Anxiety in Autism Spectrum Disorder

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1 Introduction

Anxiety has been linked to autism spectrum disorder (ASD) since Leo Kanner and Hans Asperger first described this condition seven decades ago. Kanner (1943) provides a detailed report on a child whose behavior was "governed by an anxiously obsessive desire for the maintenance of sameness." For example, he would get very anxious if furniture was moved around, but then his anxiety would suddenly disappear when things were rearranged as they were previously. Other children described by Kanner would experience anxiety in response to loud sounds or mechanical noises. Asperger (1944) mentions anxiety in a different context, reporting that some of his patients would feel anxious as a consequence of being mercilessly bullied at school.

Clarifying the nature of the link between autism and anxiety is currently considered to be a priority in the field, as anxiety issues can interfere drastically with the ability to participate in home, school, and community activities, and might impact on the child and family well-being and quality of life above and beyond the core symptoms of ASD (Davis III et al. 2014; Pellecchia et al. 2015).

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2 Prevalence

The existing research shows that individuals with ASD exhibit higher levels of anxiety compared to both typically developing individuals (Kim et al. 2000; Bellini 2004; Gadow et al. 2005; Lopata et al. 2010) and individuals from other clinical groups, including Down syndrome (Evans et al. 2005), conduct disorder (Green et al. 2000), specific language impairment (Gillott et al. 2001), Williams syndrome (Rodgers et al. 2012a), and learning disabilities (Gadow et al. 2005; Gillot and Standen 2007). Additionally, there is evidence that individuals with ASD experience anxiety levels that are comparable to those of clinically anxious non-ASD individuals (Russell and Sofronoff 2005; Farrugia and Hudson 2006).

Reported prevalence of anxiety in ASD has varied widely, with estimates ranging from 13.6 to 84.1 % (Bellini 2004; Bradley et al. 2004; Kim et al. 2000; Muris et al. 1998; Lidstone et al. 2014). A recent systematic review (van Steensel et al. 2011) has identified that clinically significant levels of anxiety were present in 39.6 % of a pooled sample of 2,121 individuals with ASD obtained from 31 studies. Although findings are inconsistent, the most frequent anxiety disorders in ASD appear to be specific phobias, generalized anxiety disorder, separation anxiety disorder, obsessive-compulsive disorder, and social phobia (Muris et al. 1998; Evans et al. 2005; Gadow et al. 2005; Weisbrot et al. 2005; de Bruin et al. 2007; Gillot and Standen 2007; Sukhodolsky et al. 2008).

In conclusion, anxiety appears to be more common in ASD than in both the general population and various clinical groups, with possibly up to 40 % of individuals in the autism spectrum presenting elevated levels of at least on anxiety subtype.

3 Phenomenology and Clinical Issues

In many autobiographical accounts of individuals with ASD, the experience of feeling anxious is described with reference to symptoms and feelings that resemble those occurring in the typical population. For example, Temple Grandin (1992) reports, “The feeling [of anxiety] was like a constant feeling of stage fright all the time. I had a pounding heart, sweaty palms, and restless movements. (…) For weeks I had horrible bouts of colitis. (…) I started waking up in the middle of the night with my heart pounding.” Nevertheless, the manifestation of anxiety in ASD might present differently from its expression in individuals without an ASD or might be less apparent. Several factors might underlie these differences.

First, manifestations of the core features of ASD and anxiety symptoms overlap frequently, and this can make anxiety symptoms “invisible” (Kerns and Kendall 2014; Renno and Wood 2013). For example, social avoidance/withdrawal can be an expression of anxiety as well as a manifestation of the social communication impairment that characterizes ASD. Similarly, ritualistic behaviors are a known manifestation of anxiety but also an expression of the restricted and repetitive features that are pathognomonic of ASD. Therefore, an anxiety disorder that manifest with social

avoidance and ritualistic behaviors, while easily identifiable in a child without ASD, can easily pass unnoticed in a child with ASD.

Additionally, even when manifestations of anxiety do not overlap with ASD symptoms, they can be less noticeable in the context of the clinical variability observed in ASD. As the range of behavioral manifestations associated with ASD is extremely large and heterogeneous, any atypical behavior in this population can be mistakenly interpreted as being a consequence of having ASD (for an example of diagnostic overshadowing, see Kanne 2013). For example, the presence of restlessness and phobias (two symptoms of anxiety that do not overlap with the characteristic features of ASD) in a child who has severe ASD might be seen as a behavioral manifestation of ASD, rather than anxiety (Helverschou and Martinsen 2011; Kerns et al. 2015).

Furthermore, individuals with ASD might present with idiosyncratic anxiety symptoms. For example, recent research (Mayes et al. 2013; Kerns and Kendall 2014) documented a high proportion of atypical anxiety symptoms, including unusual specific phobias (e.g., vacuum cleaners, toilets) and fears of change/novelty. However, it is unclear whether such symptoms are manifestations of anxiety or reflect aspects of the core symptoms of ASD.

Communication difficulties further complicate the picture, as many individuals with ASD do not have the communication skills necessary to express their experience of distress or discomfort verbally. This both affects the overt manifestations of anxiety and limits the possibility to ascertain the presence of anxiety symptoms, in particular in minimally verbal children.

In summary, despite the high prevalence of anxiety in the ASD population, there is still uncertainty in the field on how to best define the clinical presentation of anxiety in individuals with ASD. This reflects the clinical issues discussed above (overlap between core symptoms of the two conditions, diagnostic overshadowing, atypical symptoms that encompass elements of both conditions, and impact of core ASD impairments in symptom expression), as well as current lack of knowledge on the causal relationship between ASD and anxiety. The increased risk for anxiety in individuals with ASD might reflect a number of different scenarios (Mazefsky and Herrington 2014; Weisbrot et al. 2005; Wood and Gadow 2010). First, it is possible that individuals with ASD are anxious as the inevitable consequence of having to cope with social demands that are beyond their level of understanding. The difficulties in core social cognition processes such as mindreading (Baron-Cohen 1997) and action understanding (Vivanti et al. 2011), as well as in social-affiliative behaviors such as establishing and maintaining social relationships, might result in perceiving the social world as unpredictable, confusing, and ultimately anxiety-provoking. Other factors that might lead to increased risk for anxiety in ASD include restrictions to self-determination that are often experienced especially in lower functioning individuals (Carter et al. 2013) and peer rejection encountered by higher functioning individuals who are motivated by the desire of friendships and relationships. Moreover, hypersensitivity to sensory stimuli (e.g., loud noises) might lead to the development of aversion and subsequent phobic responses to situations (e.g., dogs barking, balloons popping, vacuum cleaners) that would not

normally trigger such reactions in typical peers. While there is evidence supporting this scenario (Wood and Gadow 2010; Hollocks et al. 2014) if anxiety is the inevitable consequence of having ASD, then is not clear why not all individuals with ASD have anxiety.

An alternative explanation is that features that are not specific or pathognomonic of ASD, but co-occur frequently in this population, confer the increased risk of anxiety in ASD. For example, intellectual disability, depression, tic disorders, and obsessive-compulsive disorder are frequently associated both with ASD and anxiety. Issues in emotional regulation, which are very frequent in ASD, might also play a relevant role (Mazefsky et al. 2013). Thus the occurrence of anxiety in this population is likely to reflect the interplay between different, co-occurring risk factors.

Finally, it is possible that ASD and anxiety share a common etiology (see section on Neurobiological Bases (Sect. 6)).

4 Correlates of Anxiety in ASD

In the typical population, the presentation of anxious symptoms is tied to normative developmental periods and the challenges they bring (Warren and Sroufe 2004). It is therefore expected that separation anxiety and phobias of animals should be predominant in children aged 6–9 years, generalized anxiety symptoms and phobias regarding danger and death in children aged 10–13 years, and social anxiety in adolescents around ages 14–17 years. Several studies have supported this model. For example, Kashani and Orvaschel (1990) looked at the fear of social situations across three age groups. In a group of 8-year-old children, fear of social situations was reported in approximately 21.4 %; this rate increased to 45.75 % of 12 year olds and to 55.7 % of 17 year olds. Furthermore, "worrying about what others think about me" was reported by 38.6 % of 8 year olds and increased to 67.1 % in 12 and 17 year olds.

Following these findings, several studies have examined the role of age and developmental level in the expression of anxiety in autism, with some studies reporting that higher levels of anxiety are associated with cognitive ability (Weisbrot et al. 2005; Lecavalier et al. 2006; Mazurek and Kanne 2010) and increased age (Kuusikko et al. 2008; Davis III et al. 2010; Green et al. 2012). However, other studies have failed to find associations between anxiety, cognitive level (Mazefsky et al. 2011; Strang et al. 2012), and chronological age (e.g., Strang et al. 2012). It is important to emphasize that existing literature has predominantly focused on school-aged children and adolescents, with only few studies examining anxiety in very young children (Davis III et al. 2011a; Matson et al. 2010; Green et al. 2012) and adult populations (Bejerot et al. 2014; Gillott and Standen 2007). A recent study by Davis III et al. (2011a) compared the levels of anxiety in 131 toddlers (aged 17–36 months), children (aged 3–16 years), and adults (aged 20–65 years) diagnosed with ASD and found that anxiety increases from toddlerhood to childhood, decreases from childhood to young adulthood, but again increases from young adulthood into older adulthood. Although the study by Davis and colleagues provides an initial insight into how anxiety might change over the lifespan in

individuals with ASD, it is necessarily limited by the use of different anxiety measures for different age groups and more importantly by its cross-sectional design.

Studies examining the relationship between overall autism severity and anxiety have yielded mixed results, with Mazurek and Keane (2010) finding a significant negative association between autism severity and anxiety levels and Lopata et al. (2010) reporting no significant association.

Although research on anxiety in non-ASD populations has consistently shown a link between impairments in language and communication and levels of anxiety (Beitchman et al. 2001; Bornstein et al. 2013), only a handful of studies have examined the relationship between the social communication impairments and anxiety in ASD, consistently reporting that anxiety symptoms are more common in children with stronger communication abilities (Davis III et al. 2011b, 2012; Sukhodolsky et al. 2008; Kerns et al. 2015). However, several authors (e.g., Strang et al. 2012; Sukhodolsky et al. 2008; Tsai 1996) have suggested that lower levels of anxiety in minimally verbal children with ASD might be a consequence of difficulties in communicating anxious symptoms rather than a true reflection of lower levels of anxiety in this subgroup.

In a recent study, Kerns et al. (2015) reported that individuals with ASD and co-occurring anxiety displayed more self-injury and depression than those with ASD alone. In the same study, co-occurring anxiety was associated with high levels of parental stress. Finally, studies in this field have consistently reported that elevated levels of anxiety are associated with both increased sensory modulation problems (Ben-Sasson et al. 2008; Green et al. 2012; Lidstone et al. 2014; Mazurek et al. 2013) and higher levels of repetitive behaviors (Sukhodolsky et al. 2008; Rodgers et al. 2012a, b; Gotham et al. 2013).

5 Diagnosis and Evaluation: Assessment Tools

The diagnosis of anxiety disorders in people with ASD is complicated by a number of factors. Firstly, as approximately 30 % of individuals with autism remain minimally verbal throughout their lifespan (Tager-Flusberg and Kasari 2013), ascertainment of anxiety symptoms in this subgroup must rely on information provided by parents, teachers, or other caregivers. Since secondhand accounts of anxious thoughts or behavior can be problematic due to common misconceptions or biases of the reporter, diagnosticians should exercise a healthy level of caution when interpreting this information. For example, repetitive patterns of play in a child with ASD may appear to their parent as a symptom of obsessive-compulsive disorder (OCD), though children with ASD usually enjoy engaging in these behaviors, whereas those with OCD do not (Turner-Brown et al. 2011).

Challenges exist also with respect to self-reports from verbally fluent people with autism, due to difficulties in interoception (the sense of one's own physiological state) as well as difficulties in verbal expression of emotional states, one aspect of alexithymia, which is present in 40–65 % of individuals with ASD (Berthoz and Hill 2005; Hill et al. 2004). Nevertheless, self-reports from the individual affected

are an important source of information in assessing symptoms and tailoring treatment strategies on individual needs.

Use of behavioral monitoring and, where possible, direct observation is recommended to supplement self- or other reports of anxiety. Behavioral monitoring has the advantage of tracking the triggers of anxiety for a particular individual in natural settings and has been used in children without ASD (e.g., Hagopian et al. 1990). Where a specific trigger is known, direct observation may include a behavioral avoidance test (Dadds et al. 1994), a method which involves systematically assessing avoidant behavior associated with a particular phobia-inducing stimulus. Therefore, as with any diagnosis, diagnoses of anxiety in ASD are likely to be more accurate when information is integrated across multiple sources.

A second source of complexity in assessing anxiety in people with ASD is the already mentioned degree of overlap in behavioral symptoms between the two disorders, despite the distinction in their function and phenomenology.

Due to this apparent overlap in symptoms, there has been an effort over the last decade to design ASD-specific diagnostic and evaluation tools for anxiety disorders which examine the particular way in which these symptoms arise, manifest, and are maintained in ASD, including potentially unique contributions of sensory sensitivities, inherent difficulties in negotiating social interactions, and difficulties regulating emotions and behavior. For example, the Autism Comorbidity Interview (ACI; Leyfer et al. 2006) includes questions to establish the child's emotions and behavior at his/her best in order to establish a baseline. Another approach is to use diagnostic and evaluation protocols for anxiety disorders designed for other populations to diagnose anxiety in individuals with ASD. However, large-scale studies on the psychometric properties of such measures when applied to ASD populations are lacking and the overlap in symptoms may cause a clinician to make incorrect inferences on the person with ASD's scores on such measures. Tools that are currently used to assess anxiety symptoms in ASD are listed in Table 2.1. As only few of these instruments are designed specifically for use in ASD, and for some the reliability and validity is yet to be established in the full range of anxiety disorders, more research in this area is needed to establish best practices in evaluating the presence and severity of anxiety features occurring in ASD.

This reinforces the need for a multi-method analysis of anxiety in ASD, including parental, caregiver, and/or teacher report and direct observation. Future research should investigate the feasibility of adding physiological measures such as heart rate and skin conductance response as an additional source of information in diagnostic and assessment protocols.

6 Neurobiological Bases of Anxiety in ASD

The very few studies that have directly explored neural correlates of anxiety in ASD have exclusively focused on the potential role of amygdala dysregulation. Kleinhans et al. (2010) found that increased levels of social anxiety were associated with increased activation of right amygdala during an emotion recognition task.

Table 2.1 Anxiety Assessment Tools

Name (reference)	Reporter	Sub-scales	Designed for ASD?	Age group
Autism Comorbidity Interview-Present and Lifetime Version (ACI-PL; Leyfer et al. 2006)	Parent version	Panic disorders, separation anxiety, social phobia, specific phobia, generalized anxiety, and OCD	Yes and has been used in some studies (e.g., Leyfer et al. 2006; Mazefsky et al. 2011; Mazefsky et al. 2012)	5–17 years
Anxiety Disorder Interview Schedule for DSM-IV-Child and Parent Versions (ADIS; Silverman and Albano 1996)	Parent and child versions available	DSM-IV referenced scales	No, but studies on ASD have been conducted (e.g., Storch et al. 2012; Chalfant et al. 2007; Drahota et al. 2011; Sze and Wood 2007, 2008; White et al. 2009; Wood et al. 2009)	6–17 years
Diagnostic Interview Schedule for Children IV (DISC IV; Shaffer et al. 2000)	Parent version	Simple phobia, social phobia, agoraphobia, panic disorder, separation anxiety disorder, avoidant disorder of childhood or adolescence, overanxious disorder, and obsessive-compulsive disorder	No, but studies on ASD have been conducted (e.g., Leyfer et al. 2006; Muris et al. 1998)	Parent: 6–17 years Child: 11–17 years
Baby and Infant Screen for Children with Autistic Traits (BISCUIT; Matson, Boisjoli, and Wilkins 2007)	Parent version	Part 1 and part 3 evaluate the symptoms of ASD and externalizing symptoms, respectively. Part 2 assesses comorbid psychopathology including an anxiety/repetitive scale, among others	Yes and has been used in some studies (e.g., Davis et al. 2010, 2011a; Matson et al. 2010)	17–37 months
Autism Spectrum Disorders-Comorbid for Children (ASD-CC; Matson and Gonzalez 2007; Matson and Wilkins 2008)	Parent version	Worry/depressed, among other scales	Yes and has been used in some studies (e.g., Davis et al. 2011a, b; Hess et al. 2010; Worley and Matson 2010)	3–16 years

(continued)

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Name (reference)	Reporter	Sub-scales	Designed for ASD?	Age group
Behavioral Assessment System for Children-2 (BASC-2; Reynolds and Kamphaus 2004)	Parent, teacher, and self-report	Anxiety, somatization, and internalizing, among other scales	No, but ASD norms included and studies on ASD have been conducted (e.g., Bellini 2004; Burnette et al. 2005; Meyer et al. 2006; Solomon et al. 2008; Lopata et al. 2010)	Preschool, 2–5 years; child, 6–11 years; and adolescent, 12–21 years
Spence Children's Anxiety Scale (SCAS)/Spence Preschool Anxiety Scale (Spence 1998)	Parent and child versions available	Generalized anxiety, social anxiety, obsessive-compulsive disorder, physical injury fears, and separation anxiety	No, but studies on ASD have been conducted (e.g., Murris et al. 1998; Gillott et al. 2001; Russell and Sofronoff 2005; Chalfant et al. 2007; Greenway and Howlin 2010)	7–19 years/3–6 years
Screening for Childhood Anxiety and Related Emotional Disorders (SCARED; Birmaher et al. 1997, 1999)	Parent and child versions available	Somatic/panic, generalized anxiety, separation anxiety, and social phobia	No, but a study on ASD has been conducted (e.g., Reaven et al. 2012)	8–18 years
Early Child Inventory-5 (ECI-5; Gadow and Sprafkin 1997)	Parent and teacher versions available	Generalized anxiety disorder, separation anxiety disorder, social phobia, posttraumatic stress disorder, simple phobia, OCD	No, but studies on ASD have been conducted (e.g., Weisbrot et al. 2005)	3–5 years
Multidimensional Anxiety Scale for Children (MASC; March et al. 1997)	Parent and child versions available	Somatic/panic, general anxiety, separation anxiety, social phobia, and school phobia	No, but studies on ASD have been conducted (e.g., Bellini 2004, 2006; Sze and Wood 2008; White et al. 2009; Wood et al. 2009)	4–19 years
Child Behavior Checklist (CBCL; Achenbach and Rescorla 2001):	Parent, teacher, and child versions available	Internalizing, anxious/depressed, somatic complaints, anxiety problems, somatic problems, among other scales	No, but studies on ASD have been conducted (e.g., Juranek et al. 2006; Kuusikko et al. 2008; Sze and Wood 2008)	1.5–5 years, 6–18 years

Diagnostic Assessment for the Severely Handicapped-II (DASH-II; Matson 1996)	Parent version	Overall anxiety scale, among other scales		33–80 years
Revised Children's Anxiety and Depression Scale (RCADS; Chorpita et al. 2005)	Self-report	Major depressive disorder, panic disorder, social phobia, separation anxiety disorder, generalized anxiety disorder, and obsessive-compulsive disorder	No, but studies on ASD have been conducted (e.g., Hallet et al. 2013; Sterling et al. 2015)	6–18 years
Psychopathology in Autism Checklist (PAC; Helvershou et al. 2009)	Staff/caregiver	Overall anxiety scale, among other scales	Yes	17–56 years

Juranek et al. (2006) reported that increased total and right (but not left) amygdala volume was associated with higher levels of anxiety (as measured by the Anxious/Depressed subscale of the Child Behavior Checklist) in a sample of 49 individuals with ASD (mean chronological age, 7 years and 11 months; range, 3 years and 8 months to 14 years and 8 months).

As the neurobiology of ASD is still poorly understood, it is informative to turn to the large body of work that has explored the role of certain brain structures in the development and maintenance of anxiety in non-ASD populations. A large network of brain structures are involved in fear and anxiety (see Paulus and Stein 2006; Shin and Liberzon 2010 for excellent overviews). Among these, the amygdala, ventromedial prefrontal cortex, hippocampus, and insula play a critical role, both separately and through their complex set of mutual connections, in the processes of threat detection, emotional learning, interceptive awareness, and monitoring that have been suggested to be impaired in anxiety disorders.

Dysregulation of these brain structures might be linked to anxiety in ASD, as structural and functional abnormalities in the amygdala, hippocampus, ventromedial prefrontal cortex, and insula have been reported in ASD across a number of research studies and investigation techniques, including postmortem exploration (Bauman and Kempler 1985), structural neuroimaging (Aylward et al. 1999; Sparks et al. 2002), and functional neuroimaging (Dalton et al. 2005). Inconsistencies exist with respect to the nature of such abnormalities, with some studies finding enlarged amygdala volume (Howard et al. 2000; Sparks et al. 2002) and overactivity (Dalton et al. 2005) and other reduced volume (Aylward et al. 1999; Pierce et al. 2001) and hypo-activity (Green et al. 2000; Muris et al. 1998). Furthermore, studies have suggested structural and functional abnormalities of prefrontal cortical areas (see Kaiser et al. 2010) and insula (Menon and Udin 2010) in ASD. Despite this suggestive evidence, the role of these regions, individually and especially in terms of patterns of connectivity, has not been fully explored, and our understanding of the neurobiology of anxiety in ASD is currently indirect and limited.

7 Treatment of Anxiety in ASD

7.1 Non-medical Treatments

The most commonly used nonmedical treatments for anxiety disorders in ASD are those rooted in cognitive behavioral therapy (CBT). The Coping Cat series of interventions for children, adolescents, and adults with anxiety has been shown to be effective (Kendall 1994), with results maintained at 1 and 7 years post treatment (Kendall et al. 2008). An adapted version of this program has recently been applied to high-functioning youth with ASD with comparable efficacy (McNally Keehn et al. 2013), showing the promise of CBT-based strategies for treatment of anxiety in ASD. However, as the treatment procedures in this program place many demands on the child's cognitive skills and language comprehension, applicability of this program might be limited to the higher functioning end of the autism spectrum.

Emerging evidence suggests that behavioral strategies, such as the use of graduated exposure and positive reinforcement for approach behavior, could be effective for treating phobic avoidance in individuals in the spectrum, including those who are more severely affected (Jennett and Hagopian 2008). Importantly, a number of intervention programs for ASD, such as TEACCH (Treatment and Education of Autistic and Communication Handicapped Children; Mesibov et al. 2004) and SCERTS (Social Communication, Emotional Regulation, and Transactional Support; Prizant et al. 2006), include targeted procedures to address anxiety issues, such as the use of highly predictable routines to decrease stress and uncertainty and strategies to prevent and recover from emotion dysregulation.

Research on the effectiveness of comprehensive intervention and specific strategies to improve anxiety symptoms in individuals with ASD, especially those with associated learning impairments, is still at its infancy.

7.2 Pharmacological Treatments

Current guidelines suggest the use of the selective serotonin reuptake inhibitors (SSRIs) and the serotonin and noradrenaline reuptake inhibitors (SNRIs) as the agents of choice for the first-line pharmacotherapy on anxiety disorders due to relatively good efficacy and relatively low incidence of adverse effects (Baldwin et al. 2011).

Only a few studies have explored potential efficacy of pharmacological agents in treating anxiety in ASD. Namerow et al. (2003) and Couturier and Nicolson (2002) have reported some evidence for treatment efficacy of SSRIs on anxiety in ASD population, while the study by Martin et al. (2003) found no evidence of improvement in anxiety symptoms. Furthermore, all three studies have noted significant adverse effects. For example, in the Martin et al. study, 13 individuals (72 %) had at least 1 adverse effect during the course of the trial, and treatment for 3 participants had to be terminated due to the behavioral activation. Similarly Namerow et al. (2003) reported adverse effects such as headache, sedation, aggression, and agitation in five individuals.

Finally, Buitelaar et al. (1998) found that 16 of 22 individuals with ASD aged 6–17 years experienced a reduction of anxiety (on the Clinical Global Impressions Scale) after being treated with buspirone for a period of 6–8 weeks. Unlike with SSRIs, side effects of buspirone were relatively mild.

7.3 Novel Treatment Strategies

One novel approach to the treatment of anxiety in children involves the use of computer-based CBT interventions. Khanna and Kendall (2010) adapted the Coping Cat program into a computer program, Camp Cope-A-Lot, and found no differences in effectiveness between the computer program and individualized CBT in young children (without ASD). This implementation method has not yet been used in people with ASD who have clinical levels of anxiety.

Another somewhat promising avenue for novel treatments of anxiety in ASD is the use of biofeedback devices to increase emotional awareness and support development in interoception in this population. Bio-monitoring systems measure, amplify, and feedback information primarily from nervous system processes such as respiration, heart rate, muscle tension, skin temperature, blood flow, and blood pressure to the individual being monitored, thus promoting awareness of these processes to facilitate voluntary control over body and mind. Recent reviews on the use of biofeedback to treat anxiety have shown some positive effects, particularly when multiple channels of biofeedback are used (Wells et al. 2012). However, the findings on bio- or neuro-feedback in ASD have not shown any specific effects on anxiety, but rather on cognitive processes such as executive functioning (Kouijzer et al. 2009). Larger scale studies are needed to confirm these findings and establish effective protocols for individuals in the autism spectrum presenting with co-occurring anxiety symptoms.

8 Conclusions and Future Directions

While anxiety is very prevalent and causes significant impairments in the ASD population, research in this area is still in its infancy. A critical challenge for researchers and clinicians alike is the issue of whether anxiety is a manifestation of core autistic symptoms, a causally unrelated co-occurring condition, a consequence of the challenges faced by individuals with ASD in their social environment, or a combination of different factors. Dedicated research programs investigating typical and atypical anxiety symptom presentation, causal links between ASD and anxiety features, stability, and developmental changes in anxiety symptoms are needed to (1) reach a consensus around the concept of anxiety in ASD; (2) develop gold standard, multiaxial, developmentally sensitive assessment protocols for anxiety in ASD to complement standard evaluation procedures, and (3) identify treatment targets and develop individualized intervention programs to address this profoundly disabling comorbidity.

References

Achenbach TM, Rescorla LA (2001) Manual for the ASEBA School-Age Forms and Profiles. Burlington, VT: University of Vermont, Research Center for Children, Youth, and Families

Asperger H (1944) Die autistischen psychopathen in Kindersalten. Arch Psychiatr Nervenkrankenheiten 117:76–136

Aylward EH, Minshew NJ, Goldstein G, Honeycutt NA, Augustine AM, Yates KO, Barta PE, Pearlson GD (1999) MRI volumes of amygdala and hippocampus in non- mentally retarded autistic adolescents and adults. Neurology 53(9):2145–2150

Baldwin DS, Waldman S, Allgulander C (2011) Evidence-based pharmacological treatment of generalized anxiety disorder. Int J Neuropsychopharmacol 14(5):697–710

Baron-Cohen S (1997) Mindblindness: an essay on autism and theory of mind. MIT Press, Boston

Bauman M, Kemper TL (1985) Histoanatomic observations of the brain in early infantile autism. Neurology 35:866–874

Beitchman JH, Wilson B, Johnson CJ, Atkinson L, Young A, Adlaf E, Escobar M, Douglas L (2001) Fourteen-year follow-up of speech/language-impaired and control children: psychiatric outcome. J Am Acad Child Adolesc Psychiatry 40(1):75–82

Bejerot S, Eriksson JM, Mörtberg E (2014) Social anxiety in adult autism spectrum disorder. Psychiatry Res 220:705–707

Bellini S (2004) Social skill deficits and anxiety in high-functioning adolescents with autism spectrum disorders. Focus Autism Other Dev Disabil 19(2):78–86

Bellini S (2006) The development of social anxiety in adolescents with autism spectrum disorders. Focus on Autism and Other Developmental Disabilities, 21(3):138–145

Ben-Sasson A, Cermak SA, Orsmond GI, Tager-Flusberg H, Carter AS, Kadlec MB (2008) Sensory subgroups of toddlers with autism spectrum disorders: differences in internalizing symptoms. J Child Psychol Psychiatry 49(8):817–825

Berthoz S, Hill EL (2005) The validity of using self-reports to assess emotion regulation abilities in adults with autism spectrum disorder. Eur Psychiatry 20(3):291–298

Birmaher B, Brent DA, Chiappetta L, Bridge J, Monga S, Baugher M (1999) Psychometric properties of the Screen for Child Anxiety Related Emotional Disorders (SCARED): a replication study. J Am Acad Child Adolesc Psychiatry 38:1230–1236

Birmaher B, Khetarpal S, Brent D, Cully M, Balach L, Kaufman J, Neer MS (1997) The Screen for Child Anxiety Related Emotional Disorders (SCARED): scale construction and psychometric characteristics. J Am Acad Child Adolesc Psychiatry 36:545–553

Bornstein MH, Hahn CS, Suwalsky JT (2013) Language and internalizing and externalizing behavioral adjustment: developmental pathways from childhood to adolescence. Dev Psychopathol 25(3):857–878

Bradley EA, Summers JA, Wood HL, Bryson SE (2004) Comparing rates of psychiatric and behavior disorders in adolescents and young adults with severe intellectual disability with and without autism. J Autism Dev Disord 34:151–161

Buitelaar JK, van der Gaag RJ, van der Hoeven J (1998) Buspirone in the management of anxiety and irritability in children with pervasive developmental disorders: results of an open-label study. J Clin Psychiatry 59(2):56–59

Burnette CP, Mundy PC, Meyer JA, Sutton SK, Vaughan AE, Charak D (2005) Weak central coherence and its relations to theory of mind and anxiety in autism. J Autism Dev Disord 35:63–73

Carter EW, Lane KL, Cooney M, Weir K, Moss CK, Machalicek W (2013) Parent assessments of self-determination importance and performance for students with autism or intellectual disability. Am J Intellect Dev Disabil 118(1):16–31

Chalfant AM, Rapee R, Carroll L (2007) Treating anxiety disorders in children with high functioning autism spectrum disorders: a controlled trial. J Autism Dev Disord 37:1842–1857

Chorpita BF, Moffitt CE, Gray J (2005) Psychometric properties of the revised child anxiety and depression scale in a clinical sample. Behav Res Ther 43(3):309–322

Couturier JL, Nicholson R (2002) A retrospective assessment of citalopram in children and adolescents with pervasive developmental disorders. J Child Adolesc Psychopharmacol 12:243–248

Dadds MR, Rapee RM, Barrett PM (1994) Behavioral observation. In: Ollendick TH, King NJ, Yule W (eds) International handbook of phobic and anxiety disorders in children and adolescents. Plenum, New York, pp 349–364

Dalton KM, Nacewicz BM, Johnstone T, Schaefer HS, Gernsbacher MA, Goldsmith HH, Alexander AL, Davidson RJ (2005) Gaze fixation and the neural circuitry of face processing in autism. Nat Neurosci 8(4):519–526

Davis III TE, Fodstad JC, Jenkins WS, Hess JA, Moree BN, Dempsey T, … Matson JL (2010) Anxiety and avoidance in infants and toddlers with autism spectrum disorders: evidence for differing symptom severity and presentation. Res Autism Spectr Disord 4:305–313

Davis III TE, Hess JA, Moree BN, Fodstad JC, Dempsey T, Jenskins WS,… Matson J (2011a) Anxiety symptoms across the lifespan in people diagnosed with autistic disorder. Res Autism Spectr Disord 5:112–118

Davis III TE, Moree BN, Dempsey T, Reuther ET, Fodstad JC, Hess JA, … Matson JL (2011b) The relationship between autism spectrum disorders and anxiety: The moderating effect of communication. Res Autism Spectr Disord 5:324–329

Davis TE III (2012) Where to from here for ASD and anxiety? Lessons learned from child anxiety and the issue of DSM-5. Clin Psychol Sci Pract 19:358–363

Davis TE III, White SW, Ollendick TH (2014) Handbook of autism and anxiety. Springer, New York

de Bruin EI, Ferdinand RF, Meester S, De Nijs PFA, Verheij F (2007) High rates of psychiatric co-morbidity in PDD-NOS. J Autism Dev Disord 37:877–886

Drahota A, Wood JJ, Sze KM, Van Dyke M (2011) Effects of cognitive behavioral therapy on daily living skills in children with high-functioning autism and concurrent anxiety disorders. J Autism Dev Disord 41(3):257–265

Evans DW, Canavera K, Klinepeter FL, Taga K, Maccubbin E (2005) The fears, phobias and anxieties of children with autism spectrum disorders and Down syndrome: comparisons with developmentally and chronologically age matched children. Child Psychiatry Hum Dev 36:3–26

Farrugia S, Hudson J (2006) Anxiety in adolescents with Asperger syndrome: negative thoughts, behavioral problems, and life interference. Focus Autism Other Dev Disabil 21(1):25–35

Gadow KD, Sprafkin J (1997) Early Childhood Inventory-4 norms manual. Stony Brook, NY: Checkmate Plus

Gadow KD, DeVincent CJ, Pomeroy J, Azizian A (2005) Comparison of DSM-IV symptoms in elementary school-age children with PDD versus clinic and community samples. Autism 9:392–415

Gillot A, Furniss F, Walter A (2001) Anxiety in high-functioning children with autism. Autism 5:277–286

Gillott A, Standen PJ (2007) Levels of anxiety and sources of stress in adults with autism. J Intellect Disabil 11:359–370

Gotham K, Bishop SL, Hus V, Huerta M, Lund S, Buja A, Krieger A, Lord C (2013) Exploring the relationship between anxiety and insistence on sameness in autism spectrum disorders. Autism Res 6(1):33–41

Grandin, T (1992) An Inside View of Autism. In E. Schopler and G.B. Mesibov (eds), High-Functioning Individuals with Autism. New York: Plenum Press 105–26

Green SA, Ben-Sasson A, Soto TW, Carter AS (2012) Anxiety and sensory over-responsivity in toddlers with autism spectrum disorders: bidirectional effects across time. J Autism Dev Disord 42(6):1112–1119

Green J, Gilchrist A, Cox A (2000) Social and psychiatric functioning in adolescents with Asperger syndrome compared with conduct disorder. J Autism Dev Disord 30:279–293

Greenway R, Howlin P (2010) Dysfunctional attitudes and perfectionism and their relationship to anxious and depressive symptoms in boys with autism spectrum disorders. J Autism Dev Disord 40(10):1179–1187

Hagopian LP, Weist MD, Ollendick TH (1990) Cognitive-behavior therapy with an 11-year-old girl fearful of AIDS infection, other diseases, and poisoning: a case study. J Anxiety Disord 4:257–265

Hallett V, Ronald A, Colvert E, Ames C, Woodhouse E, Lietz S, Bolton P (2013) Exploring anxiety symptoms in a large-scale twin study of children with autism spectrum disorders, their co-twins and controls. Journal of Child Psychology and Psychiatry, 54(11), 1176–1185

Helverschou SB, Martinsen H (2011) Anxiety in people diagnosed with autism and intellectual disability: recognition and phenomenology. Res Autism Spectr Disord 5(1):377–387

Helvershou SB, Bakken TL, Martinsen H (2009) The psychopathology in autism (PAC): a pilot study. Res Autism Spectr Disord 3:179–195

Hess JA, Matson JL, Dixon DR (2010) Psychiatric symptom endorsements in children and adolescents diagnosed with autism spectrum disorders: a comparison to typically developing children and adolescents. J Dev Phys Disabil 22:485–496

Hill EL, Berthoz S, Frith U (2004) Brief report: cognitive processing of own emotions in individuals with autistic spectrum disorder and in their relatives. J Autism Dev Disord 34(2): 229–235

Hollocks MJ, Jones CR, Pickles A, Baird G, Happé F, Charman T, Simonoff E (2014) The association between social cognition and executive functioning and symptoms of anxiety and depression in adolescents with autism spectrum disorders. Autism Res 7(2):216–228

Howard MA, Cowell PE, Boucher J, Broks P, Mayes A, Farrant A, … Roberts N (2000) Convergent neuroanatomical and behavioral evidence of an amygdala hypothesis of autism. Neuroreport 11:2931–2935

Jennett HK, Hagopian LP (2008) Identifying empirically supported treatments for phobic avoidance in individuals with intellectual disabilities. Behav Ther 39:151–161

Juranek J, Filipek PA, Berenji GR, Modahl C, Osann K, Spence MA (2006) Association between amygdala volume and anxiety level: magnetic resonance imaging (MRI) study in autistic children. J Child Neurol 21(12):1051–1058

Kaiser MD, Hudac CM, Shultz S, Lee SM, Cheung C, Berken AM, Deen B, Pitskel NB, Sugrue DR, Voos AC, Saulnier CA, Ventola P, Wolf JM, Klin A, Vander Wyk BC, Pelphrey KA (2010) Neural signatures of autism. Proc Natl Acad Sci 107(49):21223–21228

Kanne S (2013) Diagnostic overshadowing. In: Encyclopedia of autism spectrum disorders. Springer, New York, pp 938–940

Kanner L (1943) Autistic disturbances of affective contact. Nerv Child 2:217–250

Kashani JH, Orvaschel H (1990) A community study of anxiety in children and adolescents. Am J Psychol 147:313–318

Kendall PC (1994) Treating anxiety disorders in children: results of a randomized clinical trial. J Consult Clin Psychol 62:100–110

Kendall PC, Hudson JL, Gosch E, Flannery-Schroeder E, Suveg C (2008) Cognitive-behavioral therapy for anxiety disordered youth: a randomized clinical trial evaluating child and family modalities. J Consult Clin Psychol 76:282–297

Kerns CM, Kendall PC (2014) Autism and anxiety: overlap, similarities, and differences. In: Handbook of autism and anxiety. Springer Cham Heidelberg New York Dordrecht London, pp 75–89

Kerns CM, Kendall PC, Zickgraf H, Franklin ME, Miller J, Herrington J (2015) Not to be overshadowed or overlooked: functional impairments associated with comorbid anxiety disorders in youth with ASD. Behav Ther 46(1):29–39

Khanna M, Kendall P (2010) Computer-assisted cognitive behavioral therapy for child anxiety: results of a randomized clinical trial. J Consult Clin Psychol 78(5):737–745

Kim JA, Szatmari P, Bryson SE, Streiner DL, Wilson FJ (2000) The prevalence of anxiety and mood problems among children with Autism and Asperger syndrome. Autism 4:117–132

Kleinhans NM, Richards T, Weaver K, Johnson LC, Greenson J, Dawson G, … Alyward E (2010) Association between amygdala response to emotional faces and social anxiety in autism spectrum disorders. Neuropsychologia 48(12):3665–3670

Kouijzer MEJ, de Moor JMH, Gerrits BJL, Buitelaar JK, van Schie HT (2009) Long-term effects of neurofeedback treatment in autism. Res Autism Spectr Disord 3(2):496–501

Kuusikko S, Pollock-Wurman R, Jussila K, Carter AS, Mattila ML, Ebeling H, Pauls DL, Moilanen I (2008) Social anxiety in high-functioning children and adolescents with autism and Asperger syndrome. J Autism Dev Disord 38(9):1697–1709

Lecavalier L, Leone S, Wiltz J (2006) The impact of behaviour problems on caregiver stress in young people with autism spectrum disorders. J Intellect Disabil Res 50(3):172–183

Leyfer OT, Folstein SE, Bacalman S, Davis NO, Dinh E, Morgan J, Tager-Flusberg H, Lainhart JE (2006) Comorbid psychiatric disorders in children with autism: interview development and rates of disorders. J Autism Dev Disord 36:849–861

Lidstone J, Uljarević M, Sullivan J, Rodgers J, McConachie H, Freeston M, … Leekam SR (2014) Relations among restricted and repetitive behaviors, anxiety and sensory features in children with autism spectrum disorders. Res Autism Spectr Disord 8(2):82–92

Lopata C, Toomey JA, Fox JD, Volker MA, Chow SY, Thomeer ML, Lee GK, Rodgers JD, McDonald CA, Smerbeck AM (2010) Anxiety and depression in children with HFASDs: symptom levels and source differences. J Abnorm Child Psychol 38(6):765–776

March JS (1997). Manual for multidimensional anxiety scale for children. Tonawanda, NY: Multi-Health System Inc

Martin A, Koenig K, Anderson G, Scahill L (2003) Low dose fluvoxamine treatment of children and adolescents with pervasive developmental disorders: A prospective, open-label study. J Autism Dev Disord 33(1):77–85

Matson JL, Benavidez DA, Compton LS, Paclawskyj T, Baglio C (1996) Characteristics of autism as assessed by the diagnostic assessment for the severely handicappated-II (DASH-II). Res Dev Disab 17, 135–143

Matson JL, Boisjoli JA, Wilkins J (2007) The Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT). Disability Consultants, Baton Rouge

Matson JL, Gonzalez ML (2007) Autism spectrum disorders – comorbidity – child version. Disability Consultants, Baton Rouge

Matson JL, Hess JA, Boisjoli JA (2010) Comorbid psychopathology in infants and toddlers with autism and pervasive developmental disorders – not otherwise specified (PDD-NOS). Res Autism Spectr Disord 4(2):300–304

Matson JL, Wilkins J (2008) Reliability of the Autism Spectrum Disorders-Comorbid for Children (ASD-CC). J Dev Phys Disabil 20(4):327–336. doi:10.1007/s10882-008-9100-1

Mayes SD, Calhoun SL, Aggarwal R, Baker C, Mathapati S, Molitoris S, Mayes RD (2013) Unusual fears in children with autism. Res Autism Spectr Disord 7(1):151–158

Mazefsky CA, Herrington J (2014) Autism and anxiety: etiologic factors and transdiagnostic processes. In: Handbook of autism and anxiety. Springer International Publishing, pp 91–103

Mazefsky CA, Kao J, Oswald DP (2011) Preliminary evidence suggesting caution in the use of psychiatric self-report measures with adolescents with high-functioning autism spectrum disorders. Res Autism Spectr Disord 5:164–174

Mazefsky CA, Herrington J, Siegel M, Scarpa A, Maddox BB et al (2013) The role of emotion regulation in autism spectrum disorder. J Am Acad Child Adolesc Psychiatry 52:679–688

Mazefsky CA, Oswald DP, Day TN, Eack SM, Minshew NJ, Lainhart JE (2012) ASD, a psychiatric disorder, or both? Psychiatric diagnoses in adolescents with high-functioning ASD. J Clin Child Adolesc Psychol 41(4):516–523

Mazurek MO, Kanne SM (2010) Friendship and internalizing symptoms among children and adolescents with ASD. J Autism Dev Disabil 40(12):1512–1520

Mazurek MO, Vasa RA, Kalb LG, Kanne SM, Rosenberg D, Keefer A, Murray DS, Freedman B, Lowery LA (2013) Anxiety, sensory over-responsivity, and gastrointestinal problems in children with autism spectrum disorders. J Abnorm Child Psychol 41(1):165–176

McNally Keehn RH, Lincoln AJ, Brown MZ, Chavira DA (2013) The coping cat program for children with anxiety and autism spectrum disorder: a pilot randomized controlled trial. J Autism Dev Disord 43(1):57–67

Menon V, Udin LQ (2010) Saliency, switching, attention and control: a network model of insula function. Brain Struct Funct 214(5–6):655–667

Mesibov GB, Shea V, Schopler E (2004) The TEACCH approach to autism spectrum disorders. New York: Springer Science & Business Media

Meyer JA, Mundy PC, van Hecke AV, Durocher JS (2006) Social attribution processes and comorbid psychiatric symptoms in children with Asperger syndrome. Autism 10(4):383–402

Muris P, Steerneman P, Merckelbach H, Holdrinet I, Meesters C (1998) Comorbid anxiety symptoms in children with pervasive developmental disorders. J Anxiety Disord 12:387–393

Namerow LB, Prakash T, Bostic JQ, Prince J, Monuteaux MC (2003) Use of citalopram in pervasive developmental disorders. J Dev Behav Pediatr 24:104–108

Paulus MP, Stein MB (2006) An insular view of anxiety. Biol Psychiatry 60:383–387

Pellecchia M, Connell JE, Kerns CM, Xie M, Marcus SC, Mandell DS (2015) Child characteristics associated with outcome for children with autism in a school-based behavioral intervention. Autism 1362361315577518

Pierce K, Muller RA, Ambrose J, Allen G, Courchesne E (2001) Face processing occurs outside the fusiform 'face area' in autism: evidence from functional MRI. Brain 124:2059–2073

Prizant B, Wetherby A, Rubin E, Laurent A, Rydell P (2006) The SCERTS® model: a comprehensive educational approach for children with autism spectrum disorders, vol 1 and 2. Paul H. Brookes, Baltimore

Reaven J, Blakeley-Smith A, Leuthe E, Moody E, Hepburn S (2012) Facing your fears in adolescence: cognitive-behavioral therapy for high-functioning autism spectrum disorders and anxiety. Autism Res Treat. doi: 10.1155/2012/423905

Renno P, Wood JJ (2013) Discriminant and convergent validity of the anxiety construct in children with autism spectrum disorders. J Autism Dev Disord 43(9):2135–2146
Reynolds CR, Kamphaus RW (2004) Manual: behavior assessment system for children, 2nd edn. American Guidance Service, Circle Pines
Rodgers J, Riby DM, Janes E, Connolly B, McConachie H (2012a) Anxiety and repetitive behaviours in autism spectrum disorders and Williams syndrome: a cross-syndrome comparison. J Autism Dev Disord 42(2):175–180
Rodgers J, Glod M, Connolly B, McConachie H (2012b) The relationship between anxiety and repetitive behaviours in autism spectrum disorders. J Autism Dev Disord 42(11):2404–2409
Russell E, Sofronoff K (2005) Anxiety and social worries in children with Asperger syndrome. Aust N Z J Psychiatry 39:633–638
Shaffer D, Fisher P, Lucas CP, Dulcan MK, Schwab-Stone ME (2000) Diagnostic interview schedule for children version IV (DISC-IV): description, differences from previous versions, and reliability of some common diagnoses. J Am Acad Child Adolesc Psychiatry 39(1):28–38
Shin LM, Liberzon I (2010) The neurocircuitry of fear, stress, and anxiety disorders. Neuropsychopharmacology 35(1):169–191
Silverman W, Albano AM (1996) Manual for the anxiety disorders interview schedule for DSM-IV: child and parent versions. Psychological Corporation, San Antonio
Solomon M, Ozonoff S, Carter C, Caplan R (2008) Formal thought disorder and the autism spectrum: relationship between symptoms, executive control, and anxiety. J Autism Dev Disord 38:1474–1484
Sparks BF, Friedman SD, Shaw DW, Aylward EH, Echelard D, Artru AA, Maravilla KR, Giedd JN, Munson J, Dawson G, Dager SR (2002) Brain structural abnormalities in young children with autism spectrum disorder. Neurology 59:184–192
Spence SH (1998) A measure of anxiety symptoms among children. Behav Res Ther 36(5):545–566
Sterling L, Renno P, Storch EA, Ehrenreich-May J, Lewin AB, Arnold E, Lin E, Wood J (2015) Validity of the Revised Children's Anxiety and Depression Scale for youth with autism spectrum disorders. Autism. 2015 Jan;19(1):113–7. doi: 10.1177/1362361313510066
Storch EA, May JE, Wood JJ, Jones AM, De Nadai AS, Lewin AB, Arnold EB, Murpy TK (2012) Multiple informant agreement on the anxiety disorders interview schedule in youth with autism spectrum disorders. J Child Adolesc Psychopharmacol 22(4):292–299
Strang JF, Kentworthy L, Daniolos P, Case L, Willis MC, Martin A, Wallace GL (2012) Depression and anxiety symptoms in children and adolescents with autism spectrum disorders without intellectual disability. Res Autism Spectr Disord 6:406–412
Sukhodolsky DG, Scahill L, Gadow KD, Arnold LE, Aman MG, McDougle CJ, Tierney E, Williams White S, Lecavalier L, Vitiello B (2008) Parent-rated anxiety symptoms in children with pervasive developmental disorders: frequency and association with core autism symptoms and cognitive functioning. J Abnorm Child Psychol 36(1):117–128
Sze KM, Wood JJ (2007) Cognitive behavioral treatment of comorbid anxiety disorders and social difficulties in children with high functioning autism: a case report. J Contemp Psychother 37:133–143
Sze KM, Wood JJ (2008) Enhancing CBT for the treatment autism spectrum disorders and concurrent anxiety. Behav Cogn Psychother 36:403–409
Tager-Flusberg H, Kasari C (2013) Minimally verbal school-aged children with autism spectrum disorder: the neglected end of the spectrum. Autism Res 6(6):468–478
Tsai LY (1996) Brief report: comorbid psychiatric disorders of autistic disorder. J Autism Dev Disord 26:159–164
Turner-Brown LM, Lam KS, Holtzclaw TN, Dichter GS, Bodfish JW (2011) Phenomenology and measurement of circumscribed interests in autism spectrum disorders. Autism 15(4):437–456
van Steensel FJ, Bogels SM, Perrin S (2011) Anxiety disorders in children and adolescents with autistic spectrum disorders: a meta-analysis. Clin Child Fam Psychol Rev 14:302–317

Vivanti G, McCormick C, Young GS, Abucayan F, Hatt N, Nadig A, Ozonoff S, Rogers SJ (2011) Intact and impaired mechanisms of action understanding in autism. Dev Psychol 47(3):841

Warren SL, Sroufe LA (2004) Developmental issues. In: Ollendick TH, March JS (eds) Phobic and anxiety disorders in children and adolescents: a clinicians guide to effective psychosocial and pharmacological interventions. Oxford University Press, New York, pp 92–115

Weisbrot DM, Gadow KD, DeVincent CJ, Pomeroy J (2005) The presentation of anxiety in children with pervasive developmental disorders. J Child Adolesc Psychopharmacol 15:477–496

Wells R, Outhred T, Heathers JAJ, Quintana DS, Kemp AH (2012) Matter over mind: a randomised-controlled trial of single-session biofeedback training on performance anxiety and heart rate variability in musicians. PLoS One 7(10):e46597

White SW, Oswald D, Ollendick T, Scahill L (2009) Anxiety in children and adolescents with autism spectrum disorders. Clin Psychol Rev 29:216–229

Wood JJ, Gadow KD (2010) Exploring the nature and function of anxiety in youth with autism spectrum disorders. Clin Psychol Sci Pract 17(4):281–292

Wood JJ, Drahota A, Sze K, Har K, Chiu K, Langer DA (2009) Cognitive behavioral therapy for anxiety in children with autism spectrum disorders: a randomized, controlled trial. J Child Psychol Psychiatry 50(3):224–234

Worley JA, Matson JL, Sipes M, Koziowski AM (2010) Prevalence of autism spectrum disorders in toddlers receiving early intervention services. Res Autism Spectr Disord 5:920–925