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ORIGINAL PAPER

Age Differences in Expression of Generalized and Social Anxiety Among Youth with Autism Spectrum Disorder

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Abstract

This study examined differences in generalized and social anxiety symptoms across two age groups of children with autism spectrum disorder (ASD) while accounting for overall anxiety level, gender, and intellectual functioning. Older children (12–18 years) expressed more overall and social anxiety symptoms than younger children (6–11 years), and social anxiety symptoms were predominant in the older group. Younger children expressed more generalized anxiety symptoms than the older youth, and there was a trend for generalized anxiety symptoms to be more dominant in the younger group. Findings are consistent with theory of differential expression of specific anxiety symptoms across different ages seen with typically developing children, yet social evaluative concerns may be even stronger for adolescents with ASD.

Keywords ASD · Anxiety · Development · Social anxiety · Generalized anxiety

Anxiety is one of the most common comorbid symptoms among youth with autism spectrum disorder (ASD). Children with ASD exhibit relatively elevated anxiety symptoms and higher rates of anxiety disorders than children in community samples (Bellini 2004; Farrugia and Hudson 2006; Guttmann-Steinmetz et al. 2010; Kuusikko et al. 2008; May et al. 2014; Russell and Sofronoff 2005), with similar or even greater symptom levels as compared to youth with anxiety disorders (e.g., Farrugia and Hudson 2006; Russell and Sofronoff 2005). Co-occurring 'impairing' anxiety has been reported in 11–84% of youth with ASD, and up to 40% meet diagnostic criteria for at least one anxiety disorder (Van Steensel et al. 2011; White et al. 2009).

Anxiety symptoms appear to be more prevalent among children with ASD as compared to children with other neurodevelopmental conditions. Studies have found youth with ASD to exhibit more social phobia symptoms and obsessive compulsive behaviors (Gadow et al. 2009), and more separation anxiety symptoms (Schiltz et al. 2017) than children with attention-deficit/hyperactivity disorder (ADHD). Children diagnosed with ASD have also been found to exhibit more anxiety than children diagnosed with language impairment (Durkin et al. 2012; Gillott et al. 2001), Down Syndrome (Evans et al. 2005), and Williams Syndrome (Rodgers et al. 2012).

Anxiety is associated with a number of negative outcomes for youth with ASD, including exacerbation of the core deficits of ASD (Joyce et al. 2017; Kim et al. 2000; Sze and Wood 2007), increased self-injurious behavior, depression, and parental stress (Kerns et al. 2014), and interference with educational success, friendships, and social engagement (Reaven 2011; White et al. 2009). The pervasive presence of anxiety and its deleterious effects on youth with ASD has sparked a surge in research aimed at understanding the phenomenology and mechanisms of anxiety among this population (South et al. 2017; Vasa et al. 2013; Williams et al. 2015). One avenue in this regard is understanding

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developmental differences in the expression of anxiety symptoms among youth with ASD.

Among children in community samples, research generally supports a longitudinal trend of decreased anxiety over the course of childhood and adolescence, as well as less anxiety in older youth as compared to younger children when measured cross-sectionally (Olatunji and Cole 2009; Ollendick et al. 1985; 1989; Weems 2008). How anxiety manifests across development in children with ASD currently remains unclear. In contrast to findings among children in community samples, several studies that have examined broad age ranges of children with ASD show that, as reported by parents, older children exhibit more anxiety than younger children (Davis et al. 2011; Mayes et al. 2011; Niditch et al. 2012; Vasa et al. 2013). At least one study using child self-report found a similar pattern (Kuusikko et al. 2008). It is important to note that a few cross-sectional studies show no differences in anxiety symptoms across ages as reported by parents (Strang et al. 2012; Sukhodolsky et al. 2008; Williams et al. 2015). Only a handful of studies have examined continuity and changes in anxiety in youth with ASD using longitudinal designs (Schiltz et al. 2017; Teh et al. 2017; May et al. 2014; Gotham et al. 2015). In two studies using parental reports of child anxiety, there were no significant changes in anxiety levels between time 1 and time 2 (Teh et al. 2017, 5–17 year-olds followed for 10–19 months; May et al. 2014, 7–12 year-old children followed for 1 year). Schiltz et al. (2017) followed 8–16 year-olds for 15 months and found that self-reported anxiety among the ASD group increased relative to a non-clinical group, although the difference was only marginally significant. Gotham et al. (2015) assessed parent-reported anxiety in a group of 5–19 year-old youth with ASD and a group of youth with developmental delays over a period of 3 years. They found that for both groups, for those children who entered the study in late childhood, males had higher anxiety than females at the outset of the study, but females had a greater increase in anxiety during adolescence relative to males. That is, although the males' anxiety increased over time, the increase in females' anxiety was greater, and by young adulthood there were no significant gender differences.

In summary, the majority of the cross-sectional literature shows a trend of increased anxiety symptoms during childhood among youth with ASD. Longitudinal studies show continuity in anxiety, but the relatively short spans of time children have been followed may not allow for detection of changes in specific anxiety symptoms for the entire sample across different developmental periods (e.g., from childhood to adolescence). Findings of increased anxiety over time among youth with ASD are in contrast to findings from community samples, which generally show less anxiety at older ages—depending on the type of anxiety symptoms under study (Weems 2008).

In community samples, our understanding of developmentally normative expressions of anxiety symptoms derives from the premise that basic biological and behavioral predispositions give rise to 'undifferentiated anxiety,' which is common among the different types of anxiety disorders. Secondary anxiety symptoms, which are specific to various types of anxiety disorders (e.g., separation-related anxiety in separation anxiety disorder, social anxiety in social phobia, and worry and general fears in generalized anxiety disorder) are further shaped by additional biological, cognitive, behavioral, and social processes (Vasey and Dadds 2001; Weems 2008; Weems and Silverman 2013). This presumption gives rise to the notion that specific symptom presentation depends, in part, on the challenges posed by varying developmental periods. For example, in younger children, the drive to individuate from parents may give rise to anxiety related to separation, whereas in adolescence, the emergence of social understanding and ego development may give rise to social evaluative concerns (Warren and Sroufe 2004; Westenberg et al. 2001; Weems 2008; Weems and Costa 2005). In general, the literature with typically developing (TD) children bear out these developmental distinctions in terms of types of symptoms that are more prevalent at certain ages (Costello et al. 2004; Weems et al. 1998, 2013). However, as Weems and Costa (2005) point out, in the context of overall decreasing anxiety over time in TD youth, it would be difficult to point to systematic differences in the predominant, or most pronounced and developmentally expected expression of anxiety, considering that such differences may be masked by overall trends in anxiety levels across ages.

Unlike in community samples, we do not have a well-defined understanding of continuity and change in anxiety symptoms or disorders of youth with ASD. However, there is some data on differential symptom expression across ages in youth with ASD. Differential symptom expression refers here to systematic differences in expression of specific childhood anxiety symptoms. Based on parent ratings, Gadow and colleagues reported screening prevalence rates of anxiety disorders (based on DSM-IV criteria and frequency criteria) for pre-school (3–5 years old; Gadow et al. 2004) and school-age (6–12 years old; Gadow et al. 2005) children who had received services at a university hospital developmental disabilities specialty clinic or a child psychiatry outpatient service clinic. Rates for pre-school children and school-age children, respectively, were 6% and 24% for generalized anxiety disorder, 6% and 7% for separation anxiety disorder, 18% and 59% for specific phobia, 5% and 41% for obsessions, and 21% and 29% for compulsions (Weisbrot et al. 2005). Magiati et al. (2016) examined anxiety expression in a sample of 6–18 year-olds using the Spence Children's

Anxiety Scale-Parent version (Spence 1999). They found a number of the subscales of the measure to be positively correlated with age, but after a Bonferroni correction, only the obsessive compulsive disorder scale remained significantly correlated. Kuusikko et al. (2008), using two separate measures of self-reported social anxiety (Social Phobia and Anxiety Inventory for Children [SPAI-C; Beidel et al. 1998] and Social Anxiety Scale for Children-Revised [SASC-R; La Greca and Stone 1993]) found that adolescents (12–15 years) with high functioning autism and Asperger's disorder (HA/AD; IQ ≥ 80) scored higher on the behavioral avoidance scale of the SPAI-C and on the fear of negative evaluation scale of the SASC-R than their younger counterparts (8–12 years). Importantly, Kuusikko et al. (2008) removed items in the measures that overlapped with symptoms of HF/AD per DSM-IV-TR (APA 2000) and ICD-10 (WHO 1993) criteria, and the results were maintained. In summary, the limited research to date generally suggests that generalized anxiety symptoms, obsessive compulsive symptoms, specific phobia symptoms, and social anxiety related symptoms (behavioral avoidance and fear of negative evaluation) are greater in older children with ASD as compared to younger children.

It is in this context that we examine differential expression of anxiety symptoms in youth with ASD, while accounting for overall anxiety levels when determining predominant symptoms at different ages. Understanding which anxiety symptoms are more predominant at different ages for youth with ASD is important for a number of reasons. For instance, differences in levels of specific anxiety symptoms across ages captured in the ASD literature to date may only be reflecting overall increases in anxiety levels across groups. For example, the findings that generalized anxiety symptoms and social anxiety symptoms are more prevalent in older youth than younger youth may only be a reflection of more overall anxiety in older youth. That is, such simple comparisons of symptom levels across age groups may tell us nothing about which types of anxiety symptoms systematically emerge and are predominant at various developmental periods. Further, we can gain a much better understanding of which developmental processes influencing anxiety trajectories in non-clinical children are likely to apply to youth with ASD, and ultimately better tailor anxiety-specific interventions for youth with ASD at different ages.

In this study, similar to Weems and Costa (2005) and Weems et al. (2013), we used a cross-sectional design to test which anxiety symptoms are the predominant expression of anxiety for younger versus older children with ASD. Specifically, to capture age ranges of youth similar to the age ranges of the Weems and colleagues studies and others and to focus on similar specific symptom areas (e.g., general anxiety and social anxiety), we compared 6–11 year-olds to 12–18 year-olds in generalized anxiety (GA) symptoms and social anxiety (SA) symptoms. Similar to the literature with non-clinical children, the ASD literature points to older children exhibiting more social anxiety symptoms; however, unlike with non-clinical youth (Weems and Costa 2005), older children with ASD also show higher levels of generalized anxiety symptoms relative to younger children (Van Steensel et al. 2011). Thus, we sought to examine: (1) whether increased GA symptoms and SA symptoms in the older group are predominant in this group or if their specific symptom levels are a function of overall increased anxiety for youth with ASD as they get older; and (2) whether either of these two types of symptoms are more predominant in younger children. Based on the literature, we hypothesized that SA symptoms would be predominant among the older children, but no specific predictions were made about which type of symptom would be more predominant for younger children.

Conceptually, some anxiety symptoms in children with ASD may not conform to DSM-defined categories and may reflect an underlying biological disposition for anxiety manifest in ASD-related areas that are salient to a particular individual, such as social avoidance (Kerns et al. 2014). Considering that social anxiety may be shaped by ASD-related impairments, similar to Kuusikko et al. (2008), we focused on social anxiety symptoms that do not overlap with DSM or ICD criteria for ASD. Finally, some literature has positively linked intellectual functioning with anxiety symptoms in youth with ASD (for reviews, see Vasa and Mazurek 2015 and van Steensel and Heeman 2017) while other literature has negatively linked intellectual functioning with anxiety symptoms (for a review, see van Steensel et al. 2011). In this study we examined the role that intellectual functioning may have on the predominant expression of anxiety symptoms across ages, but did not make specific predictions.

Methods

Participants

Archival data from families seen for evaluation at a hospital-based autism center in a city in the Southeast United States between June 2006 and June 2016 were used for this study. The participants were 294 children aged 6–11 years and 60 adolescents aged 12–18 years (N = 354). There were 284 males and 70 females. Mean of IQ for the entire sample was 76.87 (SD = 19.55) (range 35–125; median = 78). 66.13% of the sample had a full scale IQ of 70 or above. 16.78% of the 6–11 year olds and 25% of the 12–18 year-olds scored in the clinical range of the Behavioral Assessment System for Children—Second Edition (BASC-2; Reynolds and Kamphaus 2004) Anxiety subscale (i.e., t score > = 70). The sole inclusion criterion for this study was diagnosis with

autistic disorder, Asperger's disorder, or PDD-NOS based on DSM-IV diagnostic criteria (APA 2000), or diagnosis of autism spectrum disorder based on DSM 5 criteria (APA 2013). Participant demographic characteristics are presented in Table 1.

Procedures

Prior to their clinical appointment, caregivers completed a packet of questionnaires, including the parent report form of the BASC-2. These forms were completed primarily by children's mothers (84.5%). On the day of the appointment, children were administered a measure of their cognitive functioning by a masters level psychometrist. Children were then administered the Autism Diagnostic Observation Schedule (ADOS; Lord et al. 2002) by either a psychometrist in the presence of a PhD psychologist or by the PhD psychologist. For children seen at the clinic June 2006 to May 2013 (n = 242), caregivers also completed the Autism Diagnostic Interview, Revised (ADI-R; Lord et al. 1994) with a PhD psychologist. Clinical diagnosis of an ASD for these 242 children was made by the psychologist based on information obtained via the ADI-R and ADOS in conjunction with clinical intake information, behavioral observation, questionnaire data, and developmental and cognitive testing. ADI-R scores for these children are presented in Table 1. For the remaining 112 children clinical diagnosis was made in the same manner excluding information from the ADI-R, which was not available for them. Institutional Review Board approval was obtained from both the hospital in which the

Table 1 Group characteristics

Variable	Children *M* (*SD*) *n*	Adolescents *M* (*SD*) *n*	Total sample *M* (*SD*) *n*
Age	7.8 (1.7) 294	14.2 (1.9) 60	8.9 (3.0) 354
Parent education			
Mother	13.5 (5.7) 271	13.4 (2.9) 55	13.5 (5.3) 326
Father	12.9 (2.7) 215	13.3 (3.1) 43	13.0 (2.7) 258
ADI-R			
Social Interaction	14.42 (5.40) 201	14.39 (5.04) 38	14.41 (5.33) 239
Communication-nonverbal	9.36 (3.49) 42	N/A	
Communication-verbal	10.20 (3.95) 158	9.76 (3.75) 38	10.12 (3.90) 196
Stereotyped behavior[a]	5.14 (1.94) 201	4.24 (1.87) 38	5.00 (1.96) 239
	n (%)	*n* (%)	*n* (%)
Gender (males)	236 (80.3)	48 (80.0)	284 (80.2)
Ethnicity			
Caucasian	180 (61.2)	42 (70.0)	222 (62.7)
African-American	71 (24.1)	13 (21.7)	84 (23.7)
Asian	3 (1.0)	0 (0.0)	3 (0.8)
Latino	15 (5.1)	1 (1.7)	16 (4.5)
Biracial	18 (6.1)	0 (0.0)	18 (5.1)
Other	7 (2.4)	4 (6.7)	11 (3.1)
PDD subtype			
Autistic disorder	100 (34.0)	13 (21.7)	113 (31.9)
PDD-NOS	63 (21.4)	16 (26.7)	79 (22.3)
Asperger's disorder	26 (8.8)	7 (11.7)	33 (9.3)
Autism spectrum disorder	105 (35.7)	24 (40.0)	129 (36.4)
	M (*SD*) Range *n*	*M* (*SD*) Range *n*	*M* (*SD*) Range *n*
IQ	77.1 (19.9) 35–125 262	75.8 (18.1) 40–105 54	76.9 (19.6) 35–125 316
GA	9.1 (3.4) 3–16 294	9.2 (2.9) 4–15 60	9.1 (3.4) 3–16 354
SA[a]	5.2 (2.4) 2–12 294	6.6 (2.5) 2–12 60	5.4(2.4) 2–12 354
Anxiety[a]	52.8 (16.9) 28–101 289	59.7 (12.7) 32–87 60	54.0 (16.4) 28–101 349

Parent education is reported in years; high school completion = 12

ADI-R Autism diagnostic interview-revised, *N/A* there were no nonverbal adolescents with ADI-R scores

[a]Significant age group difference

data were collected and the university with which the first author is affiliated. Because de-identified archival data was utilized in this study, consent and assent were not obtained from the participants.

Measures

Autism diagnostic observation schedule (ADOS; Lord et al. 2002). The ADOS is a structured observation-based measure during which the child is presented with tasks requiring social and communicative skills that are generally impaired in youth with ASDs. The ADOS has excellent inter-rater reliability (.92) and test–retest reliability (.82) (Lord et al. 2002).

Autism diagnostic interview, revised (ADI-R; Lord et al. 1994). The ADI-R is a semi-structured interview administered to parents, designed to inform ASD diagnosis based on DSM-IV diagnostic criteria. The ADI-R has demonstrated good internal consistency, with kappa coefficients ranging by section from .54 to .84, and most sections demonstrating kappa coefficients of .76 or above (Lecavalier et al. 2006), and good inter-rater reliability (62–.95) (Lord et al. 1994).

Intellectual functioning Intellectual functioning was assessed through one of several standard batteries based on age and abilities. Some children were administered the Mullen Scales of Early Learning (Mullen 1995) (10.5% of participants) or one of the Wechsler intelligence tests: Wechsler Preschool and Primary Scale of Intelligence—Third Edition (WPPSI-III; Wechsler 2002) (14.7% of participants) or WPPSI-IV (Wechsler 2012) (2.5% of participants); Wechsler Intelligence Scale for Children—Third Edition (WISC-III; Wechsler 1991) (.8% of participants) or WISC-IV (WISC-IV; Wechsler 2003) (40.1% of participants); Wechsler Adult Intelligence Scales—Third Edition (WAIS-III; Wechsler 1997) (.8% of participants) or WAIS-IV (Wechsler 2008) (.5% of participants); Wechsler Abbreviated Scales of Intelligence—Second Edition (WASI-II; Wechsler 2011) (13.3% of participants). Participants who could not perform on measures of verbal ability were administered the Leiter International Performance Scale—Revised (Roid and Miller 1997) (1.4% of participants) or the Wechsler Nonverbal Measure of Ability (WNV; Wechsler and Naglieri 2006) (2.8% of participants). Six children (1.7%) were administered two testing batteries (e.g., Mullen and WPPSI-III). For these children, we used the higher of the two scores. Thirty-four children (10.7% of participants) had missing cognitive tests or the tests had been deemed invalid by the clinician.

Parent Rating Scales (PRS) of the Behavioral Assessment System for Children—Second Edition, (BASC-2; Reynolds and Kamphaus 2004) were used in this study. The Child and Adolescent versions of the PRS were used among parents of 6–11 year-old and 12–18 year-old children, respectively. The BASC-2 is a multidimensional measure that assesses children's functioning across several domains. Items are presented as statements and parents are asked to rate on a four-point scale ranging from 'never' to 'almost always' how descriptive each item is of his or her child's behavior. Age-normed *t* scores for each of several scales are generated based on parent responses for children as young as 2 years. Children with autism spectrum disorders were included in the BASC-2 general and clinical norm samples and in the reliability and validity studies (Reynolds and Kamphaus 2004). The PRS have demonstrated excellent psychometric properties, with internal consistencies ranging from .70 to .80 for each scale, and test–retest reliability ranging from .70 to the low .90s (Reynolds and Kamphaus 2004).

The BASC-2 PRS Anxiety subscale total *t* score and its individual items were used in this study to measure overall anxiety levels, and GA and SA symptoms, respectively. To gauge whether the items on this subscale could be used to assess GA symptoms and SA symptoms, consistent with the literature (Kuusikko et al. 2008), we first examined the items to determine if any of these overlapped with symptom criteria for an ASD diagnosis. None of the symptoms overlapped. We then conducted a principal component analysis (PCA) including a Varimax rotation with Kaiser Normalization of the child and adolescent versions separately (Table 2). The PCA for the child version generated two factors explaining 56.3% of the variance in scores with one factor tapping generalized anxiety symptoms (4 items; e.g., *"worries"*, *"is fearful"*) and the second factor measuring social anxiety symptoms (9 items; e.g., *"Worries about what other children think"*). The PCA for the adolescent version generated three factors explaining 58.6% of the variance in scores. The first factor was comprised of the same 4 items as the child version tapping into generalized anxiety symptoms. The second factor gauged social anxiety symptoms and was composed of 4 items, 3 of which overlapped with the items of the child version. A third factor with two items measured fear of failure (e.g., *"Says 'I am not very good at this"*) rather than social evaluation. Because we were interested in comparing scores across the two age groups, rather than using all 9 items of the social anxiety factor of the child version, we only used the 3 items that overlapped with the adolescent version for this factor. Thus, we ended up with a generalized anxiety subscale (4 items) and a social anxiety subscale (3 items) that had the same items across age groups and could thus be combined for analyses. Cronbach's alphas for the GA subscale and SA factors for the entire sample were .81 and .77, respectively.

Data Analytic Strategy

Descriptive statistics were used to screen the data before analysis. To examine the validity of the GA and SA factors, we conducted correlational analyses between the GA and SA

Table 2 Factor loadings for items of child and adolescent versions of PRS BASC-2 anxiety subscale

Items for child (6–11 years) version	F 1	F 2	Items for adolescent (12–21 years) version	F 1	F 2	F 3
Worries	.398	**.747**	Worries	**.691**	.050	.444
Is fearful	.221	**.777**	Is fearful	**.636**	.187	.142
Is nervous	.224	**.811**	Is nervous	**.652**	.387	-.032
Worries about things that cannot be changed	.490	**.623**	Worries about things that cannot be changed	**.747**	.065	.030
Worries about what teachers think	**.731**	.363	Worries about what teachers think	.108	**.728**	.372
Worries about what other children think	**.734**	.281	Worries about what other adolescents think	.165	**.715**	.078
Tries too hard to please others	**.623**	.162	Tries too hard to please others	.109	**.664**	.289
Says 'I am not very good at this'	**.714**	.271	Says 'I am not very good at this'	-.058	.153	**.830**
Worries about making mistakes	**.527**	.190	Worries about making mistakes	.429	.194	**.635**
Worries about school work	**.581**	.352	Says 'I get nervous during tests'	.449	**.562**	-.170
Says 'I am afraid I will make a mistake'	**.743**	.324	Says 'I am afraid I will make a mistake'	.485	.258	.465
Worries about what parents think	**.695**	.330				
Says 'It's all my fault'	**.697**	.195				
Is too serious	.499	.314				

Note Factor loadings greater than .525 are shown in boldface

factor scores and the *t* scores of individual externalizing and internalizing subscales of the BASC-2 with the current sample. To examine convergent validity, we ran correlational analyses between the factors and the Depression and Somatization subscales, and to examine divergent validity, we ran correlational analyses between the two factors and the Hyperactivity, Aggression, and Conduct Problems subscales. A multivariate analysis of variance (MANOVA) was conducted to compare the age groups in parents' level of education and IQ. A second MANOVA was conducted comparing age groups in BASC-2 Anxiety subscale *t* scores, and GA and SA factor scores. Raw scores for the GA (4 items) and SA (3 items) factors were used for this latter analysis. To test the hypotheses, first, subscale scores for GA and SA symptoms using the derived factors were computed across the entire sample as standard deviation scores (*Z* scores) so valid comparisons could be made using a within-subjects model. That is, because the GA and SA factors had different scale ranges, using the raw scores could confound the results if not standardized. Then, a mixed factorial within-subjects (type of symptom, GA or SA, as the within-subjects measure) by age group (6–11, 12–18) by sex (as between-subjects factors) analysis of covariance was conducted. A significant type of symptom by age group interaction with the predicted SA symptoms predominant in the older group would confirm our hypothesis. Supplemental follow-up comparisons were made within age groups using t-tests testing differences between symptoms. The BASC-2 PRS Anxiety subscale total *t* score was entered as a covariate to account for overall differences in anxiety symptoms. The full scale IQ score on the intelligence measures was also entered as a covariate.

Results

In terms of convergent validity of the two factors, correlations between the GA factor and the Depression *t* score and the Somatization *t* core were $r = .60$, $p < .001$ and $r = .49$, $p < .001$, respectively. Correlation coefficients between SA factor and the same two BASC-2 *t* scores were $r = .59$, $p < .001$ and $r = .39$, $p < .001$. In terms of divergent validity, correlations between the GA factor and the Hyperactivity *t* score, Aggression *t* score, and Conduct Problems *t* score were $r = .16$, $p = .046$, $r = .06$, $p = .241$, $r = .17$, $p = .002$, respectively. Correlation coefficients between the SA factor and the same three BASC-2 *t* scores were $r = .09$, $p = .080$, $r = .04$, $p = .444$, $r = .10$, $p = .071$, respectively. In all, these findings provide support for the convergent and discriminant validity of the two factors scores. Correlations among study variables for the entire sample are presented in Table 3.

Table 3 Correlations between study variables

Variable	Correlations (total sample)				
	1.	2.	3.	4.	5.
1. Age	–				
2. IQ	.05	–			
3. GA	.11*	.34**	–		
4. SA	.25**	.33**	.59**	–	
5. Anxiety	.21**	.40**	.83**	.82**	–

GA generalized anxiety factor score, *SA* social anxiety factor score, *Anxiety* total *t* score on the BASC-2 Anxiety scale

*p < .05; **p < .01

Main demographic information for the sample, and means and standard deviations for non-transformed scores on the IQ measures, generalized anxiety factor, social anxiety factor, and BASC-2 Anxiety scale are presented in Table 1. Examination of the skewness of these latter four scores indicated acceptable levels for the planned analyses. Five cases were missing data for the BASC-2 Anxiety scale *t* score, and 32 children and 6 adolescents were missing IQ scores. Analyses were conducted using listwise deletion. Chi square analyses indicated no differences between the two age groups (6–11, 12–18) in type of ASD diagnosis (autistic disorder, Asperger's disorder, PDD-NOS, autism spectrum disorder), χ^2 (3) = 3.67, $p = .299$, sex, χ^2 (1) = 0.00, $p = .962$, or ethnicity (Caucasian, African-American, Asian, Latino, Biracial, Other), χ^2 (5) = 9.27, $p = .099$. Analyses of variance indicated that the 6–11 year old children scored higher on the Restricted Repetitive Behaviors (stereotyped behavior) scale of the ADI-R than the 12–18 year old children, F (1, 238) = 7.02, $p = .009$, $\eta^2 = .03$. There were no other differences in ADI-R scale scores.

The 2 (sex) X 2 (age group) multivariate analysis of variance with the three anxiety scores (BASC-2 Anxiety scale, SA, GA) yielded a significant effect of age group, Wilks multivariate F (3, 340) = 8.30, $p < .001$, $\eta_p^2 = .07$. Parents reported more overall anxiety through the BASC-2 Anxiety subscale, F (1, 346) = 7.76, $p = .006$, $\eta_p^2 = .02$, and more social anxiety F (1, 346) = 10.62, $p = .001$, $\eta_p^2 = .03$ for adolescents than children (Table 1). There were no sex or interaction effects for any of the three anxiety dependent variables. The second MANOVA predicting parent education and IQ yielded no sex, group, or interaction effects.

A repeated measures ANCOVA controlling for the BASC-2 Anxiety scale *t* scores and full scale IQ scores was run to test for differences in symptom expression (z score-transformed scale scores) yielding a significant age group by symptom type (GA vs SA) interaction, F (1, 306) = 10.57, $p = .001$, $\eta_p^2 = .03$. BASC-2 Anxiety *t* score was a significant covariate, F (1, 306) = 1417.83, $p < .001$, $\eta_p^2 = .82$. There were no main effects of IQ, sex, and symptom type, and there were no other significant two-way interactions or a three-way interaction. Follow-up contrasts indicated that adolescents showed more SA symptoms than children, F (1, 308) = 3.89, $p = .049$, $\eta_p^2 = .01$, and children showed more GA symptoms than adolescents F (1, 308) = 18.07, $p < .001$, $\eta_p^2 = .06$. Co-variate adjusted means for standardized symptom scores between the two age groups are presented in Fig. 1 showing differences in mean scores across the two age groups.

Supplemental within-group comparisons revealed that, as predicted for adolescents, SA symptoms were predominant relative to GA symptoms, t (59) = 3.51, $p = .001$ (95% confidence interval .19–.70). For children, GA symptoms were higher but not statistically significantly different from SA symptoms, t (293) = − 1.80, $p = .07$ (95% confidence interval − .19 to .01).

Discussion

This study furthers our understanding of age differences in expression of specific anxiety symptoms among youth diagnosed with ASD. Consistent with our hypothesis, adolescents with ASD exhibit a greater number of social anxiety symptoms than their younger counterparts, and these social anxiety symptoms are dominant over general anxiety symptoms within the adolescent group. A growing body of

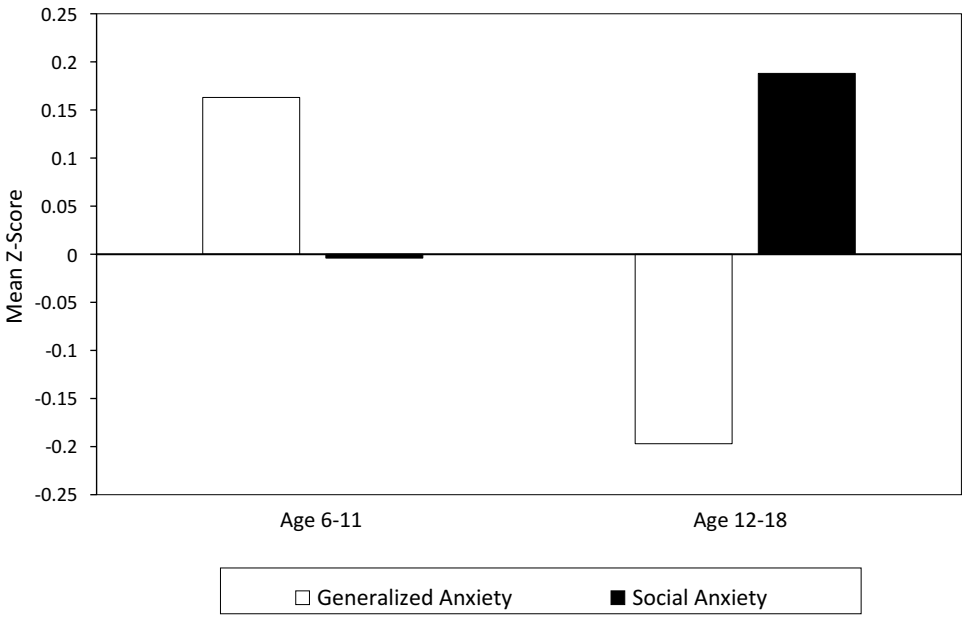

Fig. 1 Covariate-adjusted standardized symptom scores across age groups for the generalized anxiety symptom and social anxiety symptom factors

literature has provided evidence that youth with ASD experience more overall anxiety symptoms as they get older. However, our findings indicate that the increase in overall anxiety symptoms for older youth with ASD is not uniform. Rather, social anxiety symptoms appear to account for the overall increase in anxiety as youth with ASD get older. In contrast, our findings suggest that general anxiety symptoms are predominant for the younger school-age children with ASD. Taken together, these findings are consistent with theories of differential expression of anxiety across age groups that are based on non-clinical community samples (Weems and Costa 2005).

In terms of overall anxiety symptom levels, the results are consistent with previous research showing a positive association between age and overall anxiety level for children diagnosed with ASD (e.g., Kuusikko et al. 2008; Mayes et al. 2011; Vasa et al. 2013). Such findings are inconsistent with and opposite of what is generally observed with non-clinical community samples, for which increased age is generally associated with lower levels of anxiety (e.g., Olatunji and Cole 2009; Ollendick et al. 1989; Weems and Costa 2005). However, of note is that even in the context of a decrease in overall anxiety symptoms for community samples of older youth, social anxiety symptoms are predominant for this population (Weems and Costa 2005). In this regard, adolescents in community samples are similar to adolescents with ASD, and it is likely that theory linking differential expression of anxiety symptoms across ages in typically developing youth applies to children with ASD (Westenberg et al. 2001; Warren and Sroufe 2004; Weems and Costa 2005). Specifically, like with typically developing youth, increased social understanding of adolescents with ASD likely gives rise to social and evaluative concerns making social anxiety and fears the predominant expression of anxiety in this age group. Of note, some research has shown that the level of social anxiety symptoms expressed by adolescents with high functioning (e.g., IQ $\geq$ 70) ASD is higher than that of adolescents with no clinical diagnoses (Gillott et al. 2001; Kuusikko et al. 2008; Melfsen et al. 2006). In our sample, however, intellectual functioning did not interact with age in predicting specific symptom type, and age group differences persisted after co-varying for any effect of intellectual functioning. This finding suggests that even for low functioning youth with ASD (e.g., IQ < 70) social evaluative concerns may be a major factor driving the type of anxiety symptom expressed in adolescence. It is possible that social understanding increases with age for youth with ASD, including some insight into social limitations linked with the disorder. In turn, greater insight may lead to social and evaluative anxiety.

In contrast to social anxiety symptoms, general anxiety symptoms were higher for the younger group in our study. General anxiety symptoms were not more dominant among the younger group than social anxiety symptoms, but there was a trend in that direction. These findings are also mostly consistent with theory of differential expression of specific anxiety symptoms across different ages. Developmentally, children who are approximately ten to thirteen years-old are proposed to develop more general fears about the world and non-specific worries that reflect generalized anxiety symptoms (Westenberg et al. 2001; Warren and Sroufe 2004). Weems and Costa (2005) found support for this proposition with 10–13 year old children exhibiting more generalized anxiety than younger and older youth. Although we were not able to compare 10–13 year olds to other age groups due to sample size, our findings suggest that generalized anxiety symptoms as the dominant expression of anxiety may be relevant for a wider age range of children diagnosed with ASD. That is, youth of school age (6–11 year-olds) diagnosed with ASD may have broader concerns or worries that are characteristic of generalized anxiety relative to adolescents with ASD.

It is not clear why youth in this broad age range (6–11 years) may exhibit more generalized anxiety symptoms than their adolescent counterparts. Cognitively, at approximately 7 years of age, typically developing children become proficient at considering multiple features of a stimulus or environmental condition (Piaget 1970, 1983). Relative to anxiety development, children at this age are better able than younger children to anticipate negative consequences and to elaborate such consequences, that is, they are better able to anticipate threat (i.e., worry) (Vasey and Daleiden 1994). It is possible that children with ASD, like typically developing children, are more susceptible to worry in general and may find any number of events or stimuli anxiety-provoking at this young age. Future research in this area should examine whether generalized anxiety symptoms are predominant at this age range relative not only to social anxiety symptoms, but also relative to fears or worries associated with parental separation, which are proposed to be more dominant for younger youth around 6–9 years old (Weems and Costa 2005).

There are limitations to consider for this study. The measurement of generalized anxiety symptoms and social anxiety symptoms was limited by the available items of the BASC-2 Anxiety subscale and were composed of four and three items, respectively. However, the two factors derived in the present study showed good internal consistency, and convergent and discriminant validity, providing confidence that the results are not idiosyncratic. Although GA was correlated (r = .17) with conduct problems, this correlation was small and consistent with research showing at least some relationship between anxiety disorders and expression of anger (Hawkins and Cougle 2011). Of note is that GA and SA were highly correlated with the BASC-2 Depression subscale, raising the possibility that

changes in overall depression across the age groups may be responsible for the observed differences in specific anxiety symptom expression across the age groups. A follow-up repeated measures ANCOVA co-varying overall depression scores in lieu of overall anxiety symptoms yielded the same results as those reported here regarding specific anxiety symptom differences across age groups. Thus, we are confident that differences in specific symptom expression across the age groups were not due to overall differences in depression. At least one study suggests that the BASC-2 PRS may have poor sensitivity in detecting anxiety disorders (Kerns et al. 2015). Although that study differed from the present study in that it focused on non-treatment seeking youth with ASD who were higher functioning (IQ Mean = 105.17, SD = 19.64) than the youth in the present sample (IQ Mean = 76.87, SD = 19.55), future research should address the sensitivity and specificity of the two derived factors relative to impairing anxiety in these two domains. Because we did not assess fears associated with parental separation, we cannot conclude that fears or worries at this broad child age range are all generalized and non-specific. Future research should include measures of separation anxiety symptoms to examine these symptoms across different age groups. Moreover, we only had parental report of the children's anxiety symptoms and were not able to capture symptom differences across ages from the children's perspective.

Despite these limitations, to our knowledge, the present study is the first to examine differences in specific anxiety symptom presentation across ages in youth with ASD, while controlling for differences in overall anxiety symptoms and IQ levels. Looking at which types of anxiety symptoms (e.g., general anxiety, social anxiety) are more prevalent during specific age ranges for youth with ASD may be uninformative in terms of developmental changes in anxiety expression if one does not take into account changes in overall anxiety levels. As an example, in this study, the two age groups did not differ in general anxiety (GA) symptoms when raw scores were used. However, once overall anxiety symptoms and IQ were considered, children's GA scores were higher than those of adolescents. Of note is that the effect size for the interaction obtained through the repeated measures analysis of covariance in this study was similar to that obtained by Weems and Costa (2005) in their study with a community sample for parent reported anxiety. The present findings suggest that future research examining the phenomenology of anxiety and impact of specific anxiety symptoms in youth with ASD across ages should consider such symptoms in the context of overall anxiety shifts across developmental periods. Notably, the findings suggest that social anxiety is a major form of anxiety expression in adolescence and may be driving the increase in overall anxiety evident in children with ASD as they get older.

Author Contributions REV conceived of the study, participated in its design, performed statistical analysis, interpretation of the data, and wrote first draft of the manuscript. CFW, LN, & EAB participated in the design of the study, commented on first draft of the manuscript, and assisted with statistical analysis. RD, JLK, & GP participated in the design of the study and in data preparation and analyses. All authors read and approved and the final manuscript.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. University of first author and hospital of third author provided IRB approval for the study.

Informed Consent Informed consent was not required per 45 CFR 46.101.d exemption 4, use of de-identified archival data.

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