; PDD-NOS = Pervasive Developmental Disorder Not Otherwise Specified; M = mean; dx = diagnosis; MR = mental retardation; (P) = parent report; (S) = self-report; BASC = Behavior Assessment System for Children; CASI = Child and Adolescent Symptom Inventory; MASC = Multidimensional Anxiety Scale for Children; SAS-A = Social Anxiety Scale for Adolescents; ADIS-C/P = Anxiety Disorders Interview Scale for DSM-IV; CBCL = Child Behavior Checklist; CSI-4 = Child Symptom Inventory-4; SDQ-P = Strengths and Difficulties Questionnaire-Parent Form; K-SADS-PL = Schedule for Affective Disorders and Schizophrenia for School-Age Children, Present and Lifetime Version; PBS = Pediatric Behavior Scale; BASC-2 = Behavior Assessment System for Children, Second Edition; CAPA = Child and Adolescent Psychiatric Assessment; ECI-4 = Early Childhood Inventory, Fourth Edition.

The majority of research investigating anxiety in ASD has been conducted with higher functioning children and adolescents (e.g., Bellini, 2004; Kim et al., 2000; White & Roberson-Nay, 2009). The diagnosis of an anxiety disorder relies heavily on self-report (Grondhuis & Aman, 2012), which can be problematic given the difficulty
individuals with HFA may have with processing and identifying emotions (Hill, Berthoz, & Frith, 2004). These difficulties may be compounded by additional impairments in receptive and expressive language inherent in individuals with lower cognitive functioning, further impeding the investigation of anxiety in the lower functioning subset of the ASD population. However, in a study conducted by Bradley, Summers, Wood, and Bryson (2004) using a diagnostic instrument specifically designed for use with lower functioning individuals, anxiety was indeed found to be prevalent among a sample of adolescents with ASD and severe intellectual disability (ID). More recent research has been conducted with participants spanning a wider range of cognitive functioning.

**Intellectual functioning.** Perhaps consistent with hypotheses suggesting a certain degree of awareness of social difficulties may relate to the development of anxiety in individuals with ASD (Bellini, 2004), many studies with this population have demonstrated a positive association between cognitive functioning and anxiety. Sukhodolsky et al. (2008) used the *Child and Adolescent Symptom Inventory* (CASI), which combines the *Child Symptom Inventory-4* (CSI-4: Gadow & Sprafkin, 1994) and *Adolescent Symptom Inventory-4* (Gadow & Sprafkin, 1997a), to examine anxiety symptoms in a sample of 171 youth with ASD dichotomized into those with cognitive impairment (IQ < 70) and without cognitive impairment (IQ ≥ 70). To accommodate participants of varying abilities, intellectual functioning was measured using a variety of intelligence tests, including the *Wechsler Intelligence Scale for Children, Third Edition* (WISC-III: Wechsler, 1991), *Wechsler Preschool and Primary Scale of Intelligence-Revised* (WPPSI-R: Wechsler, 1998), *Leiter International Performance Scale-Revised*
(Roid & Miller, 1997), Mullen Scales of Early Learning (MSEL: Mullen, 1995), and the Slossen Intelligence Test (Jensen & Armstrong, 1985). Findings from this study indicate parent ratings of anxiety on the CASI were higher in youth without cognitive impairment then in youth with cognitive impairment (Sukhodolsky et al., 2008). Likewise, Mazurek and Kanne (2010) found a positive relation between cognitive functioning and anxiety using the Child Behavior Checklist (CBCL: Achenbach & Rescorla, 2001) as a measure of anxiety in a well-characterized sample of 1,202 children and adolescents with ASD. Study data were obtained from the Simons Simplex Collection database, which utilized the Differential Abilities Scale-2nd Edition (DAS-II: Elliot, 2007) as the primary measure of intellectual functioning. Similar results suggesting higher levels of intellectual functioning are related to higher levels of anxiety have been found across a wide age range in studies using multiple measures of intelligence and anxiety (e.g., Mayes, Calhoun, Murray, & Zahid, 2011; Niditch, Varela, Kamps, & Hill, 2012).

In contrast, other studies failed to find a relation between intellectual functioning and anxiety in ASD. For example, Eussen et al. (2012) examined factors related to anxiety in 134 children with ASD and varying degrees of intellectual functioning (IQ range: 48-124). Despite the wide range of IQs sampled using the Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV: Wechsler, 2004), the majority of participant scores reflected average cognitive functioning. Results from this study indicated that cognitive functioning was unrelated to parent ratings of anxiety on the CBCL, perhaps because few participants scored at the extreme ends of the IQ distribution. Similarly, Strang et al. (2012) found no relation between intellectual functioning and anxiety in a sample of 95 children and adolescents with high functioning
ASD, which was defined as having an IQ greater than 70 on the WISC-IV or the *Wechsler Abbreviated Scale of Intelligence* (WASI: Wechsler, 2003). Some researchers have attributed results indicating a relation between intelligence and anxiety in ASD to the inclusion of children with ID in such studies (Strang et al., 2012); however, research conducted with participants whose IQ scores ranged from 19 to 124 also failed to find a significant relation between intelligence and likelihood of holding an anxiety diagnosis (Simonoff et al., 2008). Simonoff and colleagues identified comorbid anxiety diagnoses in their sample of 112 children with ASD using the *Child and Adolescent Psychiatric Assessment* (CAPA: Angold & Costello, 2000) and multiple verbal and nonverbal measures of intelligence.

A number of factors may have contributed to these contradictory findings, including measurement tools utilized (e.g., structured interviews [Simonoff et al., 2008] versus rating scales [Mazurek & Kanne, 2010; Strang et al., 2012; Sukhodolsky et al., 2008]; different measures of intelligence), operationalization of anxiety (e.g., general anxiety symptoms [Mazurek & Kanne, 2010; Strang et al., 2012] versus symptoms of specific anxiety disorders [Sukhodolsky et al., 2008] versus diagnoses [Simonoff et al., 2008]), and individual characteristics of the study participants not accounted for (e.g., adaptive functioning). According to a meta-analysis investigating anxiety in ASD conducted by Van Steensel et al. (2011), the relationship between IQ and anxiety may not be simple and linear but rather quadratic. Van Steensel and colleagues examined 31 studies and found that studies including children with IQs ranging from 70-87 reported higher levels of anxiety than those including children whose IQ scores fell above or below that range.
Chronological Age. Age has been implicated as a factor in development of anxiety in youth with ASD, albeit inconsistently. In their meta-analysis, Van Steensel et al. (2011) found studies featuring older participants reported higher rates of anxiety, which is consistent with other studies citing an increase in anxiety with age in youth with ASD (e.g., Mayes et al., 2011; Weisbrot, Gadow, DeVincent, & Pomeroy, 2005). Weisbrot and colleagues examined two groups of participants: 3-5 year and 6-12 years; parent ratings on the Early Childhood Inventory, Fourth Edition (ECI-4: Gadow & Sprafkin, 1997b) and CSI-4 indicated the older group of children had more symptoms of anxiety than the younger group of children (2005). Similar findings were reported by Mayes et al. (2011) using the Pediatric Behavior Scale (PBS: Lindgren & Koepppl, 1987) parent ratings to examine anxiety in 627 participants spanning a wide age range (1-17 years). However, findings from this study should be interpreted with caution, as the dependent measure of anxiety was endorsement of a single item on the PBS (i.e., “fearful, anxious, or worried”). Caution is also warranted when assessing anxiety in young children in general, as many fears and worries are evident early on in typical childhood developmental processes (Muris et al., 1998).

In contrast, other recent studies also with samples spanning wide age ranges have not found age to be related to anxiety in ASD (Mazurek & Kanne, 2010; Strang et al., 2012; Sukhodolsky et al., 2008). Each study spanned the entire range of school-aged children and demonstrated similar results using multiple measures of anxiety. It may be the case that these studies failed to find a relation between age and anxiety because their samples did not include very young children. Although recent studies have indicated that anxiety presents in up to 9% of typically developing preschoolers (e.g., Egger & Angold,
2006; Lavigne et al., 2009), perhaps anxiety is not present in children preschool age and younger with ASD. Alternatively, symptoms of anxiety may be present but expressed differently or mistakenly attributed to core autism symptoms, similar to the phenomenon of diagnostic overshadowing, or attribution of psychiatric symptoms to symptoms of the primary diagnosis, seen with individuals with intellectual disability (Mason & Scior, 2004). Regardless of the cause of these discrepant findings, further research is necessary to clarify the relation between age and anxiety in youth with ASD.

**Autism severity.** Several studies have reported an inverse association between anxiety and autism severity; however, the relation has been shown to vary as a function of how severity is defined and measured. In a study comparing symptoms of DSM-IV-TR anxiety disorders in 6- to 12- year-old children with ASD to children from clinic and community settings, severity was operationalized as a specific ASD diagnosis, with AD representing the greatest severity (Gadow, Devincent, Pomeroy, & Azizian 2005). Results indicated that children with AD had fewer parent-rated symptoms of anxiety on the CSI-4 than children with AspD and PDD-NOS (Gadow et al., 2005). Snow and Lecavalier (2011) also measured severity via diagnosis and obtained similar results in a sample that included children aged 2.5 to 12 years with AD and with PDD-NOS. Likewise, studies measuring severity using the calibrated severity score (CSS) from the *Autism Diagnostic Observation Schedule-Generic* (ADOS-G: Lord, Rutter, DiLavore, & Risi, 1999) with children aged 4 to 17 years found an inverse association between autism severity and anxiety (Mazurek & Kanne, 2010; Eussen et al., 2012).

In contrast to the studies described above, Simonoff et al. (2008) failed to find any relation between anxiety and ASD severity operationalized as the number of
International Classification of Disease-10 (ICD-10) symptoms endorsed during the diagnostic evaluation. These results are consistent with their findings regarding intellectual functioning (Simonoff et al., 2008). Given the strong associations of intelligence with autism severity demonstrated in prior research (e.g., Spiker, Lotspeich, Dimiceli, Myers, & Risch, 2002), similar associations between the two factors and anxiety are to be expected.

Discrepant from findings based on the use of diagnoses and observational measures as indicators of severity, the following studies found a positive association between autism severity and anxiety when measuring severity via parent-report. In a large-scale study investigating parent report of psychiatric comorbidity in 4,343 children (5-18 years) with ASD, greater autism severity measured via the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) was related to greater likelihood of being diagnosed with anxiety in the community (Rosenberg, Kaufmann, Law, & Law, 2011). In another study using structural equation modeling to investigate anxiety and depression, parents of children ages 6 to 16 with ASD (N=285) and parents whose children exhibited sub-clinical ASD traits (N = 37) completed on-line questionnaires regarding ASD symptomatology, anxiety and depression, and peer and family conflict (Kelly, Garnett, Attwood, & Peterson, 2008). Specifically, ASD symptomatology was measured via a scale created by the authors (Australian Scale for Autism Spectrum Disorder) and the emotional subscale of the Strengths and Difficulties Questionnaire-Parent Form (SDQ-P: Goodman, 2001) provided a measure of anxiety and depression. Study results indicate that ASD symptomatology is positively related to anxiety and depression (Kelly et al., 2008). Finally, in the Mayes et al. (2011) study that examined variables associated with
anxiety, the authors defined autism severity as the number of ASD symptoms endorsed on the PBS and anxiety as endorsement of a single item on the PBS. While ASD severity, age and IQ were all found to be associated with anxiety in ASD, ASD severity was the best predictor of anxiety (Mayes et al., 2011). However, this association may be attributable to shared method variance, given the use of a single measure for both the predictor and outcome variables.

In summary, when objective measures are used to measure broad ASD severity (e.g., diagnostic criteria), an inverse relation is typically found between symptom severity and anxiety; however, the opposite relation is found when ASD severity is measured via parent report. Further variation has been demonstrated in studies examining independent ASD deficits as opposed to broad symptom severity.

**Social Impairment.** Impaired social reciprocity is considered to be the primary core deficit in ASD (Sigman, 2004). Social impairments similar to those observed in ASD have been associated with anxiety in studies with typically developing youth (e.g., Cartwright-Hatton, Hodges, & Porter, 2003; Strauss, Lease, Kazdin, Dulcan, & Last, 1989). Given the social deficits inherent in ASD, examination of associations with anxiety is especially important in this population.

The first study to explore the relation between social factors and anxiety did so using parent and self report of social skills deficits and symptoms of social anxiety in a sample of 41 adolescents (12-18 years) with HFA, AspD, or PDD-NOS (Bellini, 2004). Parents and adolescents completed the *Social Skills Rating Scale* (SSRS; Gresham & Elliot, 1990) as a measure of social skills. The SRSS is composed of five subscales measuring different social skills, including cooperation, assertion, self-control,
responsibility, and empathy. Anxiety was measured via self-report ratings on the *Multidimensional Anxiety Scale For Children* (MASC; March, 1999) and the *Social Anxiety Scale for Adolescents* (SAS-A; La Greca, 1999) as well as parent ratings on the *Behavior Assessment System for Children* (BASC; Reynolds & Kamphaus, 1992).

Whereas parent-rated social skills were not found to be associated with self-reported social anxiety, self-reported social anxiety increased as self-reported rates of assertion, or likelihood of initiating or responding to social behaviors, decreased (Bellini, 2004). Additionally, self-reported empathy exhibited a curvilinear relation with social anxiety such that social anxiety initially increased as empathy increased, but once levels of empathy began to approach the normative mean, social anxiety decreased (Bellini, 2004).

Chang, Quan, and Wood (2012) obtained results similar to Bellini (2004) regarding assertion in a younger sample of 53 high functioning children (aged 7-11) with ASD and at least one comorbid anxiety disorder using parent-ratings from the SSRS. Anxiety disorder diagnosis was confirmed using the *Anxiety Disorders Interview Scale for DSM-IV: Parent and Child Versions* (ADIS-C/P; Albano & Silverman, 1996). Social anxiety disorder was the only diagnosed anxiety disorder found to be related to social skills in this study. Results indicated that parent-rated assertion and responsibility were negatively associated with social anxiety (Chang et al., 2012).

Similar results have been found in studies that measured social functioning with scales other than the SSRS. White and Roberson-Nay (2009) utilized parent ratings from the *Social Competence Inventory* (SCI; Rydell, Hagekull, &Bohlin, 1997) to measure social skills in their sample of 20 children and adolescents (aged 7-14) with ASD. Anxiety was measured via parent-report (CBCL) and self-report (MASC). Although
parent-rated social competencies were not significantly related to child reported levels of anxiety, the initiation subscale of the SCI was significantly negatively associated with parent-rated levels of anxiety, such that parents reported elevated levels of anxiety in children who were less likely to initiate social interactions (White & Roberson-Nay, 2009).

Social understanding is another specific aspect of social impairment in ASD. Unlike relations between initiation and anxiety, social understanding has been found to be positively correlated with anxiety (Niditch et al., 2012). Niditch and colleagues found higher scores on the Social Understanding subscale of the Behavior Assessment System for Children, 2nd Edition (BASC-2; Reynolds & Kamphaus, 2004) were associated with greater anxiety, also measured via the BASC-2, in their sample of 231 young children with ASD. Perhaps greater social understanding paired with otherwise impaired social functioning permits greater awareness of other social deficits and, therefore, increased anxiety.

Social deficits defined more broadly have also been shown to relate to anxiety. Sukhodolsky et al. (2008) reported that youth with more social interaction deficits as measured by the Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994) had higher levels of anxiety, although this relation was only found to be significant in the high functioning group. Sukhodolsky and colleagues also examined parent-reported social impairment via parent-report using the Lethargy/Withdrawal subscale of the Aberrant Behavior Checklist (ABC; Aman et al. 1895). Results indicated youth with more problems initiating and responding to social interactions exhibited higher levels of anxiety, regardless of cognitive functioning (Sukhodolsky et al. 2008).
Likewise, Eussen et al. (2012) found lower quality of social relationships, as measured by the social relations subscale of the *Children’s Communication Checklist* (CCC; Bishop, 1998), to be associated with higher levels of parent-rated anxiety on the CBCL.

Whereas the vast majority of research investigating the relationship between social functioning and anxiety suggest greater social deficits to be associated with more anxiety, a few studies have found no relation. Strang et al. (2012) utilized the ADOS to examine the relation of the triad of ASD impairments with anxiety in youth with HFA. Results suggest that neither severity of social and communication deficits nor stereotyped and repetitive behaviors were related to levels of anxiety (Strang et al., 2012). The authors suggest failure to find a relation between severity of the triad of ASD core deficits and anxiety might have been a result of their use of a higher functioning sample that may have limited the range of symptom severity (Strang et al. 2012).

In sum, most studies found that anxiety increases as factors related to social reciprocity decrease (Bellini, 2004; Chang et al., 2004; Eussen et al., 2012; Sukhodolsky et al., 2008). The opposite relation was demonstrated upon investigation of social understanding (Niditch et al., 2012), such that anxiety increased as social understanding increased. Similarly, Bellini (2004) found empathy to positively relate to anxiety; however, the relation became negative once empathy reached normative levels. Across all research reviewed regarding the relation between social impairment and anxiety, significant associations were only found when the same person was rating both social impairment and anxiety (i.e., both parent-rated or both youth-rated). As such, perhaps significant findings are the result of shared method variance as opposed to actual relations between social impairment and anxiety.
Adaptive functioning. Adaptive functioning refers to the ability to perform a variety of behaviors required for everyday life. Such behaviors include functional communication, social, daily living, and motor skills (Sparrow, Cicchetti, & Balla, 2005). Whereas youth with ASD demonstrate deficits across all areas of adaptive functioning (Paul et al., 2004; Tomanik et al., 2007), patterns of strengths and weaknesses in other studies have been observed. The typical adaptive profile of youth with ASD includes relative strength in academic skills and communication, relative weakness in daily living skills and severe weakness in adaptive social behaviors (e.g., Bolte & Poustka, 2002; Lopata et al., 2012).

Despite a broad base of research indicating severe adaptive functioning deficits in youth with ASD (e.g., Paul et al., 2004; Tomanik et al., 2007) as well as the consensus that youth with ASD and comorbid anxiety symptoms evidence more impairment than those without anxiety, few studies have investigated the relation between adaptive functioning and anxiety in youth with ASD. The lack of investigation into the association between adaptive behaviors and anxiety may be due to an assumption that social and communication deficits inherent in ASD are synonymous with lower adaptive social and communication skills. However, research has demonstrated a lack of adaptive skills is less similar to social and communication deficits in youth with ASD than assumed (Kanne et al., 2011; Klin et al., 2007).

Klin et al. (2007) examined social abilities and disabilities in males with ASD and IQ scores greater than 70. Participants were included from the Yale Child Study Center and two university autism clinics in Michigan. ADOS domain scores were utilized as measures of social and communication deficits while social and communicative abilities
were measured via the Vineland Adaptive Behavior Scale-Second Edition (VABS; Sparrow et al., 2005). Whereas communication ability was significantly inversely related to communication and social deficits across all participants, social ability was unrelated to autism symptomatology in the Yale sample and only minimally, yet significantly, related to communication and social deficits in the Michigan sample. Despite some variability between the two sites, which authors attributed to sample size differences, overall correlations were weak between autism deficits and adaptive skills.

Similar results were obtained by Kanne et al. (2011) in a larger sample of youth with autism and a wide range of intellectual functioning. In addition to the VABS and ADOS, Kanne and colleagues used the ADI-R and SRS as supplementary measures of autistic symptomatology. While negative correlations were noted between adaptive behavior and parent report of social and communication impairment, there was no relation between adaptive behavior and social and communication impairment observed on the ADOS. The authors hypothesized that the significant correlations found may be due to common ascertainment method and represent informant rather than participant characteristics (Kanne et al., 2011). Results suggest that independence of social and communication abilities and disabilities exists across all levels of intellectual functioning.

In the most recently published investigation of adaptive behavior and autistic symptomatology, Lopata et al. (2012) utilized the Adaptive Behavior Assessment System-II (ABAS-II: Harrison & Oakland, 2003) with 41 children with HFA. Consistent with Klin et al. (2007) and Kanne et al. (2011), Lopata et al. (2012) found adaptive social and communication skills to be unrelated to social and communication deficits. Given similar findings across studies using different samples and measures of adaptive functioning, the
role that adaptive behavior plays in manifestation of associated problems such as anxiety should be examined in youth with ASD.

Of the few studies that have investigated the association of adaptive functioning with anxiety in ASD, all have used exploratory analyses with no a priori hypotheses. Findings across studies have been inconsistent. In their study of parent-rated anxiety symptoms in high and low functioning children with ASD, Sukhodolsky et al. (2008) used the VABS as a measure of adaptive functioning to explore the relation of daily living, socialization, and communication skills with anxiety. When looking at the entire sample together, all adaptive behaviors were positively associated with anxiety; however, upon splitting the sample into high and low cognitive functioning groups, the associations remained significant only in the lower functioning group. In their study of social and communicative abilities and disabilities, Klin and colleagues (2007) found that as IQ scores increase, the correlation between IQ and adaptive behaviors decreased. Given differential associations of IQ and adaptive behaviors depending on intelligence level, perhaps the results obtained by Sukhodolsky and colleagues in the low functioning group actually reflect the association between IQ and anxiety. Additionally, results demonstrate the importance of looking at adaptive behaviors separately, as relatively strong communication skills may mask lower adaptive social and daily living skills when defining adaptive functioning broadly. Further examination of specific adaptive behaviors and anxiety in both high and low functioning individuals with ASD is necessary to clarify the nature of their relation.

Simonoff et al. (2008) also used the VABS to measure adaptive functioning in their investigation of comorbid diagnoses in a population-based sample of children with
ASD. The authors utilized the composite score, which reflects all behaviors required for adaptive functioning. In contrast to results obtained by Sukhodolsky et al. (2008), Simonoff et al. failed to find a relation between adaptive functioning and comorbid anxiety diagnoses in children with autism, consistent with other non-significant findings related to IQ and age in this sample (2008). The authors propose that individual characteristics such as adaptive functioning lack utility in predicting anxiety relative to ASD diagnosis, a more potent risk factor (Simonoff et al., 2008). Alternatively, looking at the adaptive composite score rather than separate domain scores or not separating high and low functioning participants may have masked significant findings.

Another study that investigated the association between adaptive functioning and comorbid psychiatric diagnoses utilized the Children’s Global Assessment Scale (CGAS: Shaffer et al. 1983) as a measure of adaptive functioning (Matilla et al., 2010). Comorbid diagnoses were assessed with the Schedule for Affective Disorders and Schizophrenia for School-Age Children, Present and Lifetime Version (K-SADS-PL; Kaufmen et al. 1997). Matilla and colleagues explored broad adaptive functioning in a community and clinic-based sample of 50 Finnish youth (7-13 years) with HFA and AspD (IQ > 75). Results indicated adaptive functioning was lower in participants with anxiety and other comorbid psychiatric conditions in this high functioning sample.

Perhaps discrepant findings regarding factors related to anxiety across studies reflect the different characteristics of the study samples (e.g., mean IQ scores, mean adaptive functioning scores), operationalization of independent variables, and outcome being investigated (symptoms or specific diagnoses). Studies investigating the relation of adaptive functioning with anxiety in samples of children with a wide range of cognitive
functioning found that higher adaptive functioning was related to more anxiety (Sukhodolsky et al., 2008). However, when limiting participants to those with HFA, either no relation (Sukhodolsky et al., 2008) or the opposite relation (Matilla et al., 2010) was found. The heterogeneous nature of ASD may be an additional reason for the contradictory findings reported across all factors reviewed (i.e., intellectual functioning, chronological age, autism severity, social impairment, and adaptive functioning). As the manifestation of ASD is highly variable across the spectrum, research with larger, more diverse samples is necessary to further elucidate the relation between individual characteristics and anxiety.

**Purpose of the Present Study**

The purpose of the present study is to further investigate characteristics related to risk for anxiety problems in children and adolescents with autism spectrum disorders using data from a large national sample. Youth in the Simons Simplex Collection (SSC) database have been characterized as having higher mean levels of anxiety problems than would be expected given the CBCL normative sample (Mazurek & Kanne, 2010), consistent with the large body of research reporting higher levels of anxiety in youth with ASD compared to typically developing youth (Van Steensel et al., 2011; White et al., 2009). Given contradictory findings across samples of varying size and composition, the current study seeks to examine how individual factors, primarily focusing on adaptive social behaviors, are associated with risk for anxiety problems in individuals with ASD. Furthermore, the study will explore how the relation between adaptive social behaviors and risk for anxiety problems differs across individuals with different levels of cognitive functioning (i.e., IQ greater than 70 or IQ less than or equal to 70). An improved
understanding of potential risk factors for anxiety problems, and whether cognitive functioning moderates the relation between adaptive social behaviors and anxiety problems, has implications for assessment and treatment. To date, no published study has explored the relation of adaptive social behaviors with anxiety problems using a priori hypotheses. The two specific questions the present study seeks to address are described below.

First, is risk for anxiety problems associated with individual characteristics, including chronological age, cognitive functioning, ASD symptom severity, social problems, and adaptive social behaviors? As findings of significant associations between age and anxiety level have been confined to studies utilizing samples that include children below age four, age is not hypothesized to be related to anxiety risk in this sample of school-aged children and adolescents (ages 4-17 years). It is hypothesized that risk for anxiety problems will be higher in youth with average or greater levels cognitive functioning (i.e., IQ > 70) and more adaptive social behaviors. Anxiety risk is also hypothesized to be positively associated with parent-reported social problems; however, consistent with past research (e.g., Eussen et al., 2012; Gadow et al., 2005; Mazurek & Kanne, 2010; Snow & Lecavalier, 2011), probability of risk for anxiety problems is hypothesized to be negatively associated with clinician-observed ASD symptom severity.

Second, does the relation between adaptive social behaviors and risk for anxiety symptoms differ between individuals with different levels of cognitive functioning? Prior investigations of the association of anxiety and social impairment have produced inconsistent findings, which some authors have postulated to be due to the varying functional level of the samples investigated (e.g., Strang et al., 2012). Thus, the second
research question attempts to elucidate the way in which intellectual functioning may affect the relation between adaptive social behaviors and risk for anxiety symptoms. Given differential correlations between adaptive behaviors and intellectual functioning as intellectual functioning increases (e.g., Perry, Flanagan, Geier, & Freeman, 2009) and prior research exploring the relation of adaptive functioning with anxiety in youth with ASD (Matilla et al., 2010; Sukhodolsky et al., 2008), it is hypothesized that probability of anxiety problems will increase as levels of adaptive social behaviors increase for youth with low cognitive functioning (i.e., IQ ≤ 70). The opposite relation is expected for youth with low average or average intellectual functioning (i.e., IQ > 70).
Chapter Two

Method

Participants

The sample for the current study was drawn from 2,759 families participating in the Simons Simplex Collection (SSC; http://sfari.org/simons-simplex-collection), a nationally representative genetic and phenotypic data collection. For the purposes of the current study, the participant pool was narrowed using listwise deletion to include only individuals with complete data and inclusion criteria, which is considered appropriate given the small percentage (3.6%) of participants excluded (Graham, 2009). After conducting listwise deletion for missing data points, the final sample consisted of 2,662 probands with AD. The majority of the sample was male (86.4%). Proband age, reported at the time of the ADOS administration, ranged from 4 to 18 years old (mean age = nine years, SD = 3.39). The majority of probands were White (78.3%) and of non-Hispanic ethnicity (88.5%). Other ethnicities comprising the SSC included more than one race (7.8%), other (4.5%), African American (4%), Asian (4%), not reported (0.8%), and Native American or Hawaiian (0.3%). Full Scale IQ scores ranged from 7 to 167 (mean = 80.61, SD = 27.78), with the majority of the sample earning scores greater than 70 (68.4%). Additional sample characteristics are reported in Table 2.

Inclusion Criteria. Simons Foundation Autism Research Initiative (SFARI) investigators established participant inclusion criteria. To be included in the SSC dataset, participants must have received an Autism Diagnostic Interview – Revised (ADI-R; Rutter et al., 2003) rating above the cutoff for the Social and Communication domains.
Participants were also included if they met the cutoff for one domain and fell within 2 points of the cutoff for the other, or if they were 1 point from the cutoff for both ADI-R domains. Additionally, participants were required to meet cutoff scores for autism spectrum or autism on the ADOS and be between the ages of 4 years and 17 years, 11 months. Inclusion criteria for cognitive abilities varied by age. At age 4 years, participants were required to have a nonverbal IQ score greater than or equal to 60, participants ages 5-8 were required to have a nonverbal IQ score greater than or equal to 40, and those 8 years and older were required to have a nonverbal mental age of 36 months or older, as measured by standardized cognitive assessment instruments. Participants must have a “best estimate diagnosis” of Autistic Disorder, Asperger’s Disorder, or PDD-NOS as delineated by the DSM-IV-TR diagnostic criteria. Finally, the biological parents and at least one sibling of the participant must not have been diagnosed with an ASD.

Exclusion Criteria. SFARI researchers also outlined participant exclusionary criteria. Children were excluded from the study if they were delivered at fewer than 36 weeks gestation, experienced significant birth complications or weighed less than 2,000 grams at birth. Participants for whom genetic testing had confirmed a diagnosis of Fragile X syndrome were excluded, as were children diagnosed with Down Syndrome. Likewise, children with sensory or motor difficulties that would preclude the valid use of a diagnostic instrument or those with a history of severe nutritional or psychological deprivation were excluded.
Data Collection

The current study used extant data collected by the Simons Foundation as part of a nationwide study to examine linkages between genotype and phenotypic features of a well-characterized sample of children with autism. Identifying information is excluded from the database made available for researchers, per SFARI procedures. The researchers were granted access to the database of phenotypic variables by the Simons Foundation. The following phenotypic variables were examined in the current study: Aberrant Behavior Checklist (ABC; Aman et al., 1985), Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2002), Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001), Differential Ability Scales, 2nd Edition (DAS-II; Elliot 2007), Mullen Scales of Early Learning (MSEL; Mullen 1995), Wechsler Intelligence Scale for Children, 4th Edition (WISC-IV; Wechsler 1999), Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler 2003), and Vineland Adaptive Behavior Scales, 2nd Edition (Vineland-II; Sparrow et al. 2005). The analyses conducted as part of the current study utilized Version 14.2 of the Simons Simplex Collection.

Measures

**Autism Severity.** The current study investigated clinician-observed autism severity, which includes social and communication deficits as well as repetitive and restrictive behaviors, via the ADOS calibrated severity score (CSS). The ADOS is a semi-structured, standardized assessment that assesses an individual’s behavior in the areas of communication, reciprocal social interaction, imagination/creativity, and stereotyped behaviors and restricted interests. It includes four modules: Module 1 (Pre-Verbal/Single Words), Module 2 (Phrase Speech – Non fluent), Module 3 (Fluent Speech
– Child/Adolescent) and Module 4 (Fluent Speech – Adolescent/Adult). The ADOS is scored via a diagnostic algorithm that provides cutoff values for diagnosis of AD and ASD. The ADOS manual reports interrater reliability studies for Modules 1 through 4 in which “all items exceeded 80% agreement” and the mean percent agreement ranged from 88.2 to 91.5%.

The CSS, a metric developed to compare overall ASD severity across individuals administered ADOS modules 1-3 (Gotham et al., 2009), was computed for all participants to serve as a measure of clinician-rated ASD symptom severity. Gotham and colleagues found the CSS to be less influenced by participant demographic characteristics than raw ADOS total scores.

**Social Problems.** Parent-rated social problems were measured via the ABC, a 58-item third-party rating scale composed of 5 subscales related to different types of problem behaviors (Irritability, Lethargy/Social Withdrawal, Stereotypic Behavior, Hyperactivity, and Inappropriate Speech). Items are rated on a 4-point scale; higher scores are representative of more severe problem behavior. The parent-rated ABC has satisfactory reliability and validity with normative data for individuals with developmental disabilities (Brown et al. 2002).

For the purposes of the current study, the Lethargy/Social Withdrawal subscale will be used as a measure of parent-rated social impairment, as items include observable behaviors reflecting a child’s social interaction (e.g., “is difficult to reach, contact, or get through to;” “shows few social reactions to others”). Research examining the ABC with youth with ASD suggests that the Lethargy/Social Withdrawal subscale may be a useful
measure of social disability in this population, as it not only reflects observable social behaviors but is also sensitive to change over time (Scahill et al., 2013).

**Intellectual Functioning.** Intellectual functioning was measured via different IQ measures dependent on participant age and ability level. The majority of participants (81%) were administered the DAS-II. Additional IQ measures utilized in the SSC study included the MSEL, WISC-IV, or WASI.

The DAS-II is composed of 20 cognitive subtests that measure conceptual and reasoning abilities with separate preschool and school age versions for use with children ages 30 months to 17 years of age. Reported psychometric statistics indicate high test-retest reliability across the major indices (coefficients range from 0.85-0.94) as well as high interrater reliability (0.98-0.99). Scores from the DAS are highly correlated with scores from the WASI, WISC-IV, WPPSI-III, Bayley-III, and Bracken School Readiness Assessment.

The WASI yields indices for Verbal and Performance ability as well as overall level of intellectual functioning (FSIQ). The test-retest reliability coefficient reported in the WASI manual was high (0.92), as was subtest inter-rater reliability (0.98-0.99).

The WISC-IV yields composite scores for verbal comprehension, perceptual reasoning, working memory, and processing speed as well an overall estimate of intellectual functioning (FSIQ). The average reliability coefficient reported for the FSIQ was 0.97 and the test-retest reliability was 0.89.

The MSEL is designed to assess cognitive and motor development in children from birth to 68 months through performance across five scales, including Gross Motor, Fine Motor, Visual Reception, Expressive Language, and Receptive Language. Scores
from the five scales together comprise the Early Learning Composite, which is used to reflect intellectual functioning in the SSC database. The MSEL manual reports test-retest reliability of over 0.80 when used with children 1-24 months of age and 0.70 for 25-56 months of age. Median split half internal consistency exceeded 0.75 for composites and subscales.

Considering the variety of intellectual assessments used with participants in the database, the equivalent of the FSIQ scores from each assessment were dichotomized into two groups: high and low cognitive functioning. Specifically, low cognitive functioning youth were classified as earning a score of 70 or below and high cognitive functioning youth were classified as having a score greater than 70.

**Risk for Anxiety Problems.** The CBCL is a standardized parent report questionnaire used to assess behavioral and emotional functioning in children and adolescents (Achenbach & Rescorla, 2001). CBCL items are scored on a 3-point scale, with higher scores indicating more symptoms of anxiety. The CBCL produces three summary scores (i.e., Total Problems, Internalizing Problems, and Externalizing Problems) as well as the following syndrome scales: anxious/depressed, withdrawn, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior, and aggressive behavior. Additionally, scores are reported for DSM-IV categories, including anxiety problems. For the DSM-oriented scales, T-scores below 65 represent the normal range and T-scores of 65 and above represent combined borderline clinical and clinically significant problems (Achenbach, Dumenci, & Rescorla, 2003). The CBCL is one of the most frequently used parent-report measures of childhood
emotional and behavioral symptoms and has been thoroughly investigated in clinical and community samples (Achenbach, 1991).

For the purposes of the current study, the DSM-IV-oriented Anxiety Problems scale was used, as it eliminates items that overlap with depression to reflect anxiety symptoms alone and demonstrates adequate psychometric properties (Nakamura, Ebesutani Bernstein, & Chorpita, 2008). Given that the primary focus of the current study was on youth with clinically significant levels of anxiety problems, the outcome variable was risk for parent-rated anxiety problems. To create the outcome variable, parent-rating scores were dichotomized into groups reflecting high and low risk for anxiety problems such that youth who received t-scores less than 65 were classified as low risk and youth who received a t-score of 65 or greater, indicating at-risk or clinically significant levels of anxiety symptoms (Achenbach & Rescorla, 2001), were classified as high risk. Although the transformation of a continuous variable into a dichotomous variable typically results in a loss of explanatory information, because the purpose of the present study is detection of factors associated with anxiety risk, it was preferable to compare individuals with scores operationalized by the CBCL as at high risk or at low risk rather than compare individuals on the basis of their actual numerical score. Given that the majority of participants had CBCL Anxiety Problems scores below 65, the potential that these participants’ scores when kept continuous may mask the detection of clinically relevant anxiety risk factors was considered more harmful than potential loss of information.

**Adaptive Social Behaviors.** The VABS-II is a semi-structured, parent interview designed to assess functional personal and social abilities in individuals from birth to
adulthood. The VABS-II yields standard scores (Mean=100, SD=15) in Communication, Daily Living Skills, Socialization, and Motor Skills domains that combine to form an overall Adaptive Behavior Composite standard score. Each domain is composed of subscales with a mean of 15 and standard deviation of 3. Higher scores indicate more advanced adaptive behaviors. For the purposes of the current study, the Socialization domain was used as a measure of youth adaptive social behaviors. The Socialization domain includes items reflecting discrete, developmentally appropriate social behaviors, including social response, social communication, emotion expression and recognition, thoughtfulness, friendship, imitation, and dating (e.g., “shows interest in children the same age;” “uses actions to show happiness or concern for others;” “answers when familiar adults make small talk”).

**Analyses**

All analyses were conducted using SPSS 21.0. Descriptive analyses were conducted to determine the means and standard deviations of all included continuous variables and frequencies of all categorical variables. Preliminary bivariate analyses were conducted to examine the associations of risk for anxiety problems with demographic variables (age, gender, and race) and other individual characteristics (cognitive functioning [1 = IQ > 70, 0 = IQ ≤ 70], clinician-reported autism severity [ADOS CSS], parent-reported social problems [ABC Social Withdrawal/Lethargy] and adaptive social behaviors [VABS-II Socialization]) as well as relations among potential predictor variables to detect multicollinearity threats.

To investigate the first research question, a multivariate logistic regression model was built to examine hypothesized predictor variables. The outcome variable for this and
all subsequent analyses was risk for anxiety symptoms based on CBCL Anxiety Problems scores (1 = High risk, 0 = low-risk). Hypothesized predictor variables, including age, gender, cognitive functioning, clinician-rated autism severity, parent-rated social problems, and parent-rated adaptive social behaviors, were entered into a multivariate logistic regression model to determine which variables were significantly associated with anxiety risk when accounting for the other variables.

An additional multivariate logistic regression model was created using moderation analysis procedures outlined by Holmbeck (2002) to examine whether intellectual functioning moderated the relation between adaptive social behaviors and risk for anxiety problems (question two). A two-step hierarchical logistic regression was conducted to examine the significance of the interaction effect of VABS-II Socialization by cognitive functioning group on risk for anxiety problems. Potential covariates (i.e., predictors found to be significantly related to anxiety risk in the first analysis), mean centered VABS-II Socialization scores and the cognitive functioning group variable were entered in the first step followed by the centered VABS-II Socialization X cognitive functioning group interaction term in the second step. The conditional effects of VABS-II Socialization scores on anxiety risk for youth with high and low cognitive functioning were examined using the Modprobe SPSS macro (Hayes & Matthes, 2009).
### Table 2

**Participant Characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>% of Sample</th>
<th>Skew</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>2301</td>
<td>86.4</td>
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<tr>
<td>Females</td>
<td>361</td>
<td>13.6</td>
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<td>White</td>
<td>2084</td>
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<tr>
<td>Non-White</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>8.82</td>
<td>3.39</td>
<td>.63</td>
<td>-.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Functioning</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ &gt; 70</td>
<td>1820</td>
<td>68.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ ≤ 70</td>
<td>842</td>
<td>31.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBCL Anxiety Problems**</td>
<td>60.44</td>
<td>9.15</td>
<td>.48</td>
<td>-.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Risk</td>
<td>1646</td>
<td>61.8</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>High Risk</td>
<td>1016</td>
<td>38.2</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>ADOS CSS</td>
<td>7.44</td>
<td>1.68</td>
<td>-.09</td>
<td>-.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VABS-II Socialization</td>
<td>71.05</td>
<td>12.62</td>
<td>.03</td>
<td>.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABC Social Withdrawal/Lethargy</td>
<td>9.71</td>
<td>7.12</td>
<td>.90</td>
<td>.66</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* CBCL = Child Behavior Checklist (parent-rated); ADOS CSS = Autism Diagnostic Observation Schedule Calibrated Severity Score (clinician-rated); VABS-II = Vineland Adaptive Behavior Scale, Second Edition (parent-rated); ABC = Aberrant Behavior Checklist (parent-rated)
Chapter Three

Results

Preliminary Analyses

Preliminary analyses were conducted to describe and compare demographic and clinical characteristics of youth with low versus high risk of anxiety problems on the CBCL (Table 3). More than 38 percent of youth in this sample fell in the high-risk group. No significant differences were found between the two groups on race or clinician-rated autism severity (ADOS CSS). Comparisons indicated that the high CBCL Anxiety Problems risk group (n = 1016) contained a significantly larger proportion of males (χ²= 5.85, p < .01) and participants with an IQ greater than 70 (χ² = 26.82, p < .001) than the low risk group (n = 1646). Compared to the low risk group, the high-risk group included participants with a higher mean age (t = 9.1, p < .001) and ABC Lethargy/Social Withdrawal score (t = 11.28, p < .001). Groups also differed in adaptive social skills, (t = 3.00, p < .01), such that mean VABS-II Socialization scores were significantly lower in the high-risk group.

Bivariate correlations revealed significant associations among several continuous predictor variables at the α = .05 level (Table 4). Small to moderate negative relations were detected between VABS-II Socialization scores and ADOS CSS scores, age, and ABC Lethargy/Social Withdrawal scores (r = -.16, -.32, and -.37, respectively). ABC scores showed a small positive association with age and ADOS CSS scores (r = .11, .10, respectively). Given that the correlations detected were small in magnitude, multicollinearity was not considered to be a threat in subsequent analyses.
Table 3

Comparison of Youth with Low and High Risk of CBCL Anxiety Problems

<table>
<thead>
<tr>
<th></th>
<th>High Risk (n = 1016)</th>
<th>Low Risk (n = 1646)</th>
<th>χ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Categorical Variables</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Functioning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ ≤ 70</td>
<td>261 (25.7)</td>
<td>581 (35.3)</td>
<td>26.82***</td>
</tr>
<tr>
<td>IQ &gt; 70</td>
<td>755 (74.3)</td>
<td>1065 (64.7)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>899 (88.5)</td>
<td>1402 (85.2)</td>
<td>5.85**</td>
</tr>
<tr>
<td>Female</td>
<td>117 (11.5)</td>
<td>244 (14.8)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>814 (80.1)</td>
<td>1270 (77.2)</td>
<td>3.24</td>
</tr>
<tr>
<td>Non-Caucasian</td>
<td>202 (19.9)</td>
<td>376 (22.8)</td>
<td></td>
</tr>
<tr>
<td>Continuous Variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADOS CSS</td>
<td>7.36 (1.69)</td>
<td>7.49 (1.67)</td>
<td>1.93</td>
</tr>
<tr>
<td>VABS-II Socialization</td>
<td>70.11 (11.85)</td>
<td>71.62 (13.04)</td>
<td>3.00**</td>
</tr>
<tr>
<td>ABC Lethargy/Social Withdrawal</td>
<td>11.65 (7.46)</td>
<td>8.52 (6.63)</td>
<td>11.28***</td>
</tr>
<tr>
<td>Age (years)</td>
<td>9.57 (3.18)</td>
<td>8.35 (3.43)</td>
<td>9.10***</td>
</tr>
</tbody>
</table>

Note. * denotes p < .05, ** denotes p < .01, *** denotes p < .001

Table 4

Correlations for Continuous Predictor Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ADOS CSS</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 VABS-II Socialization</td>
<td>-.16***</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 ABC Lethargy/Social Withdrawal</td>
<td>.10**</td>
<td>-.37***</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4 Age (years)</td>
<td>-.01</td>
<td>-.32***</td>
<td>.11***</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. * denotes p < .05, ** denotes p < .01, *** denotes p < .001

Primary Analyses

**Question one: Individual characteristics associated with anxiety risk.** A multivariate logistic regression model was fit to the data to test the hypothesized relations of several individual characteristics with risk for CBCL Anxiety Problems (0 = low-risk, 1 = high-risk), the outcome variable. The proportion of high-risk youth is provided in
Table 2. Since age and gender differed significantly across high and low anxiety risk groups, both variables were entered into the logistic regression as covariates despite no hypothesized relation. The hypothesized explanatory variables entered in the model were intellectual functioning (0 = IQ > 70, 1 = IQ ≤ 70), clinician rated autism severity (ADOS CSS score), parent-rated social problems (ABC Lethargy/Social Withdrawal score), and parent-rated adaptive social behaviors (VABS-II Socialization score).

Results of the logistic regression analysis investigating youth risk for anxiety problems are provided in Table 5. The likelihood ratio statistic indicated that when compared to the baseline model, the model containing the hypothesized explanatory variables provided a better fit to the data; however, the goodness-of-fit statistic indicated that the model did not provide the best fit to the data. When considering individual characteristics, gender, intellectual functioning, age, and parent-rated social problems were significantly related to the log of the odds of being at risk for anxiety problems at the α = .05 level. Holding other hypothesized explanatory variables constant, high-risk youth were significantly less likely to be female (odds ratio [OR] = 0.69, 95% CI [0.54, 0.89]) and more likely to have average or greater intellectual functioning (OR = 1.96, 95% CI [1.58, 2.43]). Additionally, likelihood of being classified as high risk increased as age (odds ratio = 1.11, 95% CI [1.08, 1.13]) and parent-reported social problems increased (OR = 1.07, 95% CI [1.06, 1.09]). Contrary to study hypotheses, parent-rated adaptive social behaviors and clinician-rated autism severity were not significantly related to risk for anxiety problems at the α = .05 level.
Table 5

Logistic Regression Analysis of Youth Risk for Anxiety Problems

<table>
<thead>
<tr>
<th>Variable</th>
<th>B(SE)</th>
<th>Wald’s $\chi^2$</th>
<th>df</th>
<th>p</th>
<th>OR [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.10 (.43)</td>
<td>24.39</td>
<td>1</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-0.37 (.13)</td>
<td>8.13</td>
<td>1</td>
<td>&lt;.01</td>
<td>0.69 [.54, .89]</td>
</tr>
<tr>
<td>Male (ref)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Age</td>
<td>0.10 (.01)</td>
<td>60.69</td>
<td>1</td>
<td>&lt;.001</td>
<td>1.11 [1.08, 1.13]</td>
</tr>
<tr>
<td>Cognitive Functioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ &gt; 70</td>
<td>0.67 (.11)</td>
<td>37.36</td>
<td>1</td>
<td>&lt;.001</td>
<td>1.96 [1.58, 2.43]</td>
</tr>
<tr>
<td>IQ ≤ 70 (ref)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>ADOS CSS</td>
<td>-0.05 (.03)</td>
<td>3.22</td>
<td>1</td>
<td>.07</td>
<td>0.96 [0.91, 1.00]</td>
</tr>
<tr>
<td>ABC Lethargy/Social Withdrawal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VABS-II Socialization</td>
<td>0 (0)</td>
<td>0.04</td>
<td>1</td>
<td>.84</td>
<td>1.00 [0.99, 1.01]</td>
</tr>
</tbody>
</table>

Overall Model Summary

| Likelihood Ratio Test      | 253.67  | 6       | <.001 |
| Goodness of Fit            |         |         |       |
| Homer Lemeshow Test        | 23.41   | 8       | <.01  |

Note. OR = odds ratio; CI = confidence interval.

**Question two: Investigation of cognitive functioning as a moderator.** A moderation analysis was conducted in accordance with the procedure outlined by Holmbeck (2002) to investigate the second research question regarding whether the relation of parent-rated adaptive social behaviors (VABS-II Socialization score) and risk for anxiety problems (CBCL Anxiety Problems) is different for children with different levels of cognitive functioning, controlling for gender, age, and parent-rated social problems (ABC Social Withdrawal/Lethargy score). The likelihood ratio statistic indicated that when compared to the baseline model, the model containing the hypothesized explanatory variables with the interaction term provided a better fit to the data than the null model; however, results from the goodness-of-fit test suggest that the
model does not provide the best fit to the data. Results from the hierarchical logistic regression model built to examine the main effects of adaptive social behaviors and cognitive functioning as well as their interaction are presented in Table 6. The adaptive social behaviors by intellectual functioning group interaction was significant (OR = 0.97, 95% CI [0.96, 0.99]), which indicates that consistent with our hypothesis, intellectual functioning moderates the relation between adaptive social behaviors and risk for anxiety problems.

The nature of the moderated effect was examined using Modprobe, an SPSS macro created by Hayes and Matthes (2009). Simple slope analyses revealed that consistent with the hypothesized relation, higher adaptive social behaviors were associated with greater risk of anxiety problems for youth with FSIQ or equivalent scores less than or equal to 70 (OR = 1.02, CI [1.00, 1.03]). As shown in Figure 1, youth with lower cognitive functioning were more likely to be at risk for CBCL Anxiety Problems when they had high VABS-II Socialization scores (1 SD above the mean) rather than low (1 SD below the mean) scores. Although the opposite relation was expected in youth with IQ greater than 70, the simple slope for youth with average or higher intellectual functioning was not significantly different from zero.
Table 6

Logistic Regression Analysis of Moderation by Cognitive Functioning

<table>
<thead>
<tr>
<th>Variable</th>
<th>B(SE)</th>
<th>Wald’s $X^2$</th>
<th>df</th>
<th>p</th>
<th>OR [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-0.36 (.13)</td>
<td>8.00</td>
<td>1</td>
<td>&lt;.01</td>
<td>0.70 [0.54, 0.90]</td>
</tr>
<tr>
<td>Male (ref)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Age</td>
<td>0.11 (.01)</td>
<td>63.79</td>
<td>1</td>
<td>&lt;.001</td>
<td>1.11 [1.08, 1.14]</td>
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<td>Cognitive Functioning</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>IQ &gt; 70</td>
<td>0.53 (.12)</td>
<td>20.07</td>
<td>1</td>
<td>&lt;.001</td>
<td>1.70 [1.35, 2.14]</td>
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<tr>
<td>IQ ≤ 70 (ref)</td>
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<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>ABC Social Withdrawal</td>
<td>0.07 (.01)</td>
<td>110.28</td>
<td>1</td>
<td>&lt;.001</td>
<td>1.07 [1.06, 1.09]</td>
</tr>
<tr>
<td>VABS-II Soc</td>
<td>0.02 (.01)</td>
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<td>1</td>
<td>&lt;.05</td>
<td>1.02 [1.00, 1.03]</td>
</tr>
<tr>
<td>VABS-II Soc x IQ</td>
<td>-0.03 (.01)</td>
<td>9.91</td>
<td>1</td>
<td>&lt;.01</td>
<td>0.97 [0.96, 0.99]</td>
</tr>
</tbody>
</table>

Overall Model Summary

<table>
<thead>
<tr>
<th>Test</th>
<th>$X^2$</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
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<td>&lt;.001</td>
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<tr>
<td>Goodness of Fit</td>
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<tr>
<td>Homer Lemeshow Test</td>
<td>20.42</td>
<td>8</td>
<td>.01</td>
</tr>
</tbody>
</table>

Note. OR = odds ratio; CI = confidence interval; cVABS-II Soc = mean centered VABS-II Socialization scores

Figure 1. Simple slopes of VABS-II Socialization relation to anxiety by IQ level.
Chapter Four

Discussion and Conclusions

Although much evidence of the high prevalence rate and additional impairment imparted by anxiety symptoms in youth with ASD has accumulated in the research literature (Van Steensel et al., 2011; White et al., 2009), findings regarding factors associated with anxiety remain highly variable across studies. In an attempt to clarify discrepant findings from prior research, the current study aimed to examine individual factors potentially related to risk for anxiety problems in a nationally representative sample of youth with ASD and differing levels of cognitive functioning. A strength of the current study was the use of a large enough sample to allow for investigation of risk for potential comorbidity as opposed to anxiety symptoms. Prevalence of anxiety risk in the current sample is consistent with estimates of anxiety problems in youth with ASD found in prior research (e.g., Simonoff et al., 2008; Sukhodolsky et al., 2008; Gadow et al., 2004) and approximately twice as large as estimates of anxiety problems in typically developing youth (Beesdo, Knappe, & Pine, 2009).

Results from the current study indicated that risk for anxiety problems was higher in youth with an IQ greater than 70 and more parent-rated social problems, which is consistent with prior research (Sukhodolsky et al., 2008; Mazeuk & Kanne, 2010) and hypothesized relations. Increasing age was also related to increased risk for anxiety problems in our sample, which was not predicted given prior research conducted by Mazeuk and Kanne (2010) using an earlier version of the SSC database. These
discrepant findings may be attributable to the addition of over one thousand participants to the SSC database since Mazurek and Kanne’s study as well as the current study’s dichotomous anxiety risk outcome measure, which differs from their continuous measurement of anxiety symptoms.

Also in contrast to proposed hypotheses, adaptive social behaviors and clinician-rated ASD severity were not found to be related to risk for anxiety problems in the current study. Non-significant findings regarding adaptive social behaviors are in contrast to those obtained by Sukhodolsky et al. (2008), where anxiety symptoms were measured continuously in a model that did not account for other potential risk factors. Results are, however, consistent with past research investigating the association of diagnosed anxiety disorders with both broad adaptive behaviors and ASD severity (Simonoff et al., 2008), perhaps suggesting that inconsistencies in prior research may be a reflection of the type of outcome investigated (i.e., continuous anxiety symptoms as opposed to dichotomous risk factors or diagnoses). Although transforming continuous variables to dichotomous variables results in a loss of explanatory information, perhaps in studies designed to investigate potential characteristics that may serve as risk factors for a given outcome, the information lost is not clinically relevant. For example, whereas it is clinically applicable to know if an individual characteristic differentiates between individuals with high and low risk for anxiety problems, it is of little practical use to know if that characteristic is differentially associated with two different scores on an anxiety measure if both scores fall below that measure’s predetermined threshold of clinical significance.
Another potential methodological explanation for inconsistencies specifically related to adaptive social behaviors may be that the current study investigated all potential risk factors simultaneously. It is important to note that adaptive social behaviors are not simply the opposite of social problems as measured in the present study. Although the Social Withdrawal/Lethargy scale from the ABC is cited as an appropriate measure of ASD-specific social impairment (Scahill, 2013), it mainly concerns withdrawal and therefore does not provide a comprehensive account of all possible social problems. It may be the case that when youth exhibits extreme withdrawal, which is strongly related to anxiety risk, observation of adaptive social behaviors is highly unlikely.

Regarding the second research question, the relation between adaptive social behaviors and risk for anxiety problems was found to differ with respect to intellectual functioning, consistent with hypothesized relations and prior research (Sukhodolsky et al., 2008). Similar to Sukhodolsky and colleagues, whereas the relation between adaptive social behaviors and risk for anxiety problems remained insignificant in individuals with average or higher levels of intellectual functioning, adaptive social behaviors were found to be positively associated with risk for anxiety problems in the low intellectual functioning group. Although adaptive social behaviors do not appear to aid in predicting risk for anxiety problems in individuals with high intellectual functioning, replication of Sukhodolsky’s findings in a larger, more representative sample provides additional evidence to support differences in anxiety risk factors across youth with varying levels of intellectual functioning.
Implications

Results from the current study provide further support for the relation of age, social problems, and cognitive functioning to anxiety risk. The present study also provides evidence of the differential relation of adaptive social ability to anxiety risk in youth with high and low cognitive functioning. A significant association between social abilities and anxiety risk may have occurred in the lower functioning group because cognitive functioning and adaptive behaviors are typically more highly correlated in individuals with lower cognitive functioning compared to individuals with higher cognitive functioning (Klin et al., 2007). Perhaps similar to significant cognitive deficits, significant deficits in adaptive social behaviors prohibit individuals from facing situations that may elicit anxiety or create difficulty communicating such anxiety. As cognitive and adaptive social skills increase, individuals are then more likely to face potentially anxiety-provoking situations and communicate experiences of anxiety. The lack of association detected between adaptive social skills and anxiety risk in individuals with higher cognitive functioning may be indicative of lower correlations between social and cognitive functioning once one reaches a certain level of cognitive functioning. Indeed, investigations conducted with typically developing youth that suggest that intellectual functioning, while moderately associated with social competence, is a separate construct (e.g., Pellegrini, 1985). Additionally, youth with autism and average or above average intellectual functioning face challenges that are not experienced by those with lower cognitive functioning (e.g., performing in the general education classroom), which may also contribute to anxiety and should be explored in future research.
Findings from the present study considered in the context of prior research on anxiety in youth with ASD have implications for clinical practice and research. Regarding clinical practice, it is suggested that youth age, social problems, and cognitive functioning should be considered as potential risk factors for anxiety when assessing a child with ASD, albeit with caution, as the relations between various individual factors and anxiety are clearly complex and likely differ across youth of varying functional levels. Given the high prevalence of anxiety in youth with ASD regardless of intellectual functioning as well as conflicting findings regarding predictors of anxiety risk in different samples, best practices for clinicians working with youth with ASD should include screening for anxiety risk. Additionally, certain individual characteristics (e.g., average or above intellectual functioning, high levels of social problems; increasing age) may warrant closer examination of anxiety symptoms.

When considering the vast body of research conducted on anxiety in youth with ASD, the variable findings reported across studies imply a certain degree of complexity that precludes much information about risk factors to be gleaned from simple investigations of main effects. As such, an implication for research is that further investigations of anxiety risk factors across youth with ASD and different characteristics (e.g., intellectual functioning) is likely necessary to both understand variable findings in prior research and increase the likelihood of uncovering additional risk factors for this population. Such research may include moderation analyses similar to that conducted in this study.
Limitations and Directions for Future Research

Regarding limitations, although the current study utilized a large, nationally representative sample of youth with ASD encompassing a wide range of functioning, the majority of the sample earned average or higher FSIQ or equivalent scores. Additionally, risk for anxiety problems served as a proxy measure for comorbidity, as information about participant anxiety diagnoses was unavailable. As such, it is not possible to conclude that the risk factors identified in the current study are in fact risk factors for being diagnosed with an anxiety disorder. Similarly, the current study measured broad anxiety problems using parent ratings from the CBCL, which is well validated for use with typically developing youth; however, given the reliance of numerous items on verbal ability and the potential that anxiety may manifest differently in youth with ASD compared to typically developing youth, the CBCL may not be the best anxiety measure for this population. That said, results from a recent evaluation of the psychometric properties of the CBCL conducted with youth with ASD suggest its ability to discriminate between youth with ASD with and without co-occurring internalizing and externalizing disorders (Pandolfi, Magyar, & Dill, 2012). However, Pandolfi and colleagues investigation of the diagnostic accuracy of the CBCL subscales suggest low specificity despite adequate sensitivity. Thus, further research is necessary to identify the best measure of anxiety problems as manifest by youth with ASD, who may or may not have the verbal abilities or overall awareness to exhibit anxiety in the same way as typically developing youth. Similarly, future research should investigate risk factors for specific anxiety disorders in youth with ASD, as individual characteristics that may be
associated with social anxiety disorder may differ from characteristics associated with generalized anxiety disorder.

Another limitation of the current study relates to the poor fit of the model to the data investigated. Whereas the individual characteristics considered in this study better predicted risk for anxiety problems than a null model with no factors, the model did not provide a good fit to the data, which suggests that more information is required regarding predictors of anxiety risk in youth with ASD. There are likely other individual characteristics and more appropriate measures of the currently investigated characteristics that are associated with anxiety risk. For example, a link between temperamental traits (e.g., fear, inhibition) and anxiety is a common finding in the extant literature on typically developing youth (e.g., Goldsmith & Lemery, 2000; Lonigan, Philips, & Vasey, 2001) that has been suggested as a potential risk factor for anxiety in ASD (Bellini, 2004). However, research investigating the association of temperamental traits and anxiety in youth with ASD is still lacking.

In light of current findings and conflicting findings in past research, it is clear that further research is necessary to uncover additional risk factors for anxiety problems as well as consider the best way to operationalize and measure risk factors. Future research should also continue to investigate how various individual characteristics may be differentially related to anxiety risk in youth with differing levels of cognitive functioning.
References


