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Review

Anxiety in children and adolescents with Autism Spectrum Disorders

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ABSTRACT

Anxiety symptoms and disorders are highly prevalent in children and adolescents with Autism Spectrum Disorder (ASD), although they are often unrecognized or misdiagnosed. The purpose of the present review is to (1) provide clinicians with practical information on assessment and diagnosis of co-morbid anxiety in children and adolescents with ASD, (2) summarize and critically examine the literature on anxiety in children and adolescents with ASD, and (3) recommend avenues for future research in this area. A review of the literature yielded several recommendations for the assessment of anxiety in youth with ASD. It was concluded that comprehensive assessments of anxiety in ASD populations should use multiple informants, multimodal assessment techniques, and standardized assessment methods that are appropriate for clinical use in ASD samples. Overall, studies suggest that youth with ASD experience greater levels of anxiety than community populations, similar levels of anxiety to clinically anxious groups, and different patterns of anxiety when compared to other clinical groups. Although existing studies are methodologically fair, their correspondence with clinical recommendations for assessment is poor. Recommendations to improve of the quality of empirical studies and directions for future research are discussed.

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Contents

1. Anxiety in children and adolescents with Autism Spectrum Disorders

Research suggests that children and adolescents with Autism Spectrum Disorders (ASDs) experience significantly higher levels of anxiety than community-based populations (e.g., Farrugia & Hudson, 2006; Kim, Szatmari, Bryson, Streiner, & Wilson, 2000; Russell & Sofronoff, 2005). Unfortunately, differentiating between co-morbid anxiety and characteristics of ASD can be problematic (Tsai, 2006). It is important to identify co-morbid anxiety in children and adolescents with ASD because anxiety symptoms can cause considerable distress and interfere with daily functioning (Muris, Steerneman, Merkelbach, Holdrinet, & Meesters, 1998). Identifying co-morbid anxiety has considerable implications for treatment and the provision of services. Clinical experience shows that specific treatment is associated with greater improvements than non-specific treatment (Leyfer et al., 2006).

The first aim of the present review is to provide clinicians with practical, evidence-based recommendations for the assessment of anxiety in youth with ASD. The second goal is to summarize and systematically evaluate the literature on anxiety in children and adolescents with ASD. Finally, avenues for future research are discussed. The majority of previous research has focused on anxiety in youth with High-Functioning Autism (HFA) and/or Asperger Disorder. As a result, the information provided in this paper is most representative of a higher functioning population of youth with ASD.

2. Overview of anxiety disorders

Anxiety disorders are highly prevalent in the normal population, making them one of the most common forms of childhood psychopathology (Spence, 1998). According to the *Diagnostic and statistical manual of mental disorders-fourth edition, text revision* (DSM-IV-TR; American Psychiatric Association, 2000), anxiety disorders include: Panic Disorder, Separation Anxiety Disorder (SAD), Specific Phobia, Social Phobia, Obsessive Compulsive Disorder (OCD), Post-Traumatic Stress Disorder (PTSD), and Generalized Anxiety Disorder (GAD) (see Table 1 for a summary of these disorders).

Anxiety symptoms and disorders can be extremely debilitating and are commonly associated with other mental or physical illnesses (for a review see Costello, Egger, & Angold, 2004). In typically developing children, evidence is accumulating that certain anxiety disorders, if left untreated, may show a chronic course into adulthood (e.g., Albano, Chorpita, & Barlow, 2003). Furthermore, the age of

Table 1
Description of DSM-IV anxiety disorders

Anxiety disorder	Description
Panic Disorder	Characterized by recurrent and unexpected panic attacks. Panic Disorder can occur with or without Agoraphobia.
Separation Anxiety Disorder	Developmentally inappropriate and excessive anxiety surrounding separation from home or from significant attachment figures.
Specific Phobia	Characterized by a significant anxiety provoked by exposure to a feared object, often leads to avoidance.
Social Phobia	Characterized by a significant anxiety provoked by exposure to certain types of social or performance situations, which often leads to avoidance.
Obsessive–compulsive Disorder	Characterized by obsessions that cause marked distress and/or by compulsions, which are performed to neutralize anxiety.
Post-Traumatic Stress Disorder	Characterized by the re-experiencing of an extremely traumatic event accompanied by increased arousal and avoidance of stimuli related to the trauma.
Generalized Anxiety Disorder	Characterized by at least 6 months of persistent and excessive anxiety and worry.

onset, developmental course, and prognosis differ among various types of anxiety (e.g., Barlow, 2002; Malcarne & Hansdottir, 2001; Weems & Costa, 2005). For example, Weems and Costa (2005) found that separation anxiety symptoms were most prevalent in youth aged 6–9, phobias of death and danger were most common in youth aged 10–13, and social anxiety symptoms were more frequent in youth aged 14–17. Therefore, the developmental trajectory of symptom expression should be considered when studying anxiety in children and adolescents.

3. Overview of ASD

Pervasive Developmental Disorders (PDDs) include Autistic Disorder (AD), Asperger Disorder (also referred to as Asperger Syndrome or AS), Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), Rett Disorder, and Childhood Disintegrative Disorder. According to the DSM-IV-TR (American Psychiatric Association, 2000), individuals with PDDs demonstrate qualitative impairments in reciprocal social interactions, verbal and non-verbal communication, and they engage in patterns of restricted, repetitive, and stereotyped behaviours, interests, and activities.

Although PDD is the term used in both the DSM-IV-TR (American Psychiatric Association, 2000) and the *International Statistical Classification of Diseases and Related Health Problems* (ICD-10; World Health Organization, 1992), these five disorders are also commonly referred to in the literature as Autism Spectrum Disorders. The three most common types of ASDs are: AD, AS, and PDD-NOS. Individuals with AS differ from those with AD primarily by having intact language abilities and normal or near normal intelligence (Blackshaw, Kinderman, Hare, & Hatton, 2001). Individuals that display symptoms of AD or AS, yet do not meet the specific criteria for either, are typically diagnosed with PDD-NOS.

According to the DSM-IV-TR (American Psychiatric Association, 2000), individuals with ASD often exhibit one or more co-morbid symptoms and disorders. Indeed, an emerging body of research on ASDs supports the presence of several co-morbid psychiatric disorders and symptoms, including anxiety, depression, Attention Deficit Hyperactivity Disorder, Tourette syndrome, OCD, suicidal ideation, obsessionality, psychotic symptoms, and conduct and behavioural problems (e.g., Clarke, Littlejohns, Corbett, & Joseph, 1989; Farrugia & Hudson, 2006; Ghaziuddin, Weidmer-Mikhail, & Ghaziuddin, 1998; Gillott, Furniss, & Walter, 2001; Green, Gilchrist, Burton, & Cox, 2000; Kim et al., 2000; Ringman & Jamkovic, 2000; Tonge, Brereton, Gray, & Einfeld, 1999; Weisbrot, Gadow, DeVincent, & Pomeroy, 2005). The present review will focus specifically on co-morbid anxiety symptoms and disorders.

4. Assessment of anxiety in youth with ASD

The assessment of anxiety in children and adolescents with ASD is challenging. As a result, co-morbid anxiety disorders in ASD populations may frequently be unrecognized or mislabelled (Tsai,

2006). A complex issue for clinicians involves determining whether psychiatric symptoms in individuals with ASD are inextricably linked to core or secondary ASD features, or whether they represent true psychiatric symptoms (e.g., Green et al., 2000; Matson & Nebel-Schwalm, 2007; Tantam, 2000; Tsai, 2006). This tendency to overlook co-morbid mental health problems in the presence of a disability is referred to as diagnostic overshadowing (Mason & Scior, 2004). Diagnostic overshadowing can occur in two ways: (1) attributing mental health problems to the more salient disability (Levitan & Reiss, 1983); and (2) ignoring co-morbid mental health problems because they are considered to be less significant than the effects of the disability (Mason & Scior, 2004). For example, some anxiety symptoms (e.g., panic attacks, obsessions) may be misinterpreted as aberrant behaviour that is directly related to the ASD (Tsai, 2006). Determining that an individual is suffering from anxiety in addition to their diagnosis of ASD has important implications for the conceptualization and treatment of these individuals.

Some researchers have suggested that clinicians should distinguish between competence and performance to help determine whether anxiety symptoms stem from true psychiatric disorders, or from core features of the ASD (Sugarman, 1984; Tantam, 2000). For example, impaired non-verbal communication is an issue of competence present in every situation, and therefore, likely part of the core ASD. On the other hand, anxiety-driven abnormalities in non-verbal communication would not occur across all situations, and may therefore be indicative of a co-morbid anxiety disorder. As such, Kim et al. (2000) recommend teasing apart core ASD symptoms from anxiety symptoms by assessing changes in the child's behaviour, rather than stable deficits or behavioural issues that may be part or the core ASD symptomatology.

Limited verbal skills, cognitive deficits, and a lack of insight into one's own difficulties and emotional states can also complicate the assessment of anxiety in ASD populations. In non-ASD populations, studies typically show poor concordance between child and parent reports of anxiety (Engel, Rodrigue, & Geffken, 1994). In ASD populations, some evidence shows agreement between child and other informant reports (i.e., parent and teacher) of emotional functioning (e.g., Farrugia & Hudson, 2006), while other evidence shows that they are unrelated (e.g., Meyer, Mundy, Vaughan Van Hecke, & Durocher, 2006). As a result, the use of multiple informants and multimodal assessment techniques allows for the most comprehensive assessment and may minimize diagnostic errors (e.g., Groden, Baron, & Groden, 2006; Romanczyk & Gillis, 2006; Tsai, 2006).

A comprehensive assessment should examine biological and psychological symptoms of anxiety. In addition, assessments should be geared to the developmental level of the child or adolescent. The following is a brief description of four assessment methods that can be used to measure anxiety in children and adolescents with ASD: (a) clinical interview, (b) anxiety rating scales (self-report and informant-report), (c) direct observation and behaviourally anchored measures, and (d) physiological measures.

4.1. Clinical interview

Clinical interviews are valuable methods of assessment and can provide a wealth of information about the psychological functioning of an individual with ASD. Interviews may be structured, semi-structured, or unstructured in nature, and can be conducted on children and adolescents with ASD, or with other informants, such as parents and teachers. Multiple-informant approaches to interviewing are optimal because there is often variation between parent and child report, which may be a result of the child's limited comprehension of the interview questions (Velting, Setzer, & Albano, 2004). Also, because youth with ASD often have limited verbal skills (e.g., Arick, Krug, Fullerton, Loos, & Falco, 2005), interviewing these individuals may not be appropriate.

When such individuals can be interviewed, a variety of factors must be considered. For example, interview techniques may need to be modified to fit the characteristics of this group, as well as the developmental level of the individual being assessed. For example, because young children often lack the ability to identify and discriminate between emotions, interview questions should target concrete, behavioural events. In addition, forced-choice questions may be more appropriate than open-ended questions for individuals who have difficulty generating words to describe feelings (Attwood, 2006).

Furthermore, having concrete, visual aids (e.g., pictorial dictionary of feelings, drawings, etc.) may be helpful when interviewing children and adolescents with ASD (Attwood, 2006).

Clinical interviews should include a comprehensive discussion about the child's developmental, family, psychiatric, medical, and school history. In addition, information should be gathered about the child's current level of functioning, as well as any anxiety symptoms they are experiencing. Finally, to help clinicians distinguish co-morbid anxiety symptoms from core ASD symptoms, detailed information should be collected regarding the onset, course, and specific contexts in which anxiety is experienced.

4.2. Anxiety rating scales

Rating scales can be given to individuals with ASD or to other informants, such as parents and teachers, to assess potential anxiety. In addition to stable measures of anxiety, instruments designed to measure state anxiety across time and settings may help clinicians determine whether anxiety symptoms are linked to core ASD symptoms, or whether they represent co-morbid anxiety.

Despite major advances in the assessment of ASD symptoms in children and adolescents, instruments to measure co-morbid anxiety in the ASD population are needed. The majority of instruments designed to measure anxiety in normal populations do not have normative data for ASD populations. Furthermore, the validity and reliability of these instruments for ASD populations has not been examined. Therefore, caution should be exercised when interpreting results of such scales with this group. There are only two existing instruments that are designed specifically for use with ASD populations.

The first instrument is The Stress Survey Schedule for Persons with Autism and Developmental Disabilities (Groden et al., 2001). On this instrument, the intensity of stress reactions to a number of potentially stressful events is rated along a five-point scale. Depending on the cognitive and developmental level of the individual with ASD, this instrument can be completed by self-report or by primary caregivers. The Stress Survey Schedule examines stress triggers relevant to the ASD population, and produces an individual stress profile that can guide intervention programs aimed at increasing coping skills (Groden et al., 2001). Although this instrument is very helpful in identifying stress triggers, it does not identify or distinguish between DSM-IV clinical diagnoses.

To address this limitation, a second instrument, the Autism Co-morbidity Interview-Present and Lifetime Version (ACI-PL; Leyfer et al., 2006), was recently developed to systematically diagnose co-morbid psychiatric disorders in individuals with autism. This instrument was created by modifying the Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS; Chambers et al., 1985) to be appropriate for use in children and adolescents with autism. It involves a semi-structured interview with a parent as the informant. The ACI-PL inquires about several anxiety-related diagnoses, including Panic Disorder, SAD, Social Phobia, Specific Phobia, GAD, and OCD. However, of these anxiety disorders, the reliability and validity of the ACI-PL has only been examined for OCD. Thus, although this instrument appears promising, further validity and reliability testing is necessary.

Most self-report rating scales for measuring anxiety often need to be modified for use with ASD populations because they have been designed for use with typically developing children and adolescents. For example, visual cues such as an "emotional thermometer" can be used to measure the strength of feelings and make number scales more meaningful (Attwood, 2006). In addition, supplementary information can be obtained through the use of daily diary questionnaires that are completed by either the individual with ASD (usually high functioning), or by informants. This allows for the analysis of changes in stress levels and the identification of specific times, events, or environments that may lead to anxiety (Romanczyk & Gillis, 2006).

4.3. Direct observation and behaviourally anchored measures

Direct observation is a very useful assessment technique that involves the simultaneous recording of observable, behavioural events (Tsai, 2006). This technique can be used in various contexts, such as home, school, and recreational settings. Direct observation of a child or adolescent with ASD can provide useful information about their interests, intellectual development, social relationships,

thoughts, and feelings (Tsai, 2006). In addition, observation techniques are particularly helpful for young children and for children and adolescents with severe communication deficits.

In addition, it is essential to assess changes in behaviour that may be reflective of anxiety (e.g., appetite, energy level, or participation in social activities) because of the difficulty in distinguishing co-morbid anxiety from core-ASD symptoms. For example, observing a child's social interactions during his or her school recess break may provide information that cannot be obtained outside of this context. Likewise, comparing behaviours across settings will also provide clinicians with valuable information.

Behaviourally anchored measures can be informative, in that an individual's actions may be a consequence of earlier feelings of anxiety. Conducting a functional analysis of behaviour is often helpful with ASD populations (Tsai, 2006). This involves the detailed recording of a particular behaviour, its antecedents, and its consequences (Groden et al., 2006). These assessments can also provide objective data about specific behaviours (e.g., crying, withdrawal, inactivity, stuttering) that might be related to feelings of anxiety (Tsai, 2006). The identification of stressors through a functional behaviour assessment can have important implications for the treatment of children and adolescents with ASD.

4.4. Physiological measures

Clinicians and researchers can also use physiological measures to assess anxiety in ASD populations. Non-verbal physiological measures of stress response include changes in heart rate, skin temperature, skin conductance, and in hormone levels (see Romanczyk & Gillis, 2006 for a review of these measures). Like behavioural observation techniques, physiological measures may also be particularly useful when assessing children and adolescents with severe communication deficits.

Unfortunately, physiological measurements of anxiety are typically used in research settings and can lack feasibility in clinical settings. However, specific protocols for the use of physiological measurement in clinical settings are beginning to emerge. For example, Groden et al. (2006) have created a protocol for the clinical use of heart rate and arousal assessment. Nevertheless, more reliable, valid, and clearly defined protocols must be established before physiological assessment can become a practical assessment technique in clinical settings.

4.5. Summary of recommendations for assessing anxiety in youth with ASD

The assessment of anxiety in children and adolescents with ASD is complex and distinguishing between core ASD symptoms and co-morbid anxiety symptoms can be difficult. To date, research on specific methods for assessing anxiety in this population is lacking. However, several recommendations have been put forth as guidelines for conducting thorough assessments of anxiety in youth with ASD. In particular, researchers and clinicians should consider developmental level and stability of symptoms when assessing anxiety in youth with ASD. In addition, assessments should be multimodal (e.g., clinical interview, rating scales, direct observation, physiological measurement), use multiple informants (e.g., parents, teachers, self-report), and use appropriate instrumentation (e.g., adequate reliability and validity, normative data for ASD samples).

5. Studies examining anxiety in children and adolescents with ASD

The second goal of this review was to evaluate the current state of the literature on anxiety in youth with ASD. To accomplish this objective, several databases were used to identify empirical studies that examined the prevalence of anxiety in children and adolescents with ASD (i.e., PsycINFO, PsycARTICLES, Psychology: A SAGE Full-Text Collection, and Medline). Various combinations of the key words, "prevalence", "anxiety", "ASD", "autism", and "Asperger" were used as search criteria. We evaluated quantitative studies, published in English between 1995 and 2008, which used anxiety as an outcome measure in samples of children and adolescents with ASD. Single case studies were excluded.

Using these criteria, 13 studies were identified and included in the present review. Sample sizes of the ASD groups ranged from 15 to 301 participants. The age of children and adolescents with ASD

ranged from 2 to 19 years. The descriptive characteristics of the 13 reviewed studies are presented in Table 2. Due to the small number of identified studies and variation in outcome variables, a mean prevalence rating of anxiety was not calculated.

The identified studies were evaluated using two rating systems. First, two independent raters evaluated the studies based on the extent to which they followed the recommendations outlined in the preceding section for the assessment of anxiety in youth with ASD. In particular, we isolated six recommendations from the literature and rated the studies based on whether they adhered to these criteria using a "yes = 1", or "no = 0" rating system. The assessment method used to measure anxiety in each study was evaluated on the following dimensions: (1) use of clinical interview; (2) use of anxiety rating scales; (3) use of direct observation; (4) use of physiological measures; (5) use of multiple informants; and (6) use of assessment methods that have comparison data available for ASD samples. The assessment methodology ratings ranged from 1 to 3, out of a possible 6 points. The mean quality rating was 1.69. The quality ratings are provided in Table 3.

Second, to assess the methodological quality of the studies, two independent raters used a checklist for evaluating the scientific merit of the research studies. This checklist was devised by substantially modifying Boyle's (1998) checklist for examining prevalence studies. The quality of each study was evaluated on the following dimensions: (1) description of sample; (2) confirmation of ASD diagnosis; (3) inclusion of current comparison group; (4) matching of comparison groups; (5) standardizing the method of data collection; (6) reliability of anxiety instruments; (7) validity of anxiety instruments; and (8) appropriateness of interpretations. We determined how many out of the eight criteria were met as a measure of the methodological quality of the prevalence studies. A rating of "yes = 1" or "no = 0" was given for each of the criteria, with the exception of two questions, which could receive a value of 0.5. Some studies compared anxiety both within ASD subtypes, and between ASD groups and other samples, and thus could receive partial value on the questions concerning comparison groups (i.e., current comparison group, and matched comparison groups). Scores for each study were compared between raters and discrepancies were resolved by reaching a consensus in all cases. The total methodological quality ratings ranged from 4 to 7, out of a possible 8 points. The mean quality rating was 5.69. These ratings are presented in Table 4.

5.1. Description of studies

The following is a narrative description of the reviewed studies. Studies are grouped according to the type of comparison group using the following criteria: (1) no comparison group, (2) comparison to community samples, (3) comparison to clinically anxious samples, (4) comparison to other clinical samples, and (5) comparison across ASD subtypes.

5.2. Anxiety in ASD samples with no comparison group

Two studies examined the rate of anxiety in groups of children and adolescents with ASD without making comparisons to other populations (e.g., de Bruin, Ferdinand, Meester, de Nijs, & Verheij, 2007; Muris et al., 1998). In their study, Muris et al. (1998) examined a wide range of anxiety symptoms in children and adolescents with ASD ($n = 44$) and concluded that severe symptoms are highly prevalent in children with ASD. Parents were interviewed to assess DSM-III-R psychiatric disorders and symptoms in their children. According to the Diagnostic Interview Schedule for Children (Version 2.3; National Institute of Mental Health, 1992), 84.1% of the children met criteria for at least one anxiety disorder. In a second study, de Bruin et al. (2007) used the Dutch version of the DISC-IV-P (Ferdinand & Van der Ende, 1998) to measure parent-reported anxiety in children with PDD-NOS ($n = 94$). Results showed that 55.3% of children with PDD-NOS met criteria for an anxiety disorder.

5.3. Anxiety in ASD samples compared only to community samples

Overall findings suggest that children and adolescents with ASD show elevated levels of anxiety when compared to normative and community samples (e.g., Bellini, 2004; Kim et al., 2000; Thede & Coolidge, 2007). In their study, Kim et al. (2000) found elevated levels of anxiety in a sample of

Table 2
Studies examining anxiety in children and adolescents with ASD

Authors	ASD participants	Comparison group	Age of participants (years)	Functioning level of ASD group	Anxiety instrument	Sampling technique	Outcomes (more specific)	Limitations
Bellini (2004)	ASD (n = 41)	No current comparison group, used community-based norms from instrument manuals	ASD: mean = 14.2; range = 12–18	High functioning (average intelligence)	Self-report (the Multidimensional Anxiety Scale for Children; the Social Anxiety Scale for Adolescents). Parent-report (the Behaviour Assessment System for Children).	39 participants were recruited based on affiliation with Indiana Resource Center for Autism (IRCA) Letters sent to all eligible participants (n = 504). Two additional participants who met selection criteria were recruited from a Louisiana school district.	Adolescents with ASD scored higher than adolescents in the general population on the following anxiety scales: physical symptoms, social anxiety, separation/panic, and scales of overall anxiety.	No current control group. ASD groups were informed about the nature of the study, possibly skewing the sample towards individuals with anxiety. 16 participants taking medication for anxiety.
de Bruin et al. (2007)	PDD-NOS (n = 94)	No comparison group	PDD-NOS: mean = 8.5; range = 6–12	Mean IQ = 91.22; range = 55–120	Parent report (Dutch version of the Diagnostic Interview Schedule for Children).	All consecutive referrals at an outpatient department of child and adolescent psychiatry center.	55.3% of children met criteria for at least one anxiety disorder: - Simple phobia (38.3%) - Social Phobia (11.7%) - Separation Anxiety Disorder (8.5%) - Agoraphobia (6.4%) - Obsessive Compulsive Disorder (8.5%) - Generalized Anxiety Disorder (5.3%)	No control group. Only parent report included. Limits to the generalizability- more severe cases are seen at the university outpatient clinic. Wide range of IQ scores.

Evans et al. (2005)	ASD (n = 25)	Down syndrome (n = 43) Typically developing mental age (MA) matched children (n = 45) Typically developing chronologically aged (CA) matched children (n = 37)	ASD: mean = 9.20 Down syndrome: mean = 11.75 MA matched: mean: = 4.26 CA matched: mean = 9.57	Mean IQ = 59.6; S.D. = 21.81	Parent report (fear survey).	Recruited from daycare centers and local school systems. Parents were sent questionnaires and were contacted to schedule testing.	Children with ASD had more situation phobias and medical fears, but less fear of harm than all other groups. Regarding social fears, children with ASD did not differ from the CA or MA groups, but scored higher than the children with Down syndrome.	Only parent report included. Fear survey was not a validated measure. Lack of diagnostic specificity for the ASD group.
Farrugia and Hudson (2006)	AS (n = 29)	Anxiety disorder group (n = 34) Community sample (non-clinical) (n = 30)	AS: mean = 13.76; range = 12–16 Anxiety disorder: mean = 13.82; range = 12–16 Non-clinical: mean = 13.90; range = 12–16	Not indicated	Self- and parent-report (the Children's Automatic Thoughts Scale; the Spence Children's Anxiety Scale; the Life Interference Measure). Parents were also asked additional questions written by the researchers that pertain to anxiety.	AS group recruited from local support groups and the Autism Association of South Wales. Anxiety disorder group recruited from Macquarie University Child and Adolescent Anxiety clinic. The community (non-clinical) group was recruited via a newspaper advertisement.	AS group experienced similar level of anxiety to the anxiety disorder group on all anxiety related scales (i.e., fears of physical injury, obsessive compulsiveness, panic/agoraphobia, Social Phobia, separation anxiety, and generalized anxiety) AS group showed higher levels of anxiety than the non-clinical group on all of the above scales except obsessive–compulsiveness. Negative thoughts and life interference were significantly higher for the AS group than the comparison groups.	Low response rate of adolescents with AS. AS and anxiety group informed about the nature of the study, possibly skewing the sample towards individuals with anxiety. Community sample was not informed about the nature of the study.

Table 2 (*Continued*)

Authors	ASD participants	Comparison group	Age of participants (years)	Functioning level of ASD group	Anxiety instrument	Sampling technique	Outcomes (more specific)	Limitations
Gillott et al. (2001)	AD (n = 15)	Language impairment group (n = 15) Typically developing group (n = 15)	AD: mean = 10.27; range = 8–12 Language impaired: mean = 10.25; range = 8–12 Typically developing: mean = 10.26; range = 8–12	High functioning (average intelligence)	Self-report (the Spence Children's Anxiety Scale; the Social Worries Questionnaire). Parent-report (the Spence Social Worries Questionnaire).	Not indicated. Authors reported that the AD group had previously received their diagnoses at a communication clinic in a local children's hospital. The language impairment group had also received previous diagnoses by a speech and language therapist.	AD group scored higher than the language impaired and typically developing groups on an overall measure of anxiety and on the separation anxiety, and Obsessive Compulsive Disorder subscales. AD group scored higher than comparison groups on a self- and parent-report measure of social anxiety.	Small sample size. Groups not matched for IQ.
Green et al. (2000)	AS (n = 20)	Conduct Disorder group (n = 20)	AS: mean = 13.75; range = 11–19 Conduct Disorder: mean = 14.47; range = 11–18	IQ $\geq$ 70	Self- and parent-report (the Isle of Wight Semi-Structured Informant and Child Interviews).	AS group referred to the project team by clinicians. Conduct Disorder participants were recruited from clinical referrals or specialist schools for children with emotional and behavioural difficulties.	AS group scored higher than the conduct disordered group on several anxiety related symptoms (e.g., worrying, hypochondriasis, non-situational anxiety or panic, specific fears, and obsessions or compulsions).	No community (non-clinical) control group.
Kim et al. (2000)	ASD (n = 59) - AD (n = 40) - AS (n = 19)	Compared across ASD subtypes Used community-based norms from instrument manual	ASD: mean = 12; range = 9–14	High functioning; IQ $\geq$ 70 on Stanford-Binet (or 68 on Leiter).	Parent-report (the Ontario Child Health Study Revised).	Children (ages 4–6) who had attended six different PDD service centers were contacted for follow-up 6 years later.	ASD group scored higher than community-based norms on a measure of generalized and separation anxiety. No differences between AD and AS groups on anxiety.	Only parent report included. No current control group without ASD. Study did not use DSM-IV criteria specifying that a diagnosis of AD be given preferentially to AS.

Muris et al. (1998)	ASD (n = 44) - AD (n = 15) - PDD-NOS (n = 29)	Compared across ASD subtypes	AD: mean = 5.9; range = 2–18 PDD-NOS: mean = 11.6; range = 2–18	AD: mean IQ = 70.5; S.D. = 7.7 PDD-NOS: mean IQ = 84.1; S.D. = 13.6	Parent-report (the Anxiety Disorders section of the Diagnostic Interview Schedule for Children).	Children identified through an autism center database. Parents were mailed a letter and contacted 1 month later to determine willingness to participate.	84.1% of the ASD children met DSM-III-R criteria for at least one anxiety disorder. - Simple phobia (63.6%) - Agoraphobia (45.5%) - Separation Anxiety Disorder (27.3%) - Overanxious Disorder (22.7%) - Social Phobia (20.5%) - Social Phobia (20.5%) - Avoidant Disorder (18.2%) - Obsessive Compulsive Disorder (11.4%) - Panic Disorder (9.1%) Several types of anxiety were more prevalent in individuals with PDD-NOS than those with AD.	Only parent report included. No control group without ASD. Children with AD were significantly younger and had lower IQ than the children with PDD-NOS. Sample size of the AD group was small.
Pearson et al. (2006)	ASD (n = 51) - AD (n = 26) - PDD-NOS (n = 25)	Compared across ASD subtypes	AD: mean = 9.5; range = 4.2–17.3 PDD-NOS: mean = 10.5; range = 4.2–18.7	AD mean IQ = 75 PDD-NOS mean IQ = 94	Parent Report (Personality Inventory for Children-Revised).	Retrospective review of consecutive clinic and research referred participants meeting eligibility criteria.	No differences on overall anxiety between AD and PDD-NOS groups.	Convenience sample: > 90% of cases had been given the PIC-R, and thus, may not be entirely representative of the population. Although AD and PDD-NOS groups differed on Full Scale IQ, Verbal IQ and Non-verbal IQ, only Verbal IQ was used as a covariate.

Table 2 (*Continued*)

Authors	ASD participants	Comparison group	Age of participants (years)	Functioning level of ASD group	Anxiety instrument	Sampling technique	Outcomes (more specific)	Limitations
Russell and Sofronoff (2005)	AS ($n = 65$)	Data from previous studies used for clinically anxious and normally developing comparison groups	Mean not indicated; range = 10–13	Not indicated	Self- and parent-report (the Social Worries Questionnaire; the Spence Children's Anxiety Scale).	Children with AS were recruited from a children's hospital, psychology clinics, and media releases.	Children with AS showed more overall anxiety symptoms than the normative population on self- and parent-report measures. Children with AS showed more social worries than the normative population on a parent report, but not on a self-report measure. No differences between AS and clinically anxious groups on measures of overall anxiety using child ratings. Parents rated children with AS as higher than clinically anxious children on overall anxiety, Obsessive Compulsive Disorder, and physical injury subscales.	No current control group. All participants with AS were receiving intervention for anxiety.
Thede and Coolidge (2007)	ASD ($n = 31$) - HFA ($n = 15$) - AS ($n = 16$)	Compared across ASD subtypes Age and sex matched control group taken from instrument normative sample ($n = 31$)	HFA: mean = 10.0; range = 5–17 AS: mean = 11.5; range = 5–17 Control: mean = 10.0; range = 5–17	HFA and AS: Parents reported no diagnosis of mental retardation ($IQ \geq 70$)	Parent Report (Coolidge Personality and Neuropsychological Inventory)	ASD group was contacted from a registry of the Autism Society of America. Parents whose children had been diagnosed with AS or HFA were contacted via mail.	AS group scored higher than HFA and control groups on scales of Generalized Anxiety Disorder and Obsessive Compulsive Disorder.	Small sample size. Lack of clinical corroboration of ASD diagnoses.

Tonge et al. (1999)	ASD (n = 127) - HFA (n = 75) - AS (n = 52)	Compared across ASD subtypes	HFA: mean = 7.1; range = 4–18 AS: mean = 9.89; range = 4–18	HFA: IQ $\geq$ 71 AS: IQ $\geq$ 70	Parent Report (the Developmental Behaviour Checklist: Primary Carer Version)	ASD participants were consecutive cases presenting for initial diagnosis at one of 5 Pervasive Developmental Disorder assessment services.	AS group scored higher than the HFA group on the anxiety subscale.	Although age and IQ were used as covariates, the AS group was older and had a higher IQ than the HFA group.
Weisbrot et al. (2005)	Preschool children with ASD (n = 182) - AD (n = 67) - AS (n = 24) - PDD-NOS (n = 91) School-age children with ASD (n = 301) - AD (n = 103) - AS (n = 80) - PDD-NOS (n = 118)	Compared across ASD subtypes Preschool clinical sample without ASD (n = 135) School aged clinical sample without ASD (n = 191)	ASD (preschool) mean = 4.2; range = 3–5 Non-ASD (preschool) mean = 4.6; range = 3–5 ASD (school-age) mean = 8.3; range = 6–12 Non-ASD (school age) mean = 8.7; range = 6–12	ASD (preschool) mean IQ = 79 Non-ASD (preschool) mean IQ = 92 ASD (school-age) mean IQ = 87 Non-ASD (school age) mean IQ = 98	Parent report and teacher report (Early Childhood Inventory—4 for children aged 3–5 years; and the Child Symptom Inventory—4 for children aged 6–12 year).	Medical chart review of consecutive referrals to a developmental disabilities clinic and child psychiatry outpatient service.	Preschool: - Teachers rated children with ASD as having more severe anxiety symptoms than the non-ASD group (i.e., Generalized Anxiety Disorder, Social Phobia, Specific Phobia, and compulsions). - Parents rated the non-ASD children as higher than ASD children on several anxiety symptoms (i.e., separation anxiety, Generalized Anxiety Disorder). - No difference in anxiety between ASD subtypes. School aged: - Parents and teachers rated ASD children as more fearful (i.e., Specific Phobia), obsessive, and compulsive than non-ASD group. - Parents and teachers rated AS group as having more severe generalized anxiety symptoms than the other two groups, and more severe obsessions than children with AD.	ASD diagnoses were not generated from specific autism diagnostic criteria.

Table 3
Evaluation of assessment methodology: do empirical studies use recommendations from the literature?

Authors	Is a clinical interview conducted?	Are anxiety rating scales used?	Is direct observation used to assess anxiety?	Are physiological assessment measures used?	Are multiple informants used to assess anxiety?	Is comparative data available for ASD populations for any of the anxiety instruments?	Total score (sum of "yes" ratings)
Bellini (2004)	No	Yes	No	No	Yes	Not indicated	2
de Bruin et al. (2007)	Yes	No	No	No	No	Not indicated	1
Evans et al. (2005)	No	Yes	No	No	No	No	1
Farrugia and Hudson (2006)	No	Yes	No	No	Yes	Not indicated	2
Gillott et al. (2001)	No	Yes	No	No	Yes	Not indicated	2
Green et al. (2000)	Yes	No	Yes	No	Yes	Not indicated	3
Kim et al. (2000)	No	Yes	No	No	No	Not indicated	1
Muris et al. (1998)	Yes	No	No	No	No	Not indicated	1
Pearson et al. (2006)	No	Yes	No	No	No	Yes	2
Russell and Sofronoff (2005)	No	Yes	No	No	Yes	Not indicated	2
Thede and Coolidge (2007)	No	Yes	No	No	No	Not indicated	1
Tonge et al. (1999)	No	Yes	No	No	No	Not indicated	1
Weisbrot et al. (2005)	No	Yes	No	No	Yes	Yes	3

Table 4
Methodological quality rating system

Authors	Is the sample well defined?	Is the ASD diagnosis confirmed by the current author?	Is there a current comparison group?	Is the comparison group matched?	Are the data collection methods standardized?	Are the anxiety instruments reliable?	Are the anxiety instruments valid?	Are the interpretations appropriate?	Total validity score
Bellini (2004)	Yes	Yes	No	No	No	Yes	Yes	Yes	5
de Bruin et al. (2007)	Yes	Yes	No	No	Not indicated	Yes	No	Yes	4
Evans et al. (2005)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	7
Farrugia and Hudson (2006)	Yes	No	Yes	No	No	Yes	Yes	Yes	5
Gillott et al. (2001)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Green et al. (2000)	Yes	Yes	Yes	Yes	No	Not indicated	Not indicated	Yes	5
Kim et al. (2000)	Yes	Yes	Yes-within ASD groups No-between ASD and non-ASD groups	No	Not indicated	Yes	Not indicated	Yes	4.5
Muris et al. (1998)	No	Yes	Yes-within ASD groups No-between ASD and non-ASD groups	No	Yes	Yes	Yes	Yes	5.5
Pearson et al. (2006)	Yes	Yes	Yes	No	Not indicated	Yes	Yes	Yes	6
Russell and Sofronoff (2005)	Yes	Yes	No	Not indicated	Yes	Yes	Not indicated	Yes	5
Thede and Coolidge (2007)	Yes	Yes	Yes-within ASD groups No-between ASD and non-ASD groups	No-within ASD groups Yes-between ASD and non-ASD groups	Yes	Yes	Yes	Yes	7
Tonge et al. (1999)	Yes	Yes	Yes	No	Not indicated	Yes	Yes	Yes	6
Weisbrot et al. (2005)	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	7

high-functioning children with ASD ($n = 59$). In this study, parents completed a questionnaire that measured a variety symptoms related to DSM-III-R disorders, including overanxious and separation anxiety symptoms. The researchers then compared their results to those from a previously collected random sample of children in the community ($n = 1751$). Results showed that 13.6 and 8.5% of ASD children scored at least 2 standard deviations above the normal population on a measure of generalized and separation anxiety, respectively. In addition, 13.6% of the ASD children were classified as "clinically relevant" on an internalizing score, which includes generalized anxiety, separation anxiety, and depression. In addition, Thede and Coolidge (2007) compared youth with AS and HFA to an age and sex matched control group taken from an instrument manual. Results showed that the AS group scored higher than the control group, but similar to the HFA group on parent-reported scales of GAD and OCD.

Using both self- and parent-report data, Bellini (2004) also found that a sample of adolescents with ASD ($n = 41$) showed significantly higher anxiety levels than norms obtained from a community sample. More specifically, scores on a self-report measure of anxiety suggested that nearly 49% of adolescents with ASD had elevated social anxiety. In addition, these adolescents scored significantly higher than the test manual's normative sample on self-report scales related to physical symptoms, social anxiety, separation/panic, and total anxiety, as well as on a parent-report scale that measured internalizing problems.

The findings from these studies suggest that children and adolescents with ASD show higher levels of anxiety than individuals in community and normative samples. However, these studies did not include current control groups (i.e., not from an instrument manual or previously collected sample). There is evidence suggesting that the prevalence of anxiety in the normal population has risen (Barlow, 2002). Therefore, comparing ASD samples to previously collected samples or outdated normative data represents an important methodological concern.

5.4. Anxiety in ASD samples compared to clinically anxious samples

The use of clinically anxious comparison groups helps to provide a comprehensive picture of the prevalence of anxiety in ASD populations. Studies comparing youth with ASD to clinically anxious samples suggest that these groups experience similar levels of anxiety (Farrugia & Hudson, 2006; Russell & Sofronoff, 2005). For example, Russell and Sofronoff (2005) compared self- and parent-report ratings of anxiety in children with AS to previously collected data from typically developing and clinically anxious children. Consistent with previous findings, they found that children with AS demonstrated significantly more overall anxiety than typically developing children on self- and parent-report measures. In addition, when comparing children with AS to clinically anxious children, they found no group differences on self-reported anxiety. However, parents of children with AS rated their children as being higher on overall anxiety, obsessive–compulsive symptoms, and physical injury fears, than did parents of clinically anxious children. Again, the lack of a current control group is a limitation to this study.

In a more recent study, Farrugia and Hudson (2006) corrected this methodological flaw by comparing anxiety symptoms in adolescents with AS ($n = 29$) to those with anxiety disorders ($n = 34$), and to non-clinical adolescents ($n = 30$). Results showed that self-report and parent ratings of anxiety in the AS group were equivalent to those in the anxiety disorders group. Consistent with previous findings, adolescents with AS scored significantly higher than those in the non-clinical group on self- and parent-reported anxiety. Within the AS group, the most common anxiety symptoms were obsessive–compulsiveness, Social Phobia, and generalized anxiety symptoms, in that order. However, both the low response rate of the AS group and the fact that this group was informed about the nature of the study may have resulted in the AS group being skewed towards adolescents already suspected of having anxiety.

5.5. Anxiety in ASD samples compared to other clinical groups

Researchers have also compared anxiety levels in ASD samples to those in other clinical groups, including individuals with Conduct Disorder (Green et al., 2000), language impairments (Gillott et al.,

2001), Down syndrome (Evans, Canavera, Kleinpeter, Maccubbin, & Taga, 2005), and a diverse clinical sample (Weisbrot et al., 2005). In their study, Green et al. (2000) compared adolescent boys with AS (n = 20) to a sample of adolescent boys with Conduct Disorder (n = 20). They found that the AS group demonstrated significantly more anxiety-related symptoms than the group with Conduct Disorder. Moreover, results showed that 35% of the adolescents with AS met ICD-10 (World Health Organization, 1992) criteria for GAD, 25% met criteria for OCD, and 10% met criteria for a phobic anxiety disorder (e.g., Social Phobia, Specific Phobia). In another study, Gillott et al. (2001) found that children with HFA (n = 15) scored higher on a broad self-report anxiety measure than did children with language impairments (n = 15) and typically developing children (n = 15). Results indicated that the autism group also scored higher than both comparison groups on self-reported panic, physical injury fears, separation anxiety, and obsessive–compulsive subscales. In addition, children with autism scored higher than comparison groups on a self- and parent-report measure of social anxiety.

Evans et al. (2005) conducted a well-designed study in which they compared parent-reported fears in children with ASD (n = 25), Down syndrome (n = 43), and typically developing children who were matched either by mental age (n = 45) or chronological age (n = 37). Children with ASD showed more situational fears and medical fears, but less fear of harm/injury than comparison groups. Furthermore, children with ASD were rated as significantly more fearful of social situations than children with Down syndrome, but similar to those in mental and chronologically age-matched groups. However, these authors created their own anxiety measure for this study, and thus, the psychometric properties of the instrument have yet to be established.

In a relatively large-scale study, Weisbrot et al. (2005) compared anxiety symptoms in a sample of preschoolers with ASD (n = 182) to a clinical sample without ASD (n = 135). They also compared samples of school-age children with ASD (n = 301) to clinical samples without ASD (n = 191). For the preschool group, teachers rated children with ASD as having more severe anxiety symptoms than the clinical (non-ASD) group. Conversely, parents rated the clinical (non-ASD) children as higher than ASD children on several anxiety symptoms (e.g., separation anxiety and generalized anxiety). For the school-age children, parents and teachers rated ASD children as more fearful, obsessive, and compulsive than the clinical (non-ASD) group. Although results are preliminary, this study highlights the importance of taking a developmental approach to studying anxiety in ASD populations. Further research is needed to investigate developmental trajectories of specific types of anxiety in children and adolescents with ASD.

Taken together, these studies suggest that youth with ASD may be experiencing higher levels of anxiety than conduct and language disordered groups, and demonstrating different patterns of anxiety than samples with Down syndrome and mixed (non-ASD) clinical samples. However, none of these studies have been replicated, and thus should be interpreted with caution.

5.6. Anxiety across ASD subtypes

Several studies have also compared anxiety levels in youth across different ASD subtypes. Although some differences across subtypes have been found (Muris et al., 1998; Thede & Coolidge, 2007; Tonge et al., 1999; Weisbrot et al., 2005), research in this area is sparse and results are mixed (Kim et al., 2000; Pearson et al., 2006).

Studies comparing anxiety levels in children and adolescents with HFA to those with AS have had mixed findings (e.g., Kim et al., 2000; Thede & Coolidge, 2007; Tonge et al., 1999). For example, Tonge et al. (1999) found that children with AS (n = 52) scored significantly higher than those with HFA (n = 75) on the anxiety subscale and total problems scale of the Developmental Behaviour Checklist (Primary Carer Version) (DBC; Einfeld & Tonge, 1994). In this study, individuals with AS were approximately 2 years older and had a higher intellectual level than those with HFA. However, analyses used both age and IQ as covariates and thus, results are unlikely to be due to differences in these factors. Consistent with these findings, Thede and Coolidge (2007) found that children with AS scored significantly higher than children with HFA and those in a control group on a parent-report measure of generalized anxiety.

Conversely, Kim et al. (2000) compared children with AS (n = 19) to children with HFA (n = 40) and found no differences between parent-reported anxiety levels. However, the absence of group

differences may have been impacted by the relatively small sample size of individuals in the AS group. Also, unlike Tonge et al. (1999), the authors of this study did not employ the DSM-IV hierarchy rule that a diagnosis of autism takes precedence over a diagnosis of AS. Therefore, Kim et al. (2000) may have used a more severe Asperger group, which could also contribute to their lack of group differences on anxiety measures.

Two additional studies have compared anxiety symptoms in children with AD and those with PDD-NOS (Muris et al., 1998; Pearson et al., 2006). In their study, Muris et al. (1998) compared anxiety symptoms in children and adolescents with PDD-NOS ($n = 29$) to those with AD ($n = 15$) on a parent-report measure of anxiety. They found that several types of anxiety were more prevalent in individuals with PDD-NOS than those with AD. More specifically, those diagnosed with PDD-NOS more frequently met DSM-III-R (American Psychiatric Association, 1987) criteria for Simple Phobia, SAD, Avoidant Disorder, and Overanxious Disorder. However, this study was limited in that children with PDD-NOS were older and functioned at a higher intellectual level than those with AD. Pearson et al. (2006) addressed this limitation by statistically controlling for intellectual ability when comparing parent-reported anxiety levels in children with AD ($n = 26$) and PDD-NOS ($n = 25$). Results indicated that anxiety symptoms did not differ between the groups.

More recently, Weisbrot et al. (2005) examined differences in psychopathology between large samples of children across all ASD subtypes. This study compared preschool and school-age children with DSM-IV diagnoses of AD ($n = 170$), AS ($n = 104$), and PDD-NOS ($n = 209$). In the preschool group, there were no significant differences between ASD subtypes on either parent or teacher reported anxiety symptoms. However, parents and teachers in the school-age sample rated the AS group as having more severe generalized anxiety symptoms than the other two groups, and more severe obsessions than the AD group. In addition, parents rated the PDD-NOS group as having more severe obsessions than the AD group.

Taken together, evidence suggests that differences may exist in anxiety symptoms across ASD subtypes (Muris et al., 1998; Thede & Coolidge, 2007; Tonge et al., 1999; Weisbrot et al., 2005). Although these findings are preliminary, four of six studies support the idea that children and adolescents with AS and PDD-NOS may experience more anxiety symptoms than individuals with AD. This may indicate that children with the least severe PDD symptoms might be the most impaired by anxiety symptoms. However, the small number of studies, relatively small sample sizes, and conflicting results mandates further research in this area. In addition, confounding group differences represent a major limitation to some of these studies (e.g., Muris et al., 1998; Tonge et al., 1999). It is possible that confounding factors, rather than the ASD subtype, were responsible for increased anxiety levels in some of the studies.

5.7. Summary and critical evaluation of studies examining anxiety in youth with ASD

This review described and evaluated 13 studies that assessed anxiety in children and adolescents with ASD. Several consistent findings emerged from the literature. First, existing research suggests that children and adolescents with ASD experience a high level of anxious symptomatology (de Bruin et al., 2007; Muris et al., 1998). The types of anxiety displayed by these individuals are extremely varied, and they include symptoms such as generalized anxiety, separation anxiety, social anxiety, phobias, panic, and obsessive–compulsiveness. Second, research suggests that children and adolescents with ASD typically show greater levels of anxiety than those in community populations (Bellini, 2004; Farrugia & Hudson, 2006; Gillott et al., 2001; Kim et al., 2000; Russell & Sofronoff, 2005; Thede & Coolidge, 2007). Third, anxiety levels in children and adolescents with ASD appear to be comparable to those in samples of clinically anxious individuals (Farrugia & Hudson, 2006; Russell & Sofronoff, 2005). Fourth, preliminary studies suggest that children and adolescents with ASD demonstrate significantly higher levels of anxiety than conduct disordered (Green et al., 2000) and language impaired individuals (Gillott et al., 2001). Furthermore, studies suggest that youth with ASD may demonstrate different patterns of anxiety than those with Down syndrome (Evans et al., 2005) and other clinical samples (Weisbrot et al., 2005). However, these studies require replication before conclusions can be drawn. Finally, studies examining anxiety across ASD subtypes suggest that children and adolescents with AS and PDD-NOS may experience more anxiety symptoms than

individuals with AD (Muris et al., 1998; Thede & Coolidge, 2007; Tonge et al., 1999; Weisbrot et al., 2005).

Our evaluation of the existing studies highlighted both strengths and limitations that should be considered when interpreting the above findings. Overall, the assessment methods used in the present studies did not match the recommendations set forth in the literature (Table 3). For example, only one of the studies used multimodal assessment techniques to evaluate anxiety. More specifically, only three of the studies used clinical interviews, one used direct observation, and none used physiological measures to assess anxiety in youth with ASD. Most of the studies relied solely on the use of rating scales to measure anxiety. In addition, less than half of the studies used multiple informants to assess anxiety. Finally, only two studies reported that the anxiety rating scales used in their study had been used previously with ASD populations. Furthermore, no studies reported that the measure had been normed in ASD populations. This poses a considerable threat to the validity of the present findings, as there is no way to ensure that the anxiety measure is appropriate for use with this population.

Overall, the methodological quality of the reviewed studies was fair (Table 4). Almost all of the studies clearly defined their samples, and took measures to confirm the diagnosis of ASD participants. In addition, most studies used reliable instruments to measure anxiety. Finally, appropriate conclusions were drawn for all studies. However, the studies also had a number of methodological limitations. For example, samples were often relatively small and lacked adequate control groups. Only seven of the studies used current comparison groups from non-ASD populations. Another limitation of the current studies is that comparison groups were not matched on important characteristics (e.g., age, IQ, etc.). Furthermore, heterogeneity in the level of functioning of ASD samples (e.g., intellectual ability, social skills, and communication ability) limits the ability to compare findings across studies. Two studies used anxiety measures that were not valid, and three studies did not report the validity of their measure. Variations in instrumentation, outcome variables, source of information, and changes in diagnostic criteria for anxiety disorders make it difficult to determine the exact prevalence of specific anxiety symptoms and disorders in this population. Finally, the majority of studies either failed to use or did not indicate the use of standardized data collection methods, preventing replication of these studies.

6. Avenues for future research

Based on the information reviewed, the following are recommendations for improving the quality of studies used to assess anxiety in children and adolescents with ASD:

1. Studies should adhere to the assessment recommendations set forth in the literature (e.g., using multimodal assessment techniques, multiple informants, and psychometrically sound instruments).
2. Appropriate control groups should be used; and these groups should be matched on important characteristics (e.g., age, sex).
3. Future research should adequately describe important study characteristics (e.g., data collection methods, procedure, instruments). We noted that a number of studies omitted or provided only vague descriptions of important study characteristics that are essential to the interpretation and replication of empirical studies.
4. Studies should strive to use psychometrically sound assessment tools. Adequate reliability and validity of the anxiety measures should be established and reported in all empirical studies.

Based on the information reviewed, several key avenues for future research are recommended:

1. More research is needed to distinguish co-morbid anxiety from core ASD symptoms. In addition, future research should investigate the prevalence and methods to assess anxiety in low functioning youth with ASD.
2. It is important to examine developmental issues in children and adolescents with ASD and co-morbid anxiety. For example, research examining age-related differences in the onset, course, and

symptom expression of anxiety will be beneficial. Likewise, age-related differences in treatment responsivity in this population have yet to be investigated.

3. New instruments are needed to measure anxiety in ASD populations (e.g., structured clinical interviews, rating scales, clearly defined protocol for direct observation). Population norms need to be established for current assessment instruments and these instruments need to be validated on ASD samples.
4. Advances in physiological assessment of anxiety are required before meaningful comparisons can be made across individuals. More reliable, valid, and clearly defined protocols must also be established before physiological assessment can become a practical assessment technique in clinical settings.
5. Although many studies suggest that youth with ASD experience greater levels of anxiety than youth in community samples, more research is needed to replicate and extend studies comparing anxiety in ASD samples to other clinical groups.

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